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Nutrition knowledge, outcome expectations, self-efficacy, and eating behaviors by calcium intake level in Korean female college students

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BACKGROUND/OBJECTIVES: Calcium is important but deficient in diets of young adult women. This study aimed to examine if cognitive factors and eating behaviors differ according to calcium intake based on the Social Cognitive Theory.
SUBJECTS/METHODS: Subjects were female college students in Seoul, Korea. Three hundred students completed the questionnaire regarding calcium intake, nutrition knowledge, outcome expectations, self-efficacy and eating behaviors. Data on 240 students were analyzed using t-test or χ^2-test. Subjects were categorized into two groups, high calcium intake (HC, $\geq$ 650 mg/day) and low calcium intake (LC, < 650 mg/day), according to recommended intakes of calcium for women aged 19-29 years.
RESULTS: The LC group constituted 77.9% of total subjects. Nutrition knowledge was not different according to calcium intake. Three out of 12 outcome expectations items were significantly different between the HC and LC groups. Subjects in the HC group agreed more strongly with the practical benefits of consuming calcium-rich foods, including 'taste' ($P < 0.01$) and 'going well with other snacks' ($P < 0.05$), compared to those in the LC group. Negative expectations of 'indigestion' were stronger in the LC group than HC group ($P < 0.001$). Among self-efficacy items, perceived ability of 'eating dairy foods for snacks' ($P < 0.001$), 'eating dairy foods every day' ($P < 0.01$), and 'eating calcium-rich side dishes at meals' ($P < 0.05$) differed significantly between the HC and LC groups. Eating behaviors including more frequent consumption of dairy foods, fruits or fruit juice ($P < 0.001$), anchovy, seaweeds, green vegetables, protein-rich foods ($P < 0.05$), and less frequent consumption of sweets or soft drinks ($P < 0.01$) were significantly related to calcium intake.
CONCLUSIONS: This study found that outcome expectations, self-efficacy in consuming calcium-rich foods, and eating behaviors are important in explaining calcium intake. Nutrition education needs to address practical benefits, reduce negative expectations of calcium-rich foods, increase self-efficacy, and modify eating behaviors contributing to calcium intake.

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INTRODUCTION

Adequate calcium intake is important for bone health and prevention of osteoporosis in later life. Inadequate consumption of calcium for a prolonged period can lead to bone loss and increased risk of osteoporosis [1]. The Korea National Health and Nutrition Examination Survey (NHANES) in 2009 reported a 4.8 times higher prevalence of osteoporosis in women aged 50 and over compared to men of the same age (38.7% vs 8.1%) [2].

One of the nutrition objectives of National Health Plan 2020 is 'to increase the proportion of individuals consuming adequate calcium to 30 percent by 2020' [3]. However, according to the results of the Korea NHANES (2013), Korean diets were especially deficient in calcium and provide only 71.1% of the recommended calcium intake [4]. When considering calcium intake by age and gender, adolescents, young adult women, and older adult women were found to consume much less calcium than recommended levels [4]. A previous study also showed that female college students consume only two-thirds of their recommended calcium intake [5].

Enough calcium should be consumed during adolescence or young adulthood in order to achieve peak skeletal deposition. To increase calcium intake, factors associated with eating behaviors in relation to calcium intake must be identified. Psychosocial theories that explain eating behaviors provide a framework for examining factors related to health or nutrition behaviors [6]. Social Cognitive Theory (SCT) is one such theory that has been used to explain nutrition behaviors. The basic premise of SCT is that cognition, behavior, and environment continuously influence each other, which necessitates consideration of these factors to explain behavioral determinants or design nutrition interventions. According to SCT, outcome expectations (beliefs), and self-efficacy are cognitive factors that provide motivation for behavioral changes [6,7]. Outcome expectations are the perceived consequences (positive, negative)

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of performing the behavior. Self-efficacy is defined as the perceived ability to perform the behavior and is known as an important predictor of nutrition behaviors [6-9]. SCT has been used to identify factors that explain nutrition behaviors, such as fruit and vegetable consumption, breakfast consumption, whole-grain intake, and prevention of weight gain [10-13].

The purpose of this study was to determine if cognitive factors, including nutrition knowledge, outcome expectations, self-efficacy, and eating behaviors, differ according to calcium intake level in female college students, based on the consideration that their calcium intake is important for bone health and osteoporosis prevention in later life. In addition, calcium intake in young adult women is well known to be inadequate compared to the recommended intake level. Study findings will provide baseline information for developing nutrition education programs for college and young adult women to increase calcium consumption.

SUBJECTS AND METHODS

Subjects

A cross-sectional survey design was employed in this study. Subjects of this study were female college students attending university in Seoul, Korea. Investigators explained the study, and those who were willing to participate in the survey completed written informed consent. Subjects were also informed that they could withdraw from the study if they were not willing to respond to the questionnaire. Data were collected by self-report from 300 female college students in 2014. Excluding incomplete responses on calcium intake or other major study variables, data on 240 students (80% of completion rate) were used for statistical analysis. This study was approved by the Institutional Review Board of Seoul Women's University (IRB-2013A-3).

Measurement

The draft of the survey questionnaire was developed based on literature reviews regarding calcium intake and related factors among young adults or college students [8,14-27]. After several revisions of the draft, the final survey questionnaire included items measuring general characteristics, calcium intake, nutrition knowledge, outcome expectations of consuming calcium-rich foods, self-efficacy in consuming calcium-rich foods, and eating behaviors.

