NCPD

2.0 ANCC Contact Hours

Changing Osteoporosis Knowledge and Behaviors Through Structured Education

Kindra McWilliam Ross ▼ Richard E. Gilder

Osteoporosis is a silent disease that is associated with enormous cost and can lead to disability and death. We identified that individuals who have sustained a fracture from a fall are often unaware of osteoporosis risk factors and have a knowledge deficit regarding osteoporosis. Therefore, they do not receive the proper treatment. An evidence-based practice project was completed using "pre-post" intervention tools with an educational intervention to measure osteoporosis knowledge and self-efficacy in individuals hospitalized with a fragility fracture. A convenience sample of 25 participants 50 years and older, who were admitted with a fragility fracture, received targeted education. Descriptive and comparative statistics were used for comparison of pre- and postintervention data. Hospitalized osteoporotic individuals have a gap in knowledge regarding the existence of osteoporosis. Healthcare workers can improve knowledge and self-efficacy by offering osteoporosis education for these individuals.

Over the past century, lifestyle changes such as reducing cigarette smoking and improved healthcare treatment have led to a dramatic increase in life expectancy. In 2018, life expectancy in the United States rose for the first time in 4 years, reaching 78.7 years, compared with a life expectancy of 78.6 years in 2017 (Kochanek et al., 2019). As a result of increased life expectancy, the prevalence of chronic conditions that primarily affect older individuals has increased considerably.

One chronic condition that has increased is osteoporosis. In 2001, the National Institutes of Health Consensus Development Panel on Osteoporosis issued an agreement on the definition of osteoporosis: "Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture" (National Institutes of Health Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy, 2001, p. 786). Osteoporotic fractures have become common in women 55 years and older resulting in increased medical costs, and increased mortality (Compston et al., 2019). According to Sözen et al. (2017) one in three women and one in five men worldwide will have an osteoporotic fracture. This incidence of fractures equates to a financial medical burden estimated at over $41 billion (Hertz & Santy-Tomlinson, 2018). To put osteoporosis in perspective, while every eighth woman suffers from breast cancer, every third woman sustains a fracture due to osteoporosis (Bartl & Bartl, 2016).

The increase in chronic conditions passes on increasing costs to individuals and healthcare systems. Sarafrazi et al. (2021) detailed that, in the United States, the prevalence of osteoporosis in women increased from 14.0% in 2007 to 19.6% in 2018. Burge et al. (2006) suggest that, by 2025, the number of annual osteoporotic fractures will increase by more than 48%, to over 3 million osteoporotic fractures. Williams et al. (2020) reported healthcare costs for individuals in the 12 months following fracture are more than $30,000. Anticipated osteoporosis costs in the United States are expected to continue, rising to more than $90 billion by 2040 (Cox & Hooper, 2020).

Although the incidence of osteoporosis is increasing, individuals are often unaware of the cause of their fractures. In one healthcare facility in the southern United States, among individuals having a ground-level fall (GLF) who sustained a fracture, a knowledge gap was noted regarding their understanding of the connection between osteoporosis and a fragility fracture. Hospitalized individuals were unaware that this fragility fracture meant they had a diagnosis of osteoporosis. Even though the orthopaedic surgeon would take care of patients' fractures and discuss their need to see their primary physician for osteoporosis care, they still would not do so because they did not feel there was a need once the fracture was healed. It was discovered that the patient would resist follow-up because they did not believe they had osteoporosis since their primary physician had not diagnosed them with it before the fall. Therefore, they did not fully understand what

Kindra McWilliam Ross, DNP, APRN, ACNS-BC, Orthopaedic Clinical Nurse Specialist, Texas Health Harris Methodist Hospital Fort Worth, Fort Worth; Clinical Assistant Professor-AO, College of Nursing and Health Innovation, The University of Texas, Arlington.

Richard E. Gilder, MS, RN, CNOR-E, Adjunct Faculty, School of Nursing, Texas Tech Health Science Center, Lubbock; Consulting Bioinformatics Data Scientist, The Gilder Company, Dallas, TX.

The authors have disclosed no conflicts of interest.

Correspondence: Kindra McWilliam Ross, DNP, APRN, ACNS-BC, Texas Health Harris Methodist Hospital Fort Worth, Fort Worth, TX (kindramcwilliam-ross@texashealth.org).

