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Relationships among Knowledge, Self-efficacy, and Health Behavior of Osteoporosis and Fall Prevention in Old Aged Women

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Purpose: This study was conducted among older women to (1) identify their levels of knowledge, self-efficacy, and health behavior in dealing with osteoporosis and falls and (2) explore the relationships between the study variables based on a health-beliefs model. **Methods:** With a cross-sectional survey design, we recruited 94 older women of ages from 65 to 74 at a community setting via convenience sampling. The study participants completed two sets of structured questionnaires (on osteoporosis and fall prevention). **Results:** The general characteristics of the study participants demonstrated that the women were at high risk for osteoporosis and falls. Overall, the levels of knowledge about osteoporosis and falls, their self-efficacy, and their preventive behaviors were average or slightly above. The relationships between the study variables showed that self-efficacy and healthy behavior, such as doing osteoporosis exercise, eating an osteoporosis diet, and avoiding falls, were related (r=38, $p<.001$; r=.33, $p<.05$; r=.26, $p<.05$). In addition, there were statistically significant relationships between osteoporosis and fall prevention knowledge (r=.37~.46, $p<.001$), self-efficacy (r=.50~.53, $p<.001$), and preventive behaviors (r=.50, $p<.001$). **Conclusion:** The women's scores on osteoporosis and fall knowledge, self-efficacy, and preventive behaviors suggest an urgent need for the implementation of educational programs for older women. A close relationship between self-efficacy and health behaviors implies a need for transformation of a traditional one-way lecture form.

Key Words: Osteoporosis, Falls, Aged, Women, Health behavior, Self-efficacy

INTRODUCTION

Osteoporosis is a prevalent metabolic disease worldwide, primarily affecting the postmenopausal women as their estrogen level decreases [1]. Estrogen is a significant factor regulating bone mineral density, and the deficient amount leads to weakening of the bone [1]. Because bone loss occurs asymptomatically, women may not know they have osteoporosis until they experience sudden collapse in their bones [2]. According to the International Osteoporosis Foundation (IOF)[3], three in four women older than age 65 face osteoporotic fractures. Bone fractures can be distressing to many as reduced range of motion and decreased quality of life may occur [4]. For an elderly population, limitation of body movements can cause death which makes morbidity and mortality as the secondary substantial complication to osteoporosis [1]. In addition, osteoporotic fracture treatment usually requires longer hospital stays than any other common chronic illnesses and frequent re-hospitalizations occur [5]. The lengthy stay in hospitals makes osteoporosis a costly disorder. To reduce the cost and incidence rates, osteoporosis and osteoporotic fracture prevention are essential.

A myriad of strategies to prevent low bone mass and its complications have been attempted [6-8]. One of the cost-effective ways to prevent osteoporosis is modifying one's lifestyle [9]. Examples of lifestyle adjustments include performing regular weight-bearing exercises, taking adequate calcium supplements, and having routine osteoporosis screening tests [9]. Most programs created to promote os-

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teoporosis prevention predominantly encourage participants to practice healthy lifestyle. Another common program to prevent osteoporotic fracture is designed to inhibit falls [10]. One in every four adults older than 65 experience falls each year, which place them at a high risk of bone fractures [11]. Fall prevention is important as bone fractures can be avoided. Some effective strategies to prevent falls include exercising, wearing non-slippery shoes, or modifying home hazards such as removing loose floor mats or brightening dimmed lights [12]. Fall prevention approaches, similar to osteoporosis prevention methods, involve one's daily habitual changes.