General characteristics included age, grade, height, weight, and the attended colleges. Calcium intake was measured by a food frequency questionnaire, which surveyed the consumption frequencies and eating sizes of 20 foods contributing to calcium intake in women, based on results of the 2012 Korea NHANES [14]. Twenty food items were used, including milk, yogurt, cheese, tofu, beans, anchovy, perilla leaves, radish leaves, and seaweeds. Subjects were surveyed on how often and how much they usually eat each food item. Consumption frequency of each food was measured using 8 categories from 'never/rare' to '≥ 3 times/day' based on the Korea NHANES food frequency questionnaire. Size of each food item eaten was measured by comparison with the serving size of each food (e.g., 1 cup of milk). For this, subjects were asked to choose their regular eating size from four categories, 'small' (0.5 times of serving size for each food) to 'about two time the serving size'. Calcium intake for each food (mg/day) was calculated by multiplying the consumption frequency of each food (converted as frequency per day) by the corresponding size of each food eaten and calcium content in the serving size of each food (e.g., calcium content in one cup of milk, anchovy 15 g, etc.) based on the food composition data [15-17]. Calcium intake for each food was summed up to represent calcium intake per day (mg/day).

Nutrition knowledge was measured using 20 items regarding general nutrition (8 items), calcium nutrition (6 items), and osteoporosis knowledge (6 items) [18-22]. Nutrition knowledge included items on balanced diet, food sources of calcium or other nutrients, recommended amounts of calcium or energy intakes, risk factors, and prevention of osteoporosis. For each nutrition knowledge item, the number and percentage of correct responses by subjects were examined. Total score of nutrition knowledge was the summated score of correct responses for the 20 nutrition knowledge items.

Outcome expectations of consuming calcium-rich foods were measured based on 12 items. These included 7 health or practical benefits (e.g., osteoporosis prevention, healthy teeth, good taste, going well with other snacks or side dishes) and 5 negative expectations (i.e., disadvantages) of consuming calcium-rich foods (e.g., indigestion of dairy foods, bad taste, time to cook green vegetables, cost) [8,23,24]. Each item was measured on a 5-point scale from 'strongly disagree' (1) to 'strongly agree' (5) to indicate the strength of each outcome expectation. Total score of outcome expectations of consuming calcium-rich foods was calculated by summing the 12 items while reversely coding the scores for negative expectation items of consuming calcium-rich foods. The higher total score indicates more positive or favorable expectations regarding consuming calcium-rich foods (Cronbach's alpha = 0.69).

Self-efficacy in consuming calcium-rich foods was measured using 10 items, including 'eating calcium-rich side dishes at meals', 'eating dairy foods for snacks', 'drinking dairy foods instead of soft drinks or caffeine beverages', and 'difficulty in eating calcium-rich foods because of cost' [8,23,25]. Each item was measured on a 5-point scale from 'very difficult' (1) to 'very easy' (5) as a measurement of the perceived ability to perform each behavior. Total score for self-efficacy in consuming calcium-rich foods was calculated by summing the 10 items while reversely coding the scores for two negatively stated items. The higher total score for self-efficacy indicates higher perceived ability to consume calcium-rich foods (Cronbach's alpha = 0.75).

Eating behaviors covered 17 items, including 3 items related to eating right (diverse foods, adequate amounts of foods, regularity of meals), 8 items related to consumption of different food groups (e.g., grains, protein foods, vegetables, fruits, dairy products, green vegetables), and 6 items related to unhealthy behaviors (e.g., eating fatty foods, salty foods, sweets, and caffeine beverages) [8,26,27]. Subjects were asked to select a frequency category of '0-2 days/week', '3-5 days/week', or '6-7 days/week'. For each eating behavior, numbers and percentages of subjects in each consumption frequency category were examined. To calculate the total score for eating behaviors, each item was coded from 1 (0-2 days/week) to 3 (5-7 days/week),

and unhealthy behaviors were reversely coded. Total score for eating behaviors was the summated score of 17 items, with a higher score indicates more desirable eating behaviors (Cronbach's alpha = 0.73).

Statistical analysis

Data on 240 students were analyzed using SPSS (PASW statistics 18.0; SPSS Inc., Chicago, IL, USA). Descriptive statistics such as frequency, percentages, mean, and standard deviation were calculated. Subjects were categorized into two groups by calcium intake level, according to the recommended intake of calcium in women aged 19-29 years [28]. Thus, subjects in the high calcium intake group (HC) had a calcium intake of 650 mg or more per day, whereas those in the low calcium intake group (LC) had a calcium intake of less than 650 mg per day. To examine differences in factors, including nutrition knowledge, outcome expectations, self-efficacy, and eating behaviors by calcium intake level, t-test or χ^2-test was used. Statistical significance was set at $\alpha = 0.05$.

RESULTS

General characteristics of subjects by calcium intake level

Table 1 presents general characteristics of subjects. Mean age of subjects was 20.4 years. Mean height, weight, and body mass index (BMI) were 161.9 cm, 54.2 kg, and 20.7, respectively. Based on recommended calcium intake (650 mg/day for women aged 19-29 years) [28], subjects were categorized into low calcium intake group (LC, n = 187, 77.9%) or high calcium intake group (HC, n = 53, 22.1%). There was no significant difference in age, mean height, weight, or BMI between the HC and LC groups. About 30% of subjects were junior and freshman students, respectively, followed by sophomore (22.5%) and senior (19.2%) students. About half of subjects (48.8%) attended college of natural sciences, followed by college of social sciences (23.3%) and humanities (16.7%). Distribution of grade or attending college was not significantly different by calcium intake level (Table 1).

Table 1. General characteristics of subjects by calcium intake level

Variables	Total (n = 240)	Calcium intake level		χ^2 or t[3]
		Low (n = 187)	High (n = 53)	
Age (yrs)	20.4 ± 1.7[1]	20.5 ± 1.8	20.2 ± 1.5	1.0
Height (cm)	161.9 ± 4.6	161.8 ± 4.6	162.4 ± 4.6	-0.9
Weight (kg)	54.2 ± 6.8	53.9 ± 6.5	55.6 ± 7.3	-1.6
Body mass index (kg/m^2)	20.7 ± 2.3	20.6 ± 2.3	21.0 ± 2.3	-1.3
Grade				
Freshman	69 (28.8)[2]	54 (28.9)	15 (28.3)	0.5
Sophomore	54 (22.5)	42 (22.5)	12 (22.6)	
Junior	71 (29.6)	52 (27.8)	19 (35.8)	
Senior	46 (19.2)	39 (20.9)	7 (13.2)	
Attending college				
Humanities	40 (16.7)	32 (17.1)	8 (15.1)	2.0
Social sciences	56 (23.3)	43 (23.0)	13 (24.5)	
Natural sciences	117 (48.8)	92 (49.2)	25 (47.2)	
Information & Media, Arts	27 (11.2)	20 (10.7)	7 (13.2)	

