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An Educational Intervention to Prevent Fractures in Older Women

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Abstract

Americans experience an estimated 2 million fragility fractures annually. Women over age 50 bear the higher burden of this condition and have a 1-in-2 lifetime risk of suffering a fracture. About half of people who experience a hip fracture never regain their previous level of function. Seven and a half percent of those who suffer a fragility fracture die within 90 days of the event. The total cost for all fractures in the year 2025 is predicted to be $18 billion for American women. The purpose of this project was to provide older women with knowledge and tools to enable changes in health behaviors and reduce their risk of suffering a fracture. To meet that goal, participants were provided with educational material about changes they can make to improve their bone health. Literature reviews found that education on diet, exercise, and smoking cessation were the most common non-pharmaceutical methods of preventing fractures. Information about the project, the pre-survey, and screening questions were mailed to 1805 women between the ages of 65 and 75 from a convenience sample of members who belong to an integrated health plan. Women with a diagnosis of a cognitive disorder or dementia; a diagnosis of osteoporosis or who take medicines for osteoporosis; who reside in a custodial care setting; or who are under the care of hospice or the palliative care team were excluded. Women who met the criteria and agreed to participate were mailed educational materials on osteoporosis, screening, bone healthy diets, and fall prevention once a week over four weeks. Participants indicated little increased knowledge after the intervention. Participants indicated that they adhered to healthy, active lifestyles before the outreach and so few lifestyle changes were reported. There was a significant difference in the scores for the pre-test (M=63.79, SD=19.95) and the post-test (M=52.87, SD=21.39); t (28) =2.932, p = 0.007. These results indicate that education via this method did not increase participants' knowledge.

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Annually, Americans experience an estimated 2 million fragility fractures (Singer et al., 2015). The costs to patients and society, in general, are significant, and as the older adult population grows, the burden on individuals and the healthcare system will increase.

There are many physiological, environmental and other extrinsic elements that make older adults more susceptible to fractures. Factors such as gait and balance disorders, decreased vision, frailty, prior fracture and use of some high-risk medications increase the risk of falls, thus contributing to overall fracture risk (Southerland, Barrie, & Falk, 2014). Lifestyle factors such as smoking and low exercise/activity level are also contributors (Weycker et al., 2017). One of the most common risk factors for fractures is osteoporosis, a skeletal disease characterized by low bone mass and an increase in bone fragility caused by a breakdown of the microarchitecture of bone (Pisani et al., 2018). Osteoporosis is highly prevalent in older adults, affecting approximately ten million Americans (Cosman et al., 2014). Women over age 50 bear the higher burden of this condition, leading to a 1 in 2-lifetime risk of having a fracture compared to men, who have a 1 in 5-lifetime risk (Cosman et al., 2014). Aside from osteoporosis, conditions such as diabetes, rheumatoid arthritis, malignancies and renal disease increase susceptibility to fractures as well (Cosman et al., 2014).

The increase in the incidence of fractures is important for numerous reasons. The mortality rate of patients who suffer a fragility fracture is significant; low impact fractures have a higher mortality rate than those with a fracture due to high-impact trauma (Southerland et al., 2014). Seven and a half percent of those who suffer a fragility fracture die within 90 days of the event and the five-year survival rate of adults with hip fractures is like that of patients with breast or other cancers (Southerland et al., 2014).

In addition to the increased risk of death, fractures can lead to a decline in mobility, functional status and a loss of independence. About one-fourth of people who suffer a hip fracture are admitted to a long-term care facility and about one-half never regain their previous level of function (International Osteoporosis Foundation [IOF], n.d.). Women are affected disproportionately by the sequelae of these injuries since they experience about 75% of all hip fractures, 80% of forearm fractures, and 75% of humeral fractures (IOF, n.d.). Adults who suffer a fracture have an increased risk of falls and re-fracture in the first year following the initial fracture leading to higher costs and disability, making secondary fractures a significant clinical problem as well (IOF, n.d.).