DOI: 10.1097/NOR.0000000000000912

osteoporosis was, nor the need for osteoporosis care (Conley et al., 2019).

The lasting effects of osteoporosis are well-documented and include loss of mobility, independence, and death (Sözen et al., 2017). Osteoporosis is a silent disease until it is complicated by fractures that can occur even with no trauma at all. Osteoporosis is usually asymptomatic and often not brought to attention until the individual has a fragility fracture as the primary presentation of this disease (Lorentzon & Cummings, 2015). Because there is no outward sign of osteoporosis, individuals face difficulty in understanding that they have the disease. Additionally, patients do not seek prevention nor accept treatment recommendations. It was once thought osteoporosis or brittle bones were just a part of aging. Research now supports patient education to guide the prevention and treatment of this disease (Bone Health & Osteoporosis Foundation [BHOF], 2022b).

Individuals who have sustained a fracture are often unaware of what osteoporosis is, including risk factors, and have a knowledge deficit of osteoporosis (Giangregorio et al., 2009). Sözen et al. (2017) define a fragility fracture as "occurring spontaneously or with minimal trauma, usually as a result of a fall from standing height or less" (p. 48). Hip and vertebral fractures resulting from a GLF are considered osteoporotic or fragility fractures. When fractures occur, the individual is more likely to be admitted to the hospital for pain control and treatment. This group of individuals could be provided with structured educational interventions and treatments for osteoporosis. Since December 2014, the American Academy of Orthopedic Surgeons has recognized osteoporosis and bone health in adults as a national public health issue. However, some physicians continue to regard osteoporosis as a normal progression of aging (American Academy of Orthopedic Surgeons, 2014). This is such a problem that less than 30% of women with osteopenia or osteoporosis are correctly diagnosed, and less than 15% of those diagnosed receive treatment (Bartl & Bartl, 2016).

When referring to bone fractures, secondary prevention describes the methods used to prevent a second fracture, known as a fragility fracture (Drew et al., 2016). A structured educational intervention is the first step in the secondary prevention of fragility fractures. Up to one half of all hip fracture patients have already sustained a previous fracture, and those who have sustained a fracture are at approximately double the risk of sustaining subsequent fractures (Harvey et al., 2017). Considering the cost and potential disabilities that individuals with osteoporosis can face, and that this is not a normal part of aging, it is important to improve osteoporosis knowledge of those affected.

Specific Aims

This project's aim was to determine whether a targeted educational intervention improves osteoporosis knowledge and self-efficacy. The objective was to develop and pilot an osteoporosis educational program. The following question guided the project: Does structured education improve knowledge of osteoporosis and self-efficacy in hospitalized fragility fracture patients?

Methods

The setting for this evidence-based practice (EBP) project was a Level 2 community trauma healthcare facility in the southern United States. The hospital is licensed for 731 beds. According to the trauma registry at the intervention facility, in 2020, there were over 1,300 individuals older than 60 years admitted for fragility fractures, of which 500 sustained a hip fracture. This hospital has two orthopaedic floors. One floor is the primary orthopaedic and trauma floor, and the second is an orthopaedic elective floor that takes the overflow of orthopaedic trauma individuals. The hospitalized fragility fracture individuals provided an opportunity to educate individuals on osteoporosis at a time when their osteoporosis was no longer a silent disease. In addition, the bone health physician assistant (PA) had the ability to consult with the individual while in the hospital to educate and encourage them to follow up for testing, further education, and treatment.

Project Design

The project design was an EBP project using a pre-/postintervention with an educational program. The tools measured knowledge and self-efficacy. The intervention utilized a bone health PA, who was available to consult on Tuesday, Wednesday, and Thursday and provided consultation and education to the participant, including a brochure that was purchased from the BHOF.

Population

The inclusion criteria were individuals 50 years or older who were admitted for a fracture of the upper or lower extremity, hip or pelvis resulting from a GLF. This included surgical and nonsurgical patients. Excluded were confused individuals, non-English-speaking individuals, and hearing-impaired individuals, as the bone health PA does not speak American Sign Language and is only fluent in English.