[1] Mean ± SD
[2] n (%)
[3] χ^2 value by χ^2-test or t value by t-test

Nutrition knowledge of subjects by calcium intake level

Total score for nutrition knowledge was 13.5 on average (possible score: 0-20), which was 67.5 out of 100 (Table 2). Total score was not significantly different between the HC and LC groups. For each nutrition knowledge item, most subjects responded correctly regarding 'excessive intake of caffeine or soda and bone loss', 'whole grains and dietary fiber', 'food sources of proteins', 'food sources of vitamin A', and 'alcohol, smoking and osteoporosis'. In contrast, less than half of subjects answered correctly regarding 'food balance wheels', 'the recommended energy intake for young adults', 'adequate intake ratio of calcium and phosphorus for bone health', 'risk factor (body weight) and osteoporosis', and 'calorie comparison of foods'.

None of the nutrition knowledge items was significantly different between the HC and LC groups. Correct responses for

Table 2. Nutrition knowledge of subjects by calcium intake level

Variables	Total (n = 240)	Calcium intake level		χ^2 or t[4]
		Low (n = 187)	High (n = 53)	
1. The calorie of a potato (medium) and a tangerine is similar to the calorie of a bowl of cooked rice.[1]	93 (38.8)[2]	73 (39.0)	20 (37.7)	0.3
2. Brown rice or whole grains contain more fiber than white rice.	237 (98.8)	184 (98.4)	53 (100.0)	0.9
3. Drinking alcoholic beverages or smoking does not increase the risk of osteoporosis.	235 (97.9)	184 (98.4)	51 (96.2)	1.0
4. The adequate intake ratio of calcium and phosphorus is 3:1 for sufficient bone mass.	58 (24.2)	16 (24.6)	12 (22.6)	0.1
5. Bones undergo remodeling continuously by adding and losing bone minerals.	180 (75.0)	140 (74.9)	40 (75.5)	0.0
6. Weight-bearing exercises (walking, aerobics, cycling, etc.) help to have healthy bones.	183 (76.3)	143 (76.5)	40 (75.5)	0.0
7. Balanced meals are the meals mainly composed of carbohydrates and proteins.	130 (54.2)	104 (55.6)	26 (49.1)	0.7
8. The recommended intake of calcium for women aged 19-29 is 650 mg a day.	186 (77.5)	141 (75.4)	45 (84.9)	2.1
9. Bone mass reaches to maximal level in one's late thirties.	192 (80.0)	150 (80.2)	42 (79.2)	0.0
10. Food balance wheels are composed of 5 food groups, including grains, meat·fish·eggs·beans, vegetables, milk, oil & sugars.	24 (10.0)	19 (10.2)	5 (9.4)	0.0
11. Excessive intake of caffeine or soda promotes bone loss.	239 (99.6)	186 (99.5)	53 (100.0)	0.3
12. Deficiency of vitamin D decreases the calcium absorption.	204 (85.0)	158 (84.5)	46 (86.8)	0.2
13. Meat·fish·eggs·beans are food sources of essential nutrient for making body tissues.	236 (98.3)	183 (97.9)	53 (100.0)	1.2
14. The adequate rate of weight loss is 2-3 kg per week.	203 (84.6)	159 (85.0)	44 (83.0)	0.1

Table 2. continued

Variables	Total (n = 240)	Calcium intake level		χ^2 or t[4]
		Low (n = 187)	High (n = 53)	
15. Each of these foods, a cup of milk, two pieces of cheese, and a cup of yogurt, contains about 200 mg of calcium.	178 (74.2)	143 (76.5)	35 (66.0)	2.3
16. Carrots, spinach and pumpkins are the major sources of vitamin A.	233 (97.1)	181 (96.8)	52 (98.1)	0.3
17. Osteoporosis occurs more frequently in underweight women than in overweight woman.	84 (35.0)	63 (33.7)	21 (39.6)	0.6
18. The recommended daily energy intake is 1,800kcal for female college students and 2,300kcal for male college students.	54 (22.5)	46 (24.6)	8 (15.1)	2.1
19. The amount of calcium in low-fat milk is similar to that in regular milk.	154 (64.2)	123 (65.8)	31 (58.5)	1.0
20. Tomatoes and carrots are vegetables high in calcium.	132 (55.0)	100 (53.5)	32 (60.4)	0.8
Total score[1]	13.5 ± 1.7[3]	13.5 ± 1.7	13.4 ± 1.6	0.5

[1] Possible score: 0-20, the summated score of 20 items. The correct response for each item gets a point.
[2] n (%) of correct response for each item
[3] Mean ± SD
[4] χ^2 value by χ^2-test or t value by t-test

some items, such as 'the recommended level of calcium intake for young adult women' (correct response: 84.9% in HC vs. 75.4% in LC), 'risk factor (body weight) and osteoporosis' (39.6% vs. 33.7%), and 'vegetable sources of calcium' (60.4% vs 53.5%), were slightly higher in the HC group than LC group, although there was no statistical significance by calcium intake level.

Outcome expectations of consuming calcium-rich foods by calcium intake level

Total score for outcome expectations regarding consumption of calcium-rich foods was 46.0 on average (possible score: 12-60), which was 76.7 out of 100 (Table 3). Total score for outcome expectations in the HC group was significantly higher than that in the LC group (47.3 vs. 45.6, $P < 0.05$).