To promote effective lifestyle modifications, prior studies on osteoporosis and fall prevention programs utilized health belief model (HBM) as a framework. HBM was originally developed in an attempt to explain one's performance of health preventive behaviors [13]. This theoretical model demonstrates the modifying factors (age, sex, ethnicity, socioeconomic status, personality, or knowledge level) influence one's perception of seriousness, susceptibility, benefits, barriers, and self-efficacy which eventually, in combination with cues to actions, shape one's health behaviors. For instance, Austin et al.[14] explained cues to actions (healthcare workers recommendations, brochures, or media), perceived barriers (fear, shame, or restricted English proficiency), and perceived susceptibility (low awareness of the needs of cancer screening) influenced the breast and cervical cancer screening behaviors of Hispanic women. In another study, Chen et al.[15] identified the HBM factors such as age, occupation, location of areas, child medical histories, perceived susceptibility of the child to influenza, perceived benefits/barriers of vaccination, and cues to action impacted the caregivers' decision making behaviors concerning their children's flu vaccination. Osteoporosis and fall prevention behaviors were also examined using the health belief model. For example, the researchers applied HBM as a conceptual framework to examine the bone health behavior factors and to predict the osteoporosis prevention behaviors [16]. In addition, another study reported the implementation and evaluation of osteoporosis prevention educational programs which were developed based on a health belief model [17]. Other than osteoporosis prevention behaviors, Jang & Ahn [18] developed a valid predictive model of fall prevention behaviors using HBM constructs to manage osteoporotic fracture incidences among postmenopausal women. An HBM-based fall prevention educational program was also developed and implemented to hospital inpatients which effectively reduced the rates of falls [19].

Despite various studies have demonstrated the benefits of both osteoporosis and fall prevention programs applying HBM constructs, few studies have effectively researched on the association between the two programs. Considering substantial portion of osteoporosis and osteoporotic fracture events can be reduced either by practicing osteoporosis or fall preventive behaviors, examining the relationship of osteoporosis and falls is meaningful. As recent studies suggested the effectiveness of the use of HBM model in facilitating healthy behaviors, the association of knowledge, self-efficacy, and health behavior was identified to provide a baseline information for designing the prevention program in the future. The purpose of this study was to 1) examine the levels of knowledge, self-efficacy, and preventive health behavior of osteoporosis and fall prevention and to 2) explore the relationships among the study variables in old aged women.

METHODS

1. Design and Subjects

This was a secondary data analysis from the intervention study [20]. With a cross-sectional survey design, we recruited old aged women via convenience sampling who met the following inclusion criteria: (1) Women aging from 65 to 74 years old; (2) residing in the community settings; and (3) being able to perform activities of daily living. Any women who had underlying comorbidities or disorders that may reduce bone density and increase bone fracture susceptibility were excluded. The minimum sample size was estimated to a total of 84 participants using an α of .05, a power value of .80, and an effect size of r=.30. A total of 94 participants were recruited.

2. Measurements

Women who agreed to participate completed 2 sets of self-report structured questionnaires. The questionnaire included a total of 76 items measuring the participants' knowledge, self-efficacy, and health behavior level on osteoporosis and fall prevention. All research tools used in this study were authorized by the tool developers, and any original survey tools written in non-Korean were replaced with Korean versions that were previously utilized in Korean research studies. Reliability and validity of all study instruments were established.

1) Osteoporosis prevention: Knowledge, self-efficacy, health behavior

The instrument developed by Kim et al.[21] was used to

measure the level of osteoporosis prevention knowledge. This tool consists a total of 24 questionnaires including 9 items on osteoporosis risk factors, 7 items on exercises, and 8 items on calcium supplements in diet. Responses on each item were scored as correct or incorrect. The level of osteoporosis prevention knowledge is measured into two subscales which are exercise and diet. The total possible score for osteoporosis exercise knowledge ranges from 0 to 16 combining the scores obtained from 9 items on osteoporosis risk factors and 7 items on exercises. The diet knowledge score ranges from 0 to 17 which is calculated by adding the 9 items on osteoporosis risk factors and the remaining 8 items on calcium supplements. The higher score indicates higher level of knowledge on osteoporosis prevention. The tool reliability was confirmed by a Cronbach's α of .50 for exercise subscale and .51 for diet subscale.