Measurement Methods

This pilot study was designed to evaluate the impact of an osteoporosis educational intervention on knowledge and self-efficacy in hospitalized individuals. Two valid and reliable measurement tools were utilized (Kim et al., 1991): the Revised Osteoporosis Knowledge Test (ROKT) and the Osteoporosis Self-Efficacy Scale (OSES). Permission to use these instruments was granted from Dr. Phyllis Gendler. Endicott (2013) utilized both tools in pre- and posttest design to examine whether knowledge, health beliefs, and self-efficacy regarding osteoporosis changed after osteoporosis-specific education. The author concluded that osteoporosis education did increase knowledge and health beliefs but found no significant statistical findings regarding self-efficacy. Kalkım and Dağhan (2017) utilized the OSES as a pre- and postintervention tool with their osteoporosis educational program, which resulted in improved perceived health beliefs and self-efficacy.

The ROKT and OSES tools have been tested for validity and reliability (Gendler et al., 2014; Kim et al., 1991). The ROKT, developed by Kim et al. (1991) and revised by Gendler et al. in 2011 and 2012, is a 32-item tool consisting of multiple-choice questions regarding knowledge of facts about osteoporosis as well as the relationship of exercise and dietary intake of calcium to osteoporosis prevention. The ROKT has two subscales: nutrition (items 1–11 and 18–32) and exercise (items 1–17 and 30–32). The nutrition and exercise subscales both share 14 common items (items 1–11 and 30–32). The exercise subscale has scores for exercise ranging from 0 to 20 and the nutrition subscale has scores for nutrition ranging from 0 to 26. The reliability coefficients for internal consistency (KR 20) for the ROKT were 0.85 for the total scale, 0.83 for the nutrition subscale, and 0.81 for the exercise subscale. This revised test was reviewed for reliability and validity and the analysis resulted in a Pearson correlation coefficient of 0.87 (Gendler et al., 2014). In addition, Qi et al. (2014) tested the psychometric properties of the ROKT and found evidence of internal consistency and a reliability score of 0.98.

The OSES has two parts, an exercise scale and a calcium scale. Each part contains six items to measure confidence for engaging in exercise and calcium intake, respectively. The validity of the OSES was evaluated by factor analysis, discriminant function analysis, and reliability coefficients for internal consistency; Cronbach's α was 0.90 (Horan et al., 1998). The Likert scale will have a line after each question and "not at all confident" to "very confident" should measure exactly 10 cm (100 mm). The individual's score on each item will be measured to the nearest millimeter. The range for each item is 0 to 100.

Implementation

A PA from a bone health clinic in the community who had received training and certification from the BHOF in the Fracture Liaison Service (FLS) Model of Care educated participants in this project. An FLS is a coordinated model of care, which aims to ensure fracture risk assessment and treatment, where appropriate, delivered to all individuals with fragility fractures (BHOF, 2022a). There are numerous resources available on the website for healthcare professionals to promote excellence in clinical care in the treatment of osteoporosis.

The project lead ran a daily report of admitted fracture individuals generated in the electric health record (EHR) to identify those who met the inclusion criteria of being 50 years or older and having a fragility fracture. The project lead then completed medical record chart reviews of the EHR-generated list and utilized the inclusion and exclusion criteria to confirm the preintervention sample population. Demographic data were also collected that included the following data points: age, gender, ethnicity, body mass index (BMI), fracture location, tobacco use, alcohol use, history of taking calcium supplements, education level, and family history of osteoporosis.

Once individuals who met the inclusion criteria were identified, the project lead provided the ROKT and OSES to the participants and assisted them in completing the questionnaires. Referrals were made each morning on Tuesday, Wednesday, and Thursday to the bone health PA as to which participants had been included and completed their preimplementation questionnaire.

The structured education intervention only occurred on Tuesday, Wednesday, and Thursday during the 7 weeks of implementation and data collection. Once the questionnaires were completed, participants received targeted education during a 30-minute consultation with the bone health PA on the definition of a fragility fracture, testing, follow-up at the bone clinic, and smoking and alcohol cessation. The bone health PA provided the patient with an osteoporosis educational pamphlet purchased from the BHOF, titled "Osteoporosis: What You Need to Know," which contains osteoporosis risk factors, calcium and vitamin D recommendations, exercises, bone mineral density testing, and fall prevention education. This pamphlet was for the patient and family to refer to after the targeted education. After the educational intervention, participants were again assisted by the project lead to complete the ROKT and the OSES before discharge.