Three out of 12 items were significantly different by calcium intake level (Table 3). Specifically, subjects in the HC group scored higher for benefits of consuming calcium-rich foods, such as 'milk or cheese is delicious' ($P < 0.01$) and 'dairy foods go well with other snacks' ($P < 0.05$), than those in the LC group. Scores for other practical benefits (e.g., dairy foods for quenching thirst, dairy foods for snack, green vegetables with other side dishes) were slightly higher in the HC group than LC group, although this difference did not reach statistical significance. Expectations regarding the health benefits of consuming calcium-rich foods, such as prevention of osteoporosis and healthy teeth, were not significantly different by calcium intake level.

Among the negative expectations of consuming calcium-rich foods, the item of 'eating dairy foods causes indigestion' was significantly different between the HC and LC groups ($P < 0.001$). Those with low calcium intake more strongly agreed with the expectation that eating dairy foods results in indigestion (e.g., diarrhea, abdominal pain).

Table 3. Outcome expectations of consuming calcium-rich foods by calcium intake level

Variables	Total (n = 240)	Calcium intake level		t[4]
		Low (n = 187)	High (n = 53)	
1. Enough calcium intake will help to prevent diseases such as osteoporosis and osteopenia.[1]	4.1 ± 0.6[3]	4.1 ± 0.6	4.0 ± 0.6	1.6
2. Calcium helps to have healthy teeth.	4.2 ± 0.6	4.2 ± 0.6	4.2 ± 0.6	0.2
3. Milk or cheese is savory and delicious.	4.2 ± 0.9	4.1 ± 0.9	4.4 ± 0.6	-2.8**
4. Dairy products (milk, cheese, yogurt, etc.) are good as a snack.	4.3 ± 0.8	4.2 ± 0.9	4.4 ± 0.6	-1.4
5. Dairy products are good to quench thirst.	2.9 ± 1.2	2.8 ± 1.1	3.1 ± 1.2	-1.7
6. Green vegetables (pepper leaves, beetroot, broccoli, etc.) are good to eat with other side dishes (meat, fish).	4.2 ± 0.7	4.1 ± 0.7	4.3 ± 0.6	-1.3
7. Dairy products go well with other snacks such as bread, cookies and fruits.	4.3 ± 0.8	4.2 ± 0.8	4.5 ± 0.7	-2.0*
8. Cooked anchovy smells and tastes bad.	2.1 ± 0.9	2.0 ± 0.9	2.2 ± 1.1	-0.9
9. Green vegetables taste bad.	2.2 ± 1.0	2.2 ± 1.0	2.1 ± 1.1	0.5
10. It's not convenient to eat green vegetables (pepper leaves, beetroot, broccoli, etc.) because it takes time to cook.	2.3 ± 1.0	2.3 ± 1.0	2.3 ± 1.1	0.4
11. Eating dairy foods causes indigestion (e.g., diarrhea, abdominal pain)	2.3 ± 1.1	2.5 ± 1.2	1.9 ± 0.9	3.2***
12. Calcium-rich foods (dairy foods, anchovy, green vegetables, etc.) are expensive.	3.2 ± 0.9	3.3 ± 0.9	3.2 ± 1.0	0.4
Total score[2]	46.0 ± 5.1	45.6 ± 5.2	47.3 ± 4.7	-2.1*

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$
[1] Each item was measured by 5-point scales ranging from 1 (strongly disagree) to 5 (strongly agree).
[2] Possible score: 12-60, the summated score of 12 belief items. To calculate the total score, five items (items from 8 to 12) were coded reversely.
[3] Mean ± SD
[4] t value by t-test

Self-efficacy regarding consuming calcium-rich foods by calcium intake level

Total score for self-efficacy regarding consumption of calcium-rich foods was 34.5 (possible score: 10-50), which was 69 out of 100 (Table 4). Total score for subjects in the HC group was 36.4, which was significantly higher than that in the LC group ($P < 0.01$). For each self-efficacy item, subjects showed high scores for 'eating cheese or yogurt for snacks' (mean score of 4.1 in a scale of 1-5), 'eating dairy products every day', and 'drinking milk or yogurt instead of soft drinks or caffeine beverages' (mean score of 3.8).

Three out of 10 self-efficacy items were significantly different between the HC and LC groups. Subjects in the HC group scored significantly higher in terms of self-efficacy items such as 'eating cheese or yogurt for snacks' ($P < 0.001$), 'eating dairy products every day' ($P < 0.01$), and 'eating calcium-rich side dishes when I have a meal' ($P < 0.05$) compared to those in the LC group. Those with high calcium intake also showed higher scores for self-efficacy of eating calcium-rich foods in situations such as eating alone and eating with others, although there was no significant difference in these self-efficacy items by calcium intake level.

Eating behaviors of subjects by calcium intake level

The total score for 17 eating behaviors was 33.9 (possible score: 17-51) on average, which was 66.5 out of 100 (Table 5). Total score was slightly higher in the HC group than LC group, although it did not reach statistical significance (34.8 vs. 33.6).

Table 4. Self-efficacy regarding consuming calcium-rich foods by calcium intake level

Variables	Total (n = 240)	Calcium intake level		t[4]
		Low (n = 187)	High (n = 53)	
1. I can eat calcium-rich side dishes (e.g., using milk, cheese, anchovies, green vegetables) frequently when I have a meal.[1]	3.4 ± 1.0[3]	3.3 ± 0.9	3.6 ± 1.1	-2.1*
2. I can eat cheese or yogurt for snacks.	4.1 ± 0.9	4.0 ± 0.9	4.4 ± 0.6	-3.7***
3. I can drink dairy products (milk or yogurt, etc.) instead of soft drinks or caffeine beverages.	3.8 ± 1.0	3.8 ± 0.9	3.9 ± 1.0	-1.0
4. I can eat calcium-rich foods (milk, cheese, anchovy, green vegetables, etc.) when I eat meals at home.	3.7 ± 0.9	3.7 ± 0.9	3.9 ± 1.0	-1.0
5. I can eat calcium-rich foods (milk, cheese, anchovy, green vegetables, etc.) when I eat out.	3.2 ± 1.0	3.2 ± 1.0	3.3 ± 1.1	-0.6
6. I can select calcium-rich foods or menu when I eat with others.	3.1 ± 1.0	3.0 ± 0.9	3.3 ± 1.2	-1.6
7. It's difficult to have calcium-rich foods because of cost.	2.9 ± 0.9	3.0 ± 0.9	2.8 ± 1.0	1.2
8. I can eat dairy products (milk, cheese, yogurt, etc.) every day.	3.8 ± 1.1	3.7 ± 1.1	4.2 ± 1.0	-3.0**
9. It's difficult to eat calcium-rich side dishes (anchovy, green vegetables, etc.) because of time constraints.	2.8 ± 0.9	2.8 ± 0.9	2.7 ± 0.9	1.1
10. I can have calcium-rich foods when I eat a meal alone.	3.2 ± 1.1	3.1 ± 1.0	3.4 ± 1.1	-1.8
Total score[2]	34.5 ± 5.4	34.0 ± 5.3	36.4 ± 5.6	-2.9**