Beyond healthcare utilization, the cost of caring for individuals with an osteoporotic fracture is significant. From 2000-2011, the total annual population cost for hospitalization was $5.1 billion for osteoporotic fractures, greater than myocardial infarction (MI) or stroke which was $4.3 billion and $3.0 billion respectively (Singer et al., 2015). Overall, the total cost for all fractures in the year 2025 is predicted to be $18 billion for American women (Singer et al., 2015).

Problem Statement

Despite the availability of risk assessment tools and guidelines from organizations such as the National Osteoporosis Foundation, fracture prevention is a lesser priority for healthcare providers, and few individuals at risk for osteoporosis are screened and treated (Curtis, Moon, Harvey, & Cooper, 2017). From 2008-2014, the osteoporosis screening rate for women ages 65-79 was 26.5% and 12% for women over the age of 80 (Gillespie & Morin, 2016). People who suffer fractures have an 86% increased risk of experiencing another fracture, but eighty percent of women over the age of 67 who experience a fracture are never even tested or treated for

osteoporosis. (International Osteoporosis Foundation [IOF], n.d.). Fracture liaison services, which incorporate osteoporosis treatment, falls risk assessment and mitigation, exercise programs, and patient education, have been implemented in several countries for secondary fracture prevention leading to reductions in mortality and improvements in osteoporosis assessment and prevention, but they have not been widely adopted in the United States (Bonanni, Sorensen, Dubin, & Drees, 2017; Hawley et al., 2016; Larcombe, Lisk, & Yeong, 2014).

An additional barrier to fracture prevention is that patients often do not understand the severity of their risk, and they do not perceive their vulnerability to fracture as an essential priority that requires either medical intervention or lifestyle modification. Many patients also cite concerns about the adverse effects of osteoporosis medications and feel they are at greater risk from potential side effects than from fractures, indicating a need for additional patient education of the risk versus benefit of these medications (Grover et al., 2014).

Purpose of the Project

The purpose of this project was to provide older women with knowledge and tools that will enable them to change their health behaviors and reduce their risk of suffering a fracture. To meet that goal, participants were provided with educational material about changes they can make to improve their bone health. Focus areas were diet, exercise and osteoporosis screening.

Clinical Question

In community-dwelling older women who are not being treated for osteoporosis, does education on fracture risk, fall prevention and osteoporosis prevention and treatment lead to changes in health behaviors to reduce the risk?

Review of Literature

Search Strategy

This writer conducted a literature search by querying the following databases: CINAHL Plus with Full Text, Medline with Full Text, PubMed and Cochrane Databases. The keywords and combinations used were osteoporosis prevention, osteoporosis treatment, fractures elderly, fracture risk, fracture prevention, and fracture prevention models of care. The limitations used to narrow the results of the search were: age of study ≤ 5 years; English language; scholarly, peer-reviewed articles; academic journals; age of subjects; age 65+; and female gender. Studies based on interventions conducted in the inpatient setting were excluded. The initial search of the databases returned 3069 results. After reviewing abstracts, the studies were limited to qualitative and quantitative research studies; single random controlled trials; systematic reviews or meta-analyses; and clinical practice guidelines. Ten studies were reviewed.

The strength of the evidence presented by the studies was evaluated using criteria developed by the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) workgroup (Guyatt et al., 2008). The GRADE approach provides a framework to systematically appraise quality of evidence, first by determining if evidence is of very low quality, low quality, moderate quality, or high quality (Guyatt et al., 2008). Very low-quality evidence is defined as having an uncertain treatment effect; our confidence in low quality evidence will likely be impacted by further evidence leading to a change in the estimate of the treatment effect; confidence in moderate quality evidence will likely be impacted by further evidence and may lead to a change in our confidence; and confidence of the estimate of treatment effect of high quality evidence is unlikely to be changed by further research (Guyatt et al., 2008). GRADE also offers two levels of recommendations, strong and weak based on an assessment of risk versus benefit (Guyatt et al., 2008). The appraisal of the evidence is

summarized in Table 1 in Appendix A. There were four studies of high quality, four of moderate quality and two of low quality. All the studies reviewed received a strong recommendation.