Data Analysis

The IBM Statistical Package for the Social Sciences (Version 25) predictive analytics software was used to analyze the data. Demographic data were analyzed using descriptive statistics, such as frequencies and percentages. Additionally, the Wilcoxon signed rank (WSR) test was the nonparametric statistical method used to identify, assess, and evaluate differences between the paired samples of pre- and posttest scores. Significance at 95% confidence was assigned when the WSR p value was .05 or less.

Results

Twenty-five completed surveys containing the ROKT and OSES were obtained from hospitalized fragility fracture individuals, 50 years or older, who met the project criteria. The ROKT and the OSES were used to evaluate osteoporosis knowledge and self-efficacy. The project was conducted over a period of 7 weeks.

Demographics

Of the individuals who completed the pre- and post-questionnaire ($N = 25$), the mean age was 70 (54–90), the mean BMI was 29.46 (17.18–56.26), and the mean 25-hydroxy vitamin D level was 33.18 (8.7–88.4). Educational background was also gathered, and 8% of the sample had completed grade school, 36% completed high school, 44% completed college, and 12% had obtained a master's degree. Demographic characteristics are listed in Table 1. Demographic characteristics of age, BMI, vitamin D level, and fracture location by gender are listed in Table 2. Fracture location consisted of hip or pelvis (28%), upper extremity (20%), and lower extremity (52%); of all participants, 20% had more than one bone fractured as seen in Table 2.

Revised Osteoporosis Knowledge Test

The WSR test was performed to compare the average pre- and postintervention osteoporosis knowledge

Table 1. Demographic Characteristics ($n = 25$)

Variable	*n* (%)
Education	
Master's degree	3 (12)
College degree	11 (44)
High school diploma	9 (36)
Completion of grade school	2 (8)
Gender	
Female	21 (84)
Male	4 (16)
Race	
Black	1 (4)
Hispanic	1 (4)
Native American	1 (4)
White	22 (88)
Tobacco use	
Current/former	14 (56)
Never	11 (44)
Alcohol use	
Yes	8 (32)
No	17 (68)
History of calcium use	
Yes	5 (20)
No	20 (80)
Family history of osteoporosis	
Yes	8 (32)
No	17 (68)
Total	25 (100)

Table 2. Demographic Characteristics by Gender

Variable	Female *M*	Male *M*
Age in years	68.9	77.0
Body mass index	30.1	26.2
Vitamin D level	33.6	30.8
Fracture location	***n* (%)**	***n* (%)**
Hip or pelvis	6 (28.5)	1 (25)
Upper extremity	5 (23.8)	0
Lower extremity	10 (47.6)	3 (75)
More than one fracture location	5 (23.8)	0

scores. Normality and uniformity of the distribution of ROKT score data points were tested with the Kolmogorov–Smirnov tests and found to have normal and uniform distributions. The ROKT score was significantly higher post-intervention ($M = 20.40$) compared with pre-intervention ($M = 12.60$) in the WSR paired samples test (WSR 324, $p = .000$) as seen in Table 3.

Table 4 depicts the pre- and postintervention scores for osteoporosis knowledge regarding risk factors, nutrition intake, and exercise. The preintervention total scores ranged from 5 to 23, and the postintervention total scores ranged from 5 to 27. The results suggest that the osteoporosis educational intervention increased osteoporosis knowledge level among the hospitalized fragility fracture individuals.

Although 48% ($n = 12$) of respondents knew that being menopausal could increase their chance of getting osteoporosis, only 20% ($n = 5$) knew that surgical removal of the ovaries was also a risk factor for osteoporosis. Fifty-two percent ($n = 13$) of respondents correctly identified smoking as a risk factor; however, only 24% ($n = 6$) knew that the consumption of two or more alcoholic drinks per day could also increase their risk of developing osteoporosis. Although 76% ($n = 19$) of individuals knew that vitamin D was required for the absorption of calcium, only 32% ($n = 8$) knew the recommended daily dose of calcium, and just 28% ($n = 7$) knew the recommended dose of daily vitamin D. Fifty-two percent ($n = 13$) correctly recognized aerobic dancing as an acceptable activity to reduce the risk of developing osteoporosis; however, only 16% ($n = 4$) knew that 30 minutes of exercise at least 5 days a week was recommended.