The osteoporosis prevention self-efficacy was measured using the tool developed by Horan et al [22]. The self-efficacy is also classified into exercise and diet subgroups. This tool uses a 5-point Likert scale, with a higher score demonstrating a higher level of self-efficacy. The tool includes a total of 12 questionnaires with 6 items on exercises (score range: 6 to 30) and 6 items on calcium supplements in diet (score range: 6 to 30). The tool reliability was confirmed by a Cronbach's α of .94 for exercise subscale and .93 for diet subscale.

The level of osteoporosis prevention health behaviors was evaluated by a tool utilized by Lee [23]. This instrument has a total of 18 questionnaires scored on a 4-point Likert scale, with 7 items on exercises, 8 items on calcium supplements in diet, and 3 items on routine follow-ups. The score of osteoporosis prevention health behaviors ranges from 18 to 72 with higher score indicating higher level of performing preventive behaviors for bone health. The tool reliability was confirmed by a Cronbach's α of .87.

2) Fall prevention: Knowledge, self-efficacy, health behavior

The level of fall prevention knowledge and self-efficacy was screened by the instrument developed by Jang & Ahn [18]. The tool for fall prevention knowledge includes a total of 8 items with a score ranging from 0 to 8. Responses on the scale were scored as correct or incorrect. The tool reliability was confirmed by a Cronbach's α of .81. The tool for fall prevention self-efficacy consists of 6 questionnaires scored on a 5-point Likert scale. The score for self-efficacy ranges from 6 to 30. The tool reliability was confirmed by a Cronbach's α of .88. The level of fall prevention health behaviors was evaluated with a questionnaire used by Moon & Lee [24]. The evaluation tool includes 8 items with a score ranging from 8 to 32. The tool uses a 4-point Likert scale for scoring the points. The tool reliability was confirmed by a Cronbach's α of .81. The higher score indicates a higher level of measured study variables for all tools related to fall prevention.

3. Data collection

Prior to conducting the original study, ethical approval was obtained from the Institutional Review Board (IRB, 2013-48) of College of Nursing at C University, Korea. A research assistant asked women to participate into the study through one-to-one interview at an elderly community center. The women who complied with the inclusion criteria received research information such as study purpose, risks, benefits, and confidentiality of their private information. For those who agreed to participate in the study signed the informed consent form and received small gifts.

4. Data Analysis

Statistical Package for the Social Sciences (SPSS) WIN 22.0 was utilized for the statistical data analysis. The level of major study variables and the participants' demographic characteristics were evaluated using descriptive statistics. For a detailed analysis of the level of study variables based on the participants' history with BMD test, osteoporosis, and degenerative arthritis, an independent t test was also used. The relationships between the study variables were measured using Pearson correlations.

RESULTS

1. Demographic Characteristics of the Study Participants

The mean age of the participants was 71.2±3.64. More than half of the women had no spouse (54.3%), had middle school graduate degree or less (60.2%), and most of them lived with their families (69.9%). For their general health information, 82.4% of them had at least one chronic disease and the most prevalent disease was hypertension. Most women (87.2%) took a bone mineral density test, 26.6 % of the women were diagnosed with osteoporosis and 12.8% had a history of falling (Table 1).

2. Levels of Knowledge, Self-efficacy, and Health Behavior of Osteoporosis and Falls

Overall, the levels of knowledge, self-efficacy, and pre-

ventive behaviors for osteoporosis and falls were considered inadequate. The mean of osteoporosis knowledge level on exercise was 9.29±2.31, and diet was 8.48±2.50 (Table 2). Although the women had general knowledge on osteoporosis and fall prevention, 37.6% of the women did not know whether having oophorectomy would cause osteoporosis. Also, many women had incorrect knowledge of the types of exercises or foods they needed to consume to prevent osteoporosis. For example, 63.4% of the women answered swimming was better in preventing osteoporosis than brisk walking (33.3%) and almost half of the women reported cabbage (54.3%) and radishes (43.6%) were rich in calcium whereas the correct answers were yogurt (34.0%) and ice cream (5.3%) instead. In addition, most participants had incorrect knowledge on the amount of exercise or calcium intake they needed to consume per day (Table 3). The mean of osteoporosis self-efficacy level on exercise was 19.72±4.56, and diet was 20.11±4.27. The mean of performance level of osteoporosis preventive behavior was 47.36±10.49. The levels of fall prevention knowledge, fall prevention self-efficacy, and fall prevention health behaviors were 6.81±1.87, 23.18±2.90, and 24.08±5.21 (Table 2).