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

[1] Each item was measured by 5-point scales ranging from 1 (very difficult) to 5 (very easy).

[2] Possible score: 10-50, the summated score of 10 items. To calculate the total score, two items (item 7, 9) were coded reversely.

[3] Mean ± SD

[4] t value by t-test

Table 5. Eating behaviors of subjects by calcium intake level

Variables (days/week)	Total (n = 240)			Calcium intake level						χ^2 or t[4]
				Low (n = 187)			High (n = 53)			
	0-2	3-5	6-7	0-2	3-5	6-7	0-2	3-5	6-7	
1. Eat a variety of foods.	74 (30.8)[2]	117 (48.8)	49 (20.4)	59 (31.6)	91 (48.7)	37 (19.8)	15 (28.3)	26 (49.1)	12 (22.6)	0.3
2. Eat adequate amounts of food at meals.	34 (14.2)	139 (57.9)	67 (27.9)	25 (13.4)	109 (58.3)	53 (28.3)	9 (17.0)	30 (56.6)	14 (26.4)	0.5
3. Eat meals regularly.	99 (41.3)	113 (47.1)	28 (11.7)	80 (42.8)	85 (45.5)	22 (11.8)	19 (35.8)	28 (52.8)	6 (11.3)	1.0
4. Eat grains (rice, breads, noodles, potatoes, sweet potatoes, etc.) more than 2 meals per day.	19 (7.9)	95 (39.7)	125 (52.3)	16 (8.6)	71 (38.0)	100 (53.5)	3 (5.8)	24 (46.2)	25 (48.1)	1.3
5. Eat protein foods (meat, fish, eggs, beans, tofu) more than 2 meals per day.	63 (26.3)	114 (47.5)	63 (26.3)	52 (27.8)	93 (49.7)	42 (22.5)	11 (20.8)	21 (39.6)	21 (39.6)	6.3*
6. Eat vegetables or vegetable side dishes more than 2 meals per day.	68 (28.3)	119 (49.6)	53 (22.1)	56 (29.9)	93 (49.7)	38 (20.3)	12 (22.6)	26 (49.1)	15 (28.3)	2.0
7. Eat Fruit or fruit juice once or more per day.	113 (47.1)	73 (30.4)	54 (22.5)	101 (54.0)	51 (27.3)	35 (18.7)	12 (22.6)	22 (41.5)	19 (35.8)	16.8***
8. Eat dairy products (milk, yogurt, cheese, etc.) once or more per day.	88 (36.8)	94 (39.3)	57 (23.8)	80 (43.0)	72 (38.7)	34 (18.3)	8 (15.1)	22 (41.5)	23 (43.4)	19.7***
9. Eat seaweeds (laver, seaweed, sea lettuce, etc.)	165 (69.0)	58 (24.3)	16 (6.7)	133 (71.5)	46 (24.7)	7 (3.8)	32 (60.4)	12 (22.6)	9 (17.0)	11.6*
10. Eat anchovy or dried strip of icefish.	187 (78.2)	42 (17.6)	10 (4.2)	148 (79.6)	34 (18.3)	4 (2.2)	39 (73.6)	8 (15.1)	6 (11.3)	8.7*
11. Eat green vegetables such as pepper leaves, perilla leaves, leaf beet and broccoli.	129 (53.8)	94 (39.2)	17 (7.1)	109 (58.3)	68 (36.4)	10 (5.3)	20 (37.7)	26 (49.1)	7 (13.2)	8.5*
12. Eat out.	103 (43.1)	108 (45.2)	28 (11.7)	79 (42.5)	86 (46.2)	21 (11.3)	24 (45.3)	22 (41.5)	7 (13.2)	0.4

Table 5. continued

Variables (days/week)	Total (n = 240)			Calcium intake level						χ^2 or t[4]
				Low (n = 187)			High (n = 53)			
	0-2	3-5	6-7	0-2	3-5	6-7	0-2	3-5	6-7	
13. Eat sweets (chocolate, ice cream, cookies, etc.) or soft drinks.	49 (32.1)	112 (47.3)	76 (32.1)	30 (16.2)	90 (48.6)	65 (35.1)	19 (36.5)	22 (42.3)	11 (21.2)	10.9**
14. Drink caffeine beverages (coffee, tea, energy drinks, etc.).	114 (47.7)	83 (34.7)	42 (17.6)	94 (50.5)	64 (34.4)	28 (15.1)	20 (37.7)	19 (35.8)	14 (26.4)	4.5
15. Eat fatty foods such as has burger, pizza, fried chicken and pork cutlet.	131 (54.6)	99 (41.3)	10 (4.2)	109 (58.3)	72 (38.5)	6 (3.2)	22 (41.5)	27 (50.9)	4 (7.5)	5.5
16. Eat instant foods (instant noodles, convenience foods).	124 (51.7)	101 (42.1)	15 (6.3)	97 (51.9)	80 (42.8)	10 (5.3)	27 (50.9)	21 (39.6)	5 (9.4)	1.2
17. Eat spicy and salty foods (salty snacks, salted fish, pickles, spicy soup).	96 (40.2)	123 (51.5)	20 (8.3)	77 (41.4)	95 (50.8)	14 (7.5)	19 (35.8)	28 (52.8)	6 (11.3)	1.1
Total score[1]	33.9 ± 4.9[3]			33.6 ± 5.0			34.8 ± 4.6			-1.5