Participants were also able to identify acceptable sources of calcium, including cheese 64% ($n = 16$), sardines 36% ($n = 9$), broccoli 48% ($n = 12$), yogurt 68% ($n = 17$), and ice cream 76% ($n = 19$). Although 68% (17) of individuals were aware that osteoporosis could be treated with medication, only 24% (6) knew a bone density scan could be used to diagnose osteoporosis.

Osteoporosis Self-Efficacy Scale

The OSES score was significantly higher post-intervention ($M = 56.2$) compared with pre-intervention ($M = 47.5$) in the WSR paired samples test (WSR 323, $p = .037$), as seen in the Table 3 comparison. Table 5 is the results of the pre- and postintervention self-efficacy score for motivation to change exercise and calcium intake. The preintervention total OSES range was 17.1 to 93.7, and the postintervention total range was 43.5 to 94.1. These results suggest that the osteoporosis educational intervention increased motivation for change in

Table 3. Comparison of Pre- and Posttest Scores

Comparisons	Preintervention	Postintervention	WSR	WSR Significance
Pre- vs. post-ROKT scores	12.6	20.4	324	.000*
Pre- vs. post-OSES scores	47.5	56.2	323	.037*

Note. OSES = Osteoporosis Self-Efficacy Scale; ROKT = Revised Osteoporosis Knowledge Test; WSR = Wilcoxon signed rank paired samples test statistic.
*Statistically significant at 95% confidence ($p < .05$).

TABLE 4. ROKT SCORES

	Preintervention			Postintervention		
	Range	*M*	*SD*	Range	*M*	*SD*
Risk factors	0–7	3.84	2.21	1–11	7.16	2.66
Nutrition	1–19	10.84	4.67	5–23	17.08	4.25
Exercise	1–11	6.60	3.72	4–20	12.75	3.98
Total score	5–23	12.60	5.51	5–27	20.4	5.52

exercise and calcium intake as well as self-efficacy among the hospitalized fragility fracture individuals.

Discussion

The findings of this project are supported by Giangregorio et al. (2019), who reported individuals have a knowledge deficit of osteoporosis and the associated risk factors. The results of the ROKT from this project suggest there is a gap in osteoporosis knowledge in hospitalized fragility fracture individuals. The purpose of this project was to examine the effect of an educational intervention on knowledge of osteoporosis and self-efficacy. The findings demonstrate a brief educational session can increase both knowledge regarding osteoporosis and self-efficacy. These findings are supported by previous research from Gai et al. (2019), as their results concluded that educational interventions significantly increased osteoporosis knowledge and outcomes. After consultation with the bone health PA, participants had significantly higher osteoporosis knowledge scores overall. Self-efficacy pre-intervention had a 57.2% total confidence level that participants could adhere to a diet high in calcium and an exercise program. Post-intervention, their total mean confidence level had increased to 64.7%. Nurses and other health professionals can play a key role in increasing self-efficacy and osteoporosis prevention by providing osteoporosis education to hospitalized individuals at risk for osteoporosis, or to those who have osteoporosis in an effort to prevent a secondary fracture. This educational intervention as performed by a bone heath PA is supported and recommended in the literature to increase awareness of osteoporosis and prevent a secondary fracture as suggested by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (2019). In the short term, the team made a difference in osteoporosis knowledge. It is unknown whether the increase in osteoporosis knowledge and self-efficacy will translate to a change in behavior or whether osteoporosis knowledge will be retained in the long term.

Limitations

There were several limitations with this project. The first is the small sample size (*N* = 25). Simple fragility fracture individuals were seen in the emergency department and sent home to follow up with the orthopaedic surgeon, and not included in the project. The more medically complex fragility fracture individuals are those who are admitted and were included in the project. There were several individuals who had to be excluded due to confusion, and some who refused due to pain and therefore did not want to be asked 44 questions. Another limitation was that the time in which the project had to be completed was only 7 weeks in the summer months. The short time frame of the observations renders it impossible to control for any of the well-known effects of seasonal variations upon interventional outcomes. The self-report method used to gather data may not be accurate information because it was reported by the participant. After the intervention, some participants may have responded to items by answering with something they believed the project lead wanted to hear. Lastly, this project did not standardize the timing of the pretest, educational event, and posttest; therefore, it took a different amount of time for each participant.