Table 1. General Characteristics of Study Participants (*N*=94)

Characteristics	Categories	n (%) or M±SD
Age (year)		71.2±3.64
Partners	No	51 (54.3)
	Yes	43 (45.7)
Educational level	Middle school or below	53 (60.2)
	Over middle school	35 (39.8)
Living with	Alone	28 (30.1)
	Family	65 (69.9)
History of BMD test	No	12 (12.8)
	Yes	82 (87.2)
History of osteoporosis	No	69 (73.4)
	Yes	25 (26.6)
Comorbidities	No	16 (17.6)
	Yes	75 (82.4)
	Types of comorbidities	
	Rheumatoid arthritis	3 (2.4)
	Hypertension	49 (39.5)
	Cardiac diseases	8 (6.5)
	Diabetes mellitus	22 (17.7)
	Degenerative arthritis	24 (19.4)
	Thyroid diseases	4 (3.2)
	Others	14 (11.3)
History of falls	No	82 (87.2)
	Yes	12 (12.8)

3. Differences of Knowledge, Self-efficacy, and Health Behavior Levels of Osteoporosis and Falls

The statistically significant differences on the levels of study variables were identified based on the participants' history of bone mineral density (BMD) test, osteoporosis, and degenerative arthritis. The results showed a higher level of self-efficacy on exercise among women who have previously taken the bone mineral density test had compared to those who have not (t=2.05, p=.044). The performance of preventive behavior level was statistically higher among the participants who had an experience with bone mineral density test than those without the experience (t=2.50, p=.014). The level of exercise and diet knowledge of osteoporosis was also greater among the women who were diagnosed with osteoporosis (t=2.14, p=.035; t=3.02, p=.003). In addition, the women with underlying degenerative arthritis had higher mean knowledge scores on falls (t=-3.00, p=.004) and elevated self-efficacy level on osteoporosis diet and falls (t=-2.53, p=.014; t=-2.62, p=.011) (Table 4).

Table 2. Levels of Knowledge, Self-efficacy, and Preventive Health Behavior on Osteoporosis and Falls (*N*=94)

Variables	Categories		M±SD	Min	Max
Knowledge	Osteoporosis	Exercise (0~16)	9.29±2.31	4	14
		Diet (0~17)	8.48±2.50	3	13
	Fall	(0~8)	6.81±1.87	0	8
Self-efficacy	Osteoporosis	Exercise (6~30)	19.72±4.56	6	30
		Diet (6~30)	20.11±4.27	11	30
	Fall	(6~30)	23.18±2.90	12	30
Preventive health behavior	Osteoporosis	(18~72)	47.36±10.49	22	72
	Fall	(8~32)	24.08±5.21	8	32

Min=minimum score reported; Max=maximum score reported.

Table 3. Frequencies of Reported Answers on Osteoporosis and Fall Knowledge (*N*=94)