* $P<0.05$, ** $P<0.01$, *** $P<0.001$
[1] Possible score: 17-51, the total score of 17 items. To calculate the total score, each item was coded from 1 (0-2 days/week) to 3 (5-7 days/week). Six items (items from 12 to 17) were coded reversely.
[2] n (%)
[3] Mean ± SD
[4] χ^2 value by χ^2-test or t value by t-test

Seven out of 17 eating behavior items were significantly different by calcium intake group. The percentage of subjects who consumed 'dairy foods once or more per day' almost every day (6-7 days/week) was significantly higher in the HC group than LC group (43.4% vs. 18.3%, $P < 0.001$). Other eating behaviors contributing to calcium intake were also significantly different by calcium intake level. The percentage of those who consumed seaweeds frequently (≥ 3 days per week) was 39.6% in the HC group and 28.5% in the LC group ($P < 0.05$). Subjects in the HC group also consumed anchovy more frequently; 11.3% of the HC group and 2.2% of the LC group ate anchovy or dried strip of icefish 6-7 days per week ($P < 0.05$). Consumption of green vegetables, such as pepper leaves, leaf beat, and broccoli, was also more frequent in the HC group than LC group ($P < 0.05$). The percentage of those who consumed 'protein foods more than two meals per day' almost every day was 39.6% in the HC group compared to 22.5% in the LC group ($P < 0.05$). The percentage of those who ate fruits or fruit juice almost every day was 35.8% in the HC group and 18.7% in the LC group ($P < 0.001$).

Among six unhealthy eating behaviors, only 'eating sweets or soft drinks' was significantly different by calcium intake level ($P < 0.01$). About 37% of the HC group compared to 16.2% of the LC group ate sweets infrequently (0-2 days/week).

DISCUSSION

This study examined the cognitive factors, including knowledge, outcome expectations, self-efficacy, and eating behaviors, in relation to calcium intake based on SCT. In this study, only 22.1% of subjects consumed the recommended level of calcium, indicating that most subjects had insufficient calcium in their diets. Mean intake of calcium by subjects in this study was 464.1 mg (not presented in Table), which was 71.4% of the recommended intake for calcium [28]. The study result was similar to that of the Korea NHANES (2013), wherein women aged 19-29 years consumed 69.4% of the recommended calcium intake [4]. Hong *et al.* (2012) [29] also reported that calcium intake by college female students was 74% of the recommended level, with significant differences among groups by bone mass (527.9 mg/day in the normal group, 488.8 mg/day in the osteopenia group, and 479.5 mg/day in the osteoporosis group). In a study by Yu *et al.* (2013) [30], calcium intake by Koreans was lower than that by Americans in all age groups examined, especially adolescents. These results raise concerns that calcium intake by young adult women is deficient and needs to be increased for bone health. A study on female college students [31] also reported that 27% of students were at risk for osteopenia or osteoporosis. In the current study, major foods contributing to calcium intake were mainly dairy products (milk 25.0%, ice cream 10.0%, yogurt 7.6%, and cheese 5.1% of calcium intake) and anchovy (6.5%, not presented in Table). Therefore, practical tips for consuming dairy foods or anchovy need to be developed to increase calcium consumption in young adult women.

The study results show that nutrition knowledge of subjects had a score of 67.5 out of 100. In a study on college students, Kim (2012) [19] reported that mean score of nutrition knowledge scored 6.7 out of 15 (44.9 out of 100). Other studies on college students also reported a nutrition knowledge score of 10.8 out of 20 (54.2 out of 100) [32] and osteoporosis knowledge score of 12.7 out of 20 (63.5 out of 100) [18]. A study on female osteoporosis patients [20] showed that osteoporosis knowledge (risk factors, food and nutrition, etc.) scored 19.8 out of 27 (73.3 out of 100). Zhang & Chandran [22] measured osteoporosis knowledge in nurses and reported a mean knowledge score of 14.5 out of 20 (72.5 out of 100). Since the nutrition knowledge measure in the current study was developed for this study based on literature reviews, it is not possible to directly compare the knowledge results to other studies. Nutrition knowledge in this study was slightly higher than that of previous studies on college students [19,32,33], although the nutrition knowledge of subjects was still inadequate. Nutrition knowledge, either total score or each knowledge score, was not different by calcium intake status. Nutrition knowledge items in this study were composed of items on general nutrition, calcium nutrition, and osteoporosis knowledge. Subjects were knowledgeable in

relation to general nutrition (e.g., food sources of nutrients) and risk factors (caffeine, alcohol) of osteoporosis. In contrast, many subjects answered incorrectly regarding specific nutrition knowledge, such as adequate energy intake for young adults, adequate intake of minerals for bone health, and energy comparison of foods. Due to increased use of the web and other IT sources, it is likely that college women obtain their nutrition information from these sources as well as from books or classes. However, it seems that college women did not know the specifics of nutrition knowledge for calcium nutrition or osteoporosis prevention. Study findings also suggest that nutrition knowledge might not be enough to promote healthy behavior, which was calcium consumption in this study.

The total score for outcome expectations (76.7 out of 100) suggests that subjects had slightly favorable expectations regarding consumption of calcium-rich foods. Subjects with high calcium intake hold more positive expectations towards consuming calcium-rich foods compared with those with low calcium intake ($P < 0.05$). College women with high calcium intake felt more strongly about the practical benefits of calcium intake, such as 'taste of milk or cheese' ($P < 0.01$) and 'dairy foods go well with other snack foods' ($P < 0.05$). Taste is the major determinant in food selection. In contrast, health benefits (e.g., osteoporosis prevention, healthy teeth) were not significantly different between the HC and LC groups. College women in both groups perceived health benefits similarly, as shown in Table 3. Similar to the current study, previous studies on children, young adults, or older adults [8,12,34] also reported a significant relationship between practical advantages (e.g., taste, convenience to cook) and healthy eating behaviors (e.g., eating fruits and vegetables). The current study suggests that nutrition education for college women needs to focus on the practical benefits of consuming calcium-rich foods, such as taste and going well with other snacks.