Conclusion

This project focused on improving osteoporosis education and self-efficacy in hospitalized fragility fracture patients 50 years and older. The analysis of data collected from this project supports that a gap in knowledge regarding osteoporosis exists, and that improvement in osteoporosis knowledge and self-efficacy is possible. The implementation of this osteoporosis educational intervention raised awareness in participants of osteoporosis risk factors, important preventative nutritional intake, and recommended preventative exercises. This information supports the need for osteoporosis education for hospitalized fragility fracture individuals. Further, quality research is needed to best

TABLE 5. OSTEOPOROSIS SELF-EFFICACY SCALE

	Preintervention			Postintervention		
	Range	*M*	*SD*	Range	*M*	*SD*
Exercise	4.4–94.1	47.5	3.72	17.8–93.2	56.2	3.6
Calcium	17.8–93.2	56.2	6.17	45.5–93.9	75.3	4.01
Total	17.1–93.7	47.5	11.18	43.5–94.1	56.2	11.76

guide the clinician in osteoporosis educational content as well as the mode of delivery that results in increased knowledge and self-efficacy.

References

American Academy of Orthopedic Surgeons. (2014). *Osteoporosis/bone health in adults as a national public health priority*. https://www.aaos.org/contentassets/1cd7f41417ec4dd4b5c4c48532183b96/1113-osteoporosis-bone-health-in-adults-as-a-national-public-health-priority.pdf

Bone Health & Osteoporosis Foundation. (2022a). *FLS resources*. https://www.bonesource.org/fls-resources

Bone Health & Osteoporosis Foundation. (2022). *What women need to know*. https://www.bonehealthandosteoporosis.org/preventing-fractures/general-facts/what-women-need-to-know/

Bartl, R., & Bartl, C. (2016). *Bone disorders: Biology, diagnosis, prevention, therapy*. Springer.

Burge, R., Dawson-Hughes, B., Solomon, D. H., Wong, J. B., King, A., & Tosteson, A. (2006). Incidence and economic burden of osteoporosis-related fractures in the United States, 2005-2025. *Journal of Bone and Mineral Research*, *22*(3), 465–475. https://doi.org/10.1359/jbmr.061113

Compston, J., McClung, M., & Leslie, W. (2019). Osteoporosis. *The Lancet*, *393*(26), 364–379. https://doi.org/10.1016/S0140-6736(18)32112-3

Conley, R. B., Adib, G., Adler, R. A., Åkesson, K. E., Alexander, I. M., Amenta, K. C., Blank, R. D., Brox, W., Carmody, E. E., Chapman-Novakofski, K., Clarke, B. L., Cody, K. M., Cooper, C., Crandall, C. J., Dirschl, D. R., Eagen, T. J., Elderkin, A. L., Fujita, M., Greenspan, S. L, & Kiel, D. P. (2019). Secondary fracture prevention: Consensus clinical recommendations from a multistakeholder coalition. *Journal of Bone and Mineral Research*, *35*(1), 36–52. https://doi.org/10.1002/jbmr.3877

Cox, S., & Hooper, G. (2020). Improving bone health and detection of osteoporosis. *The Journal for Nurse Practitioners*, *17*(2), 233–235. https://doi.org/10.1016/j.nurpra.2020.05.008

Drew, S., Judge, A., Cooper, C., Javaid, M. K., Farmer, A., & Gooberman-Hill, R. (2016). Secondary prevention of fractures after hip fracture: A qualitative study of effective service delivery. *Osteoporosis International*, *27*(5), 1719–1727. https://doi.org/10.1007/s00198-015-3452-z

Endicott, R. D. (2013). Knowledge, health beliefs, and self-efficacy regarding osteoporosis in perimenopausal women. *Journal of Osteoporosis*, *2013*, 1–6. https://doi.org/10.1155/2013/853531

Gai, Q. Y., Lv, H., Li, Y. P., Fu, Q. M., & Li, P. (2019). Education intervention for older adults with osteoporosis: A systematic review. *Osteoporosis International*, *31*(4), 625–635. https://doi.org/10.1007/s00198-019-05166-5