Categories	Statement	Correct answers	Most frequently reported answers
Osteoporosis - general	Exercising on a regular basis	Less Likely (86.0)	Less Likely (86.0)
	Eating a diet LOW in milk products	More Likely (72.0)	More Likely (72.0)
	Being menopausal; "changing life"	More Likely (71.3)	More Likely (71.3)
	Taking cortisone (steroids e.g. Prednisone) for long time	More Likely (53.8)	More Likely (53.8)
	Being a skinny woman with a small body frame	More Likely (49.5)	More Likely (49.5)
	Eating a diet high in dark green leafy vegetables	Less Likely (46.7)	Less Likely (46.7)
	Having a mother or grandmother who has osteoporosis	More Likely (44.7)	More Likely (44.7)
	Having big bones	Less Likely (44.6)	Less Likely (44.6)
	Having ovaries surgically removed	More Likely† (33.3)	Don't Know (37.6)
Osteoporosis - physical activities	Which of the following is the best way to reduce a person's chance of getting osteoporosis?	Aerobic dancing (77.4)	Aerobic dancing (77.4)
		Jogging or running for exercise (70.2)	Jogging or running for exercise (70.2)
		Bicycling (50.0)	Bicycling (50.0)
		Walking briskly† (33.3)	Swimming (63.4)
	How many days a week do you think a person should exercise to strengthen the bones?	3 or more days a week (94.6)	3 or more days a week (94.6)
	What is the least amount of time a person should exercise on each occasion to strengthen the bones?	20 to 30 minutes (64.9)	20 to 30 minutes (64.9)
	Exercise makes bones strong, but it must be hard enough to make breathing:	Much faster, but talking is possible† (28.0)	Just a little faster (67.7)
Osteoporosis - diet	Which of these is a good source of calcium?	Canned Sardines (97.8)	Canned Sardines (97.8)
		Cheese (78.7)	Cheese (78.7)
		Broccoli (46.8)	Broccoli (46.8)
		Yogurt† (34.0)	Cabbage (54.3)
		Ice cream† (5.30)	Radishes (43.6)
	Which of the following is the best reason for taking a calcium supplement?	If a person does not get enough calcium from diet (42.6)	If a person does not get enough calcium from diet (42.6)
	How much milk must an adult drink to meet the recommended amount of calcium	2 or more glasses daily (400 cc)† (37.2)	1 glass daily (200 cc) (57.4)
	Which of the following is the recommended amount of calcium intake for an adult?	800 mg or more daily† (6.5)	Don't Know (66.3)
Fall	Wearing lower heel or non-slippery shoes	Less Likely (91.5)	Less Likely (91.5)
	Walking slowly to keep the balance on the bumpy ground (e.g. icy roads)	Less Likely (90.3)	Less Likely (90.3)
	Holding side rails when going up and down the stairs	Less Likely (89.4)	Less Likely (89.4)
	Looking around and moving slowly when sitting up and down	Less Likely (86.2)	Less Likely (86.2)
	Attaching fall preventive tape on the bathroom floor tiles	Less Likely (85.1)	Less Likely (85.1)
	Restarting with light exercises and gradually increasing the amount of activities after taking a short break	Less Likely (81.9)	Less Likely (81.9)
	Brightening up the rooms to avoid falling down	Less Likely (80.9)	Less Likely (80.9)
	Reorganizing the furniture to prevent tripping over when going in and out	Less Likely (76.6)	Less Likely (76.6)

† Inconsistent answers between correct and most frequently reported answers.

4. Relationships among Knowledge, Self-efficacy, and Health Behavior of Osteoporosis and Falls

The relationships among study variables were also examined. Higher osteoporosis knowledge level for exercise was associated with higher osteoporosis self-efficacy level for exercise (r=.24, $p<.05$), and the osteoporosis self-efficacy level for exercise was related with higher performance level for osteoporosis preventive behaviors (r=.38, $p<.001$). For fall prevention, greater fall self-efficacy level was related to performing better preventive behaviors for fall prevention (r=.26, $p<.05$). Furthermore, there were significant correlations between knowledge level of osteoporosis and fall prevention (r=.37~.46, $p<.001$), between self-efficacy of osteoporosis and fall (r=.50~.53, $p<.001$), and between preventive behaviors for osteoporosis and falls (r=.50, $p<.001$)(Table 5).