With respect to the disadvantages of consuming calcium-rich foods, 'eating dairy foods cause indigestion' was the belief that differentiated those in the HC group from those in the LC group. Lactose intolerance is common in Asians compared to Caucasians. However, there might be several ways to deal with lactose intolerance, including choosing lactose-free or lactose-degraded milk, drinking small servings of milk each time, eating milk with other foods (e.g., bread, crackers), and choosing other dairy foods (e.g., cheese, yogurt). Nutrition educators might provide several tips for consuming milk for those with lactose intolerance.

In this study, young adult women in the HC group showed significantly higher self-efficacy in consuming calcium-rich foods than those in the LC group ($P < 0.01$). As suggested in previous studies [5,23,34,35], the current study supports the importance of self-efficacy in performing healthy eating behaviors, including eating dairy foods, fruits, and vegetables as well as reading nutrition labels. Self-efficacy in this study was measured by perceived confidence in doing specific behaviors or performing behaviors in specific situations (e.g., eating out, eating with others). Results on each self-efficacy item suggest that the two groups differed in perceived confidence of performing specific behaviors, such as eating dairy foods regularly, eating dairy foods for snacks, and eating calcium-rich side dishes at meals. These findings suggest that teaching strategies to increase the perceived ability of performing specific, simple behaviors (e.g., eating one or more dairy foods every day, eating yogurt as snacks) might be useful in nutrition education to increase calcium intake. In contrast, there was no difference in the perceived ability to eat calcium-rich foods in specific situations, such as eating out and eating with others. Results for these self-efficacy items (possible score: 1-5, mean score 3.2 for eating out, 3.1 for eating with others) indicate that the perceived ability to consume calcium-rich foods was not high in social situations. Therefore, college women should learn the methods for choosing calcium-rich foods in social eating situations. Contrary to previous studies [35], perceived constraints of cost or time were not barriers to calcium intake.

The study results show that eating behaviors in general or consumption of food groups were not desirable in the current study. Eating behaviors such as eating a variety of foods, eating adequate amounts, and eating meals regularly were not significantly different by calcium intake level. A previous study on college women [36] also reported problems such as irregular meals, skipping meals, eating speed, and eating late at night.

With respect to consumption of food groups, several differences in eating behaviors were noted by calcium intake status. College women in the HC group, showed more desirable behaviors in eating dairy foods ($P < 0.001$), anchovies, seaweeds, green vegetables, and protein foods ($P < 0.05$) than those in the LC group. Foods in these food groups are major sources of dietary calcium, and thus more frequent consumption of these foods contributes to higher calcium intake. This study also showed that those with high calcium intake exhibited more desirable eating behaviors, such as eating fruits more often ($P < 0.001$) and having sweets or soft drinks less ($P < 0.01$). Song *et al.* [37] reported that the traditional meal group (e.g., healthy eating) showed higher intakes of nutrients (e.g., proteins, iron, and vitamin A) and higher bone mass compared to the modified group (e.g., like to eat noodles, bread, fast food, snack, etc.). Studies on nutrient intakes [38-40] have reported that intakes of calcium, protein, iron, and vitamins contribute to bone mass, suggesting the importance of modifying eating behaviors.

In conclusion, this study examined the factors related to calcium intake by applying theoretical background (SCT) and revealed that those with high calcium intake had more favorable outcome expectations, higher self-efficacy in consuming calcium-rich foods, and more desirable eating behaviors. However, there was no difference in nutrition knowledge by calcium intake level. Based on this study, nutrition education for college women needs to modify personal expectations of consuming calcium-rich foods, increasing self-efficacy in consuming calcium-rich foods, and changing specific behaviors for increased calcium intake. More specifically, nutrition education might focus on practical benefits of eating calcium-rich foods (e.g., taste, for snack foods, convenience, etc.) as well as health benefits. Nutrition education should also incorporate methods for increasing perceived confidence to consume calcium-rich foods (e.g., eating dairy foods regularly, eating dairy foods for snacks, eating high-calcium side dishes at meals). Perceived self-efficacy might be increased through step-by-step performance of eating behaviors, observing others' healthy behaviors, and praise or persuasion [7]. These methods could be used to

plan nutrition education for college women. To modify eating behaviors for calcium intake, behavior modification skills such as monitoring, goal setting, stimulus control, behavior substitution, and reinforcement might be employed in nutrition education for college women.