Gendler, P., Coviak, C., Martin, J., Kim, K. K., Dankers, J. K., Barclay, J., & Sanchez, T. A. (2014). Revision of the osteoporosis knowledge test. *Western Journal of Nursing Research*, *37*(12), 1623–1643. https://doi.org/10.1177/0193945914537565

Giangregorio, L., Dolovich, L., Cranney, A., Adili, A., deBeer, J., Papaioannou, A., Thabane, L., & Adachi, J. (2009). Osteoporosis risk perceptions among patients who have sustained a fragility fracture. *Patient Education and Counseling*, *74*(2), 213–220. https://doi.org/10.1016/j.pec.2008.08.001

Harvey, N. W., McCloskey, E. V., Mitchell, P. J., Dawson-Hughes, B., Pierroz, D. D., Reginster, J., Rizzoli, R., Cooper, C., & Kanis, J. A. (2017). Mind the (treatment) gap: A global perspective on current and future strategies for prevention of fragility fractures. *Osteoporosis International*, *28*(5), 1507–1529. https://doi.org/10.1007/s00198-016-3894-y

Hertz, K., & Santy-Tomlinson, J. (2018). *Fragility fracture nursing holistic care and management of the orthogeriatric patient*. Springer International Publishing. https://doi.org/10.1007/978-3-319-76681-2_12

Horan, M. L., Kim, K. K., Gendler, P., Froman, R. D., & Patel, M. D. (1998). Development and evaluation of the osteoporosis self-efficacy scale. *Research in Nursing & Health*, *21*(5), 395–403. https://doi.org/10.1002/(SICI)1098-240X(199810)21:5<395::AID-NUR3>3.0.CO;2-I

Kalkım, A., & Dağhan, Ş. (2017). Theory-based osteoporosis prevention education and counseling program for women: A randomized controlled trial. *Asian Nursing Research*, *11*(2), 119–127. https://doi.org/10.1016/j.anr.2017.05.010

Kim, K. K., Horan, M. L., Gendler, P., & Patel, M. K. (1991). Development and evaluation of the osteoporosis health belief scale. *Research in Nursing & Health*, *14*(2), 155–163. https://doi.org/10.1002/nur.4770140210

Kochanek, K., Murphy, S., Xu, J., & Arias, E. (2019). *National vital statistics reports volume 68, number 9 June 24, 2019 deaths: Final data for 2017*. Retrieved June 8, 2020, from https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_09-508.pdf

Lorentzon, M., & Cummings, S. R. (2015). Osteoporosis: The evolution of a diagnosis. *Journal of Internal Medicine*, *277*(6), 650–661. https://doi.org/10.1111/joim.12369

National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2019). *Once is enough: A guide to preventing future fractures*. https://www.bones.nih.gov/sites/bones/files/pdfs/onceisenoughguidepreventingfractures-508-11-18.pdf

National Institutes of Health Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy. (2001). Osteoporosis prevention, diagnosis, and therapy. *JAMA*, *285*(6), 785–795. https://doi.org/10.1001/jama.285.6.785

Qi, B. B., Resnick, B., & Nahm, E. S. (2014). Reliability and validity of the Revised Osteoporosis Knowledge Test. *Journal of Nursing Measurement*, *22*(2), 342–356. https://doi.org/10.1891/1061-3749.22.2.342

Sarafrazi, N., Wambogo, E., & Shepherd, J. (2021). *Osteoporosis or low bone mass in older adults: United States, 2017-2018* (NCHS Data Brief No. 405). National Center for Health Statistics. https://doi.org/10.15620/cdc:103477

Sözen, T., Özişik, L., & Çalik Başaran, N. (2017). An overview and management of osteoporosis. *European Journal of Rheumatology*, *4*(1), 46–56. https://doi.org/10.5152/eurjrheum.2016.048

Williams, S., Chastek, B., Sundquist, K., Barrera-Sierra, S., Leader, D., Weiss, R. J., Wang, Y., & Curtis, J. R. (2020). Economic burden of osteoporotic fractures in US managed care enrollees. *The American Journal of Managed Care*, *26*(5), e142–e149. https://doi.org/10.37765/ajmc.2020.43156