DISCUSSION

This study was conducted to identify the levels and relationships of osteoporosis and fall prevention knowledge, self-efficacy, and health behaviors among old aged women. The reason for choosing to focus on the three elements (knowledge, self-efficacy, and health behaviors) over other study variables within the health belief model was based on the authors belief that healthcare providers could easily intervene one's knowledge compared to other

Table 4. Differences on the Levels of Study Variables (*N*=94)

Variables	Categories		History of BMD test				History of osteoporosis				Degenerative arthritis			
			Yes	No	t	*p*	Yes	No	t	*p*	Yes	No	t	*p*
			M±SD	M±SD			M±SD	M±SD			M±SD	M±SD		
Knowledge	Osteo	Exercise	9.44±2.30	8.36±2.25	1.44	.153	10.13±2.38	8.95±2.21	2.14	.035	9.50±2.06	9.23±2.40	-0.46	.648
		Diet	8.59±2.56	7.83±2.04	0.97	.338	9.71±2.80	7.97±2.18	3.02	.003	8.82±2.17	8.35±2.61	-0.75	.455
	Falls		6.90±1.76	6.17±2.48	1.28	.205	7.17±1.52	6.68±1.97	1.10	.275	7.50±0.93	6.57±2.05	-3.00	.004
Self efficacy	Osteo	Exercise	20.09±4.31	17.25±5.51	2.05	.044	19.72±3.71	19.72±4.86	0.00	.997	20.88±4.06	19.31±4.68	-1.46	.149
		Diet	20.39±4.29	18.17±3.71	1.70	.092	20.00±4.54	20.14±4.21	-0.15	.885	21.71±3.24	19.56±4.46	-2.53	.014
	Falls		23.23±2.86	22.83±3.27	0.45	.657	23.20±1.63	23.18±3.26	0.05	.963	24.21±1.82	22.83±3.12	-2.62	.011
Preventive health behaviors	Osteo		48.39±10.32	40.18±9.11	2.50	.014	48.43±7.99	46.98±11.27	0.67	.508	50.40±9.71	46.29±10.61	-1.63	.108
	Falls		24.10±5.40	23.92±3.92	0.11	.910	23.71±4.37	24.21±5.50	-0.40	.690	24.87±5.61	23.81±5.08	-0.84	.402

Osteo=osteoporosis; BMD=bone mineral density.

Table 5. Relationships between Major Study Variables

Variables	Knowledge (Osteo-exercise)	Knowledge (Osteo-diet)	Knowledge (Falls)	Self-efficacy (Osteo-exercise)	Self-efficacy (Osteo-diet)	Self-efficacy (Falls)	Preventive behaviors (Osteo)
	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)
Knowledge (Osteo-diet)	.79 (<.001)						
Knowledge (Falls)	.46 (<.001)	.37 (.001)					
Self-efficacy (Osteo-exercise)	.24 (.032)	-.02 (.865)	.01 (.913)				
Self-efficacy (Osteo-diet)	.18 (.114)	.05 (.638)	.13 (.210)	.65 (<.001)			
Self-efficacy (Falls)	.28 (.013)	.04 (.714)	.18 (.083)	.53 (<.001)	.50 (<.001)		
Preventive Behaviors (Osteo)	.17 (.147)	.08 (.497)	.07 (.486)	.38 (<.001)	.33 (.002)	.28 (.010)	
Preventive behaviors (Falls)	.14 (.227)	.10 (.361)	.03 (.796)	-.01 (.904)	.14 (.190)	.26 (.012)	.50 (<.001)

Osteo=osteoporosis.

modifying factors (e.g. age, sex, ethnicity, socioeconomic status, personality) and that self-efficacy was the most significant factor that induced one's behavior. The average scores of study variables revealed a need for improvements of the women's knowledge, self-efficacy, and health behaviors related to osteoporosis and fall prevention. Other key findings were similar level of preventive behavior performances between women with and without osteoporosis history although women with previous diagnosis had higher knowledge. The correlation analysis revealed statistically significant relationships between self-efficacy and preventive behaviors. However, there were no direct associations between knowledge and preventive behaviors. Another noteworthy relationship finding was positive linear correlations between osteoporosis and fall prevention of all study variables.