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REFERENCES

1. Choi HJ, Lee DJ. The characteristics of biochemical bone markers postmenopausal women and its clinical efficacy in evaluating the treatment response. Korean J Bone Metab 2000;7:1-11.
2. Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. Korea Health Statistics 2009: Korea National Health and Nutrition Examination Survey (KNHANES IV-3). Cheongwon: Korea Centers for Disease Control and Prevention; 2010.
3. Ministry of Health and Welfare. Health Plan 2020. Seoul: Ministry of Health and Welfare; 2011.
4. Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. Korea Health Statistics 2013: Korea National Health and Nutrition Examination Survey (KNHANES VI-1). Cheongju: Korea Centers for Disease Control and Prevention; 2014.
5. Choi JH, Kim SK. Comparison of the dietary factors between normal and osteopenia groups by bone mineral density in Korean female college students. J Korean Soc Food Sci Nutr 2008;37:869-78.
6. Glanz K, Rimer BK, Viswanath K. Health Behavior and Health Education: Theory, Research, and Practice. 4th ed. San Francisco (CA): Jossey-Bass; 2008.
7. Bandura A. Social Foundations of Thought and Action: a Social Cognitive Theory. Englewood Cliffs (NJ): Prentice Hall; 1986.
8. Ahn Y, Kim KW. Beliefs regarding vegetable consumption, self-efficacy and eating behaviors according to the stages of change in vegetable consumption among college students. Korean J Community Nutr 2012;17:1-13.
9. Ievers-Landis CE, Burant C, Drotar D, Morgan L, Trapl ES, Kwoh CK. Social support, knowledge, and self-efficacy as correlates of osteoporosis preventive behaviors among preadolescent females. J Pediatr Psychol 2003;28:335-45.
10. Molaison EF, Connell CL, Stuff JE, Yadrick MK, Bogle M. Influences on fruit and vegetable consumption by low-income black American adolescents. J Nutr Educ Behav 2005;37:246-51.
11. Bruening M, Larson N, Story M, Neumark-Sztainer D, Hannan P. Predictors of adolescent breakfast consumption: longitudinal findings from Project EAT. J Nutr Educ Behav 2011;43:390-5.
12. Rosen RA, Burgess-Champoux TL, Marquart L, Reicks MM. Associations between whole-grain intake, psychosocial variables, and home availability among elementary school children. J Nutr Educ Behav 2012;44:628-33.
13. Strong KA, Parks SL, Anderson E, Winett R, Davy BM. Weight gain prevention: identifying theory-based targets for health behavior change in young adults. J Am Diet Assoc 2008;108:1708-15.
14. Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. Korea Health Statistics 2012: Korea National Health and Nutrition Examination Survey (KNHANES V-3). Cheongwon: Korea Centers for Disease Control and Prevention; 2013.
15. Rural Development Administration (KR). Food Composition Table. 8th rev. ed. Suwon: Rural Development Administration; 2011.
16. Lee RD, Nieman DC. Nutritional Assessment. 5th ed. Boston (MA): McGraw-Hill; 2010.
17. Yoon JS, Lee MJ. Calcium status and bone mineral density by the level of sodium intake in young women. Korean J Community Nutr 2013;18:125-33.
18. Min H, Oh HY. A study on osteoporosis knowledge, health beliefs and health behaviors among female college students. J Korean Acad Community Health Nurs 2011;22:111-20.
19. Kim WK. Relationship among individual, social, environmental factor and leisure time physical activity of undergraduates. Korean J Sports Sci 2012;21:1189-98.
20. Lee HY. A Study of correlation among the knowledge of the disease, health promoting behaviors and the quality of life in the female patients with osteoporosis. J Rheumatol Health 2001;8:65-85.
21. Ailinger RL, Lasus H, Braun MA. Revision of the facts on osteoporosis quiz. Nurs Res 2003;52:198-201.
22. Zhang RF, Chandran M. Knowledge of osteoporosis and its related risk factors among nursing professionals. Singapore Med J 2011;52: 158-62.
23. Kim KW, Shin EM. Using the theory of planned behavior to explain dairy food consumption among university female students. Korean J Community Nutr 2003;8:53-61.
24. Han JS, Kim JH. Calcium intake and cognition on calcium of adolescents in Busan area. J Korean Soc Food Sci Nutr 2002;31: 1026-34.
25. Shin SJ, Shin KR, Yi HR, Ju SK. Knowledge, health belief, and self-efficacy related to osteoporosis. J Korean Acad Nurs 2005;35: 850-7.
26. Kim MS, Koo JO. Comparative analysis of food habits and bone density risk factors between normal and risk women living in the Seoul area. Korean J Community Nutr 2008;13:125-33.
27. Neumark-Sztainer D, Wall MM, Larson N, Story M, Fulkerson JA, Eisenberg ME, Hannan PJ. Secular trends in weight status and weight-related attitudes and behaviors in adolescents from 1999 to 2010. Prev Med 2012;54:77-81.
28. The Korean Nutrition Society. Dietary Reference Intakes for Koreans. 1st rev. ed. Seoul: The Korean Nutrition Society; 2010.
29. Hong MS, Pak HO, Sohn CY. Comparative study of food behaviors and nutrients intake according to the bone mineral density of female university students. Korean J Food Nutr 2012;25:156-62.
30. Yu AR, Yang YJ, Jeong SR, Kim JH, Kim YJ, Kwon OR, Oh SY, Kim JH. Calcium intakes in Korean and American populations. J Korean Diet Assoc 2013;19:46-58.
31. Jeong HR, Yun S, Kim MH. Evaluation of food and nutrient intake by food frequency questionnaire between normal and risk groups according to the bone mineral density of female college students residing in Gangwon area. Korean J Community Nutr 2010;15: 429-44.
32. Kim BR. A Study on nutrition knowledge, dietary habits, health-related life style and health condition of college students in Chuncheon. J Korean Soc Food Sci Nutr 2006;35:1215-23.
33. Barzegari A, Ebrahimi M, Azizi M, Ranjbar K. A study of nutrition knowledge, attitudes and food habits of college students. World Appl Sci J 2011;15:1012-7.

34. Sjoberg S, Kim K, Reicks M. Applying the theory of planned behavior to fruit and vegetable consumption by older adults. J Nutr Elder 2004;23:35-46.
35. Lim HJ, Kim MJ, Kim KW. Factors associated with nutrition label use among female college students applying the theory of planned behavior. Nutr Res Pract 2015;9:63-70.
36. Min KH. A study on the eating habits and healthy eating behaviors of the university students in Jeonbuk area. Korean J Food Cookery Sci 2013;29:399-406.
37. Song YJ, Paik HY, Yu CH. Factors affecting bone mineral density by dietary pattern group for some Korean college women. Korean J Nutr 2006;39:460-6.
38. An GS, Shin DS. A comparison of the food and nutrient intake of adolescents between urban areas and islands in south Kyungnam. Korean J Community Nutr 2001;6:271-81.
39. Ro HK. Comparisons of nutrient intakes, dietary behavior and perception about body image between adolescent boys and girls in rural area. Korean J Community Nutr 2000;5:280-8.
40. Jung KY, Lee YS, Kim SM. The study of dietary behavior, BMI and nutrient intake status in middle school students of Daegu area. J East Asian Soc Diet Life 2005;15:1-10.