1. Levels of Knowledge, Self-efficacy, and Health Behaviors of Osteoporosis and Falls

The mean scores of study variables showed the participants had insufficient level of bone health knowledge, self-efficacy, and preventive behaviors. This result was consistent with previous studies conducted worldwide which have also reported low levels of knowledge [25-28], self-efficacy [25,26], and preventive behaviors [25,28]. Considering the results from the previous studies and no complete scores both on bone health exercise and diet knowledge within this study participants suggest higher demands in facilitating the old women's osteoporosis knowledge.

The reported frequencies of answers on general osteoporosis knowledge implied most women were aware of prevention of bone loss through regular exercises and milk products. However, more than half of the participants did not know consuming dark green leafy vegetables improved their bone health. This result was inconsistent with a study by Oh et al. [25] which majority of the middle aged women answered spinach, kale, and broccoli contained much calcium. Although applying a different tool may have caused the dissimilar outcome, it may also have been caused from targeting a different age group. This suggests the information needs to be tailored specifically to the older aged group when delivering the knowledge.

The reported answers on osteoporosis exercise knowledge suggested the study participants had inaccurate knowledge on specific types or intensity of physical activities. For example, most women chose swimming as a better way of preventing osteoporosis while brisk walking was the correct answer. In addition, most participants reported 'just a little faster' breathing was an appropriate intensity of exercising while 'much faster, but talking is possible' was the right answer. This result was similar to the previous study conducted on women screened by BMD test [27]. This consistency implies an educator will need to focus on teaching accurate and specific knowledge related to osteoporosis exercise.

Similar to exercises, most participants had incorrect knowledge on specific types or amount of diet they needed to consume to prevent bone loss. Despite most women knew eating diet high in milk products would less likely to cause osteoporosis, they answered cabbage and radishes were a better source of calcium than yogurt or ice cream. On the other hand, in a study surveyed a group of Polish women, most participants reported yogurt and ice cream were the best source of calcium [27]. This contrasting outcome may have caused from cultural differences, as many Korean seniors are not familiar with western foods. However, in terms of the amount of calcium the women needed to take each day, the participants from both of this study and Janiszewska et al. [27] had inaccurate knowledge. If a healthcare educator is developing a curriculum related to osteoporosis diet, he or she will need to consider the cultural background of the audience and deliver precise information on types or amount of diet.

For further analysis of the study variables, the authors evaluated the score differences based on the women's experiences with BMD test, osteoporosis, and degenerative arthritis. Among the group of women who have previously taken the BMD test, a higher self-efficacy to exercise and a greater involvement to preventive behaviors were identified compared to the participants who did not take the BMD test. However, no differences on knowledge level were found based on the experience of the BMD test. This highlights women with BMD test experiences tend to be more confident and active even though they may have similar knowledge level to those with no BMD test experiences. This may suggest one's self-efficacy has more impact on inducing lifestyle changes compared to one's knowledge level.

Other study variables analyzed based on the history of osteoporosis demonstrated women with a previous diagnosis had greater knowledge than those without history of the disease. However, contrary to our expectations, there were no differences on the scores of self-efficacy and preventive behaviors. The results imply that women with a history of osteoporosis may have received or searched for information when diagnosed with low bone mass but the knowledge did not impact either self-efficacy or behaviors. This alerts the non-adherence issues to self-care behaviors consistent with other studies reporting problems

with low compliance to treatment regimen or lifestyle changes [29, 30]. In the light of current and previous study results, widespread health educational strategies which mostly focus on strengthening one's knowledge may have limitations in motivating old aged women to practice healthy behaviors.

Lastly, the level of study variables based on the diagnosis of degenerative arthritis were evaluated. The statistically significant score differences were identified on fall preventive knowledge and self-efficacy among the participants. A higher level of knowledge and self-efficacy on fall prevention suggest women with degenerative arthritis were well aware with the risk of falls and they also had more confidence in conducting fall preventive behaviors.

2. Relationships among Knowledge, Self-efficacy, and Health Behavior of Osteoporosis and Falls

The relationships among study variables suggested a way to encourage women to perform healthy behaviors. The associations of study variables indicated women with more knowledge on osteoporosis exercise had greater self-efficacy leading to higher level of conducting preventive behaviors. This result was consistent with the concept of health belief model. However, regarding to osteoporosis diet and fall prevention, the women with higher self-efficacy practiced more preventive behaviors whereas no associations between knowledge and self-efficacy were found. In addition, no direct relationships were found between knowledge and preventive behaviors on any study variables. This result was inconsistent with other studies which reported statistically significant relationships between bone health knowledge and preventive behaviors [25,26]. The different age group or the cultural variations may have caused the contrasting outcome from previous research studies. Although previous studies showed a significant association between knowledge and preventive behaviors, no direct relationships between the two variables in this study imply improving the self-efficacy as much as knowledge may be effective in encouraging women change their lifestyle.

Other highlighting relationships observed were statistically significant associations between all study variables of osteoporosis and fall prevention. The positive linear relationships between osteoporosis and falls suggested both components could be considered together when arranging contents for osteoporosis prevention programs.

3. Limitations

This study had limitations despite several meaningful findings. First, the tool reliability for osteoporosis exercise and diet knowledge was low within this study. Considering Kim et al. [21] reported a Cronbach's α of .69 for exercise knowledge and .72 for diet knowledge of the original instrument, future studies will need to examine the use of this tool more carefully. Another improvement that needed to be made was the measurement of other study variables within health belief model such as perception of seriousness, susceptibility, benefits, and barriers. By measuring these study variables, the way to promote one's health behavior could be understood better which will help healthcare providers in arranging their osteoporosis treatment plans for old aged women.

4. Implications for Nursing Education and Practice

In summary, applying an HBM-based osteoporosis and fall prevention program would be effective in facilitating old aged women to perform preventive behaviors. If a healthcare provider is planning to design an educational program, one must remember promoting the participants' self-efficacy may have more direct impact in making women practice healthy lifestyles. Along with enhancing the self-efficacy, the educator should deliver precise and culturally tailored information on specific types or amount of exercises and diet related to bone health. Through accurate and practical knowledge, the participants with enhanced self-efficacy will be able to conduct proper preventive behaviors.

The overall study results suggest a traditional one-way lecture which focus on strengthening the knowledge may have limitations in having women change their lifestyle. The previous systematic reviews suggest offering direct and indirect experiences, role modeling, providing positive feedbacks, or recognition and problem-solving skills are useful strategies to improve one's self-efficacy [31]. To integrate these techniques into a conventional lecture form, small group education or one-to-one counselling may be more appropriate. The healthcare providers should continue to strive to seek for innovative strategies of teaching methods that are sensitive and tailored to the old aged women.

CONCLUSION

Conducting preventive behaviors for osteoporosis and falls are important for old aged women who are at high risk for low bone density. The insufficient scores of study variables demand the needs to enhance the knowledge, self-efficacy, and preventive behaviors of osteoporosis and

fall prevention among old aged women. In addition, a close relationship between self-efficacy and preventive behavior suggests reinforcing one's self-efficacy would have more direct effect in having women change their habitual lifestyle. A higher knowledge but similar behavioral performances between women with and without previous osteoporosis diagnosis feature a didactic form of education may have limitations in motivating women to modify their behaviors. Establishing an osteoporosis and fall prevention educational program using small group activities or one-on-one interventions using health belief model as a framework is desired to promote preventive health behaviors among old aged women.

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Summary Statement

■ What is already known about this topic?

Both osteoporosis and fall prevention can be facilitated by improving one's knowledge and self-efficacy. However, few studies have examined the association of knowledge, self-efficacy, and health behavior with osteoporosis and fall prevention.

■ What this paper adds?

Women with higher prevention knowledge, self-efficacy, and healthier behavior in dealing with osteoporosis demonstrated the same three strengths in dealing with falls as well.

■ Implications for practice, education and/or policy

Developing a program that combines osteoporosis and fall prevention contents, focusing on increasing women's self-efficacy by delivering culturally tailored information, could effectively encourage women to deal better with both osteoporosis and fall prevention.