Studies that described primary and/or secondary fracture prevention interventions in the outpatient setting were reviewed. The studies are summarized and organized by the type of intervention studied in the following paragraphs.

Literature Review

Primary Fracture Prevention

Five of the studies reviewed the effectiveness of interventions aimed at primary fracture prevention that focused on education, exercise, and diet.

A systematic review of 16 randomized controlled trials and literature reviews conducted by Senderovich, Tang, & Belmont (2017) concluded that strength training increased BMD, muscle mass and reduced fractures. This study was based on high quality evidence and has a strong recommendation.

A study of Chinese immigrants (low quality of evidence, strong recommendation) measured participants' confidence in their ability to perform physical activity after receiving osteoporosis education. The study found that participants' Osteoporosis Self-Efficacy Scale scores increased after receiving the education (Zou, Hampton, Shade, & Kaku, 2017).

Other studies found that the benefits of an exercise program had positive long-term benefits. In a randomized controlled trial (Grade level moderate quality) conducted of community-dwelling Finnish women who participated in a resistance and balance-jumping exercise program significantly reduced falls (51%) and fractures (74%) over a 5- year period (Karinkanta, Kannus, Uusi-Rasi, Heionen, & Seivanen, 2015).

The only study that examined the effect of diet on bone health solely found a significant decrease in the rate of fracture-related hospitalizations of patients whose intake of vegetables was greater than 3 servings per day, but fruit intake had no effect, neither positive or negative (Blekkenhorst et al., 2017).

Only one study examined the effect of care models on fracture prevention. A retrospective chart review of female patients over the age of 65 found that utilization of an evidence-based osteoporosis treatment tool led to a 40% improvement in identification and treatment of osteoporosis which is an essential step in the prevention of fractures (Jones & Henry, 2017). Using the Grade criteria, this study was a strong recommendation, with low-quality evidence due to the use of a chart review.

Secondary fracture prevention

All the secondary fracture prevention studies evaluated the effectiveness of various aspects of coordinated fracture prevention models of care. A wide variety of outcomes using multifactorial interventions were studied. All studies examined in this systematic review found that coordinated model of care interventions led to increases in bone mineral density testing and treatment initiation. Models that were fully coordinated were effective in reducing re-fracture rates.

The following two studies received a strong recommendation for the same reason. A historical cohort study of patients >age 50 with minimal trauma fractures determined that patients receiving lifestyle and dietary education via a formalized treatment program resulted in a 30% reduction in re-fracture rates (Nakayama, Major, Holliday, Attia, & Bogduk, 2015). One prospective observational study measured the effectiveness of a fracture prevention service to increase adherence to osteoporosis treatment. The results were that 47.62% of patients received

BMD testing in the post-intervention phase compared to 14.53% in the pre-intervention phase; 48.51% received osteoporosis medication treatment post intervention versus 17.16% before; and 52.48% had follow-up in a fall/fracture clinic compared to 2.37% post intervention (Ruggiero et al., 2015).

A third study that used this intervention was rated a strong recommendation with moderate quality evidence of an observational study of 2207 fragility fracture patients. The results found that a fracture liaison service improved both rates of BMD testing after a fracture and adherence to drug treatment over the course of a year, an important factor in reducing fracture and re-fracture rates (Eekman et al., 2014).

The final two studies reviewed focused on quality and education. The quality study, a retrospective chart review, reviewed the care of patients discharged with a fracture and compared nurse practitioner care to physician care and their compliance to the proposed JCAHO core measure measuring the quality of care for osteoporosis-related fractures (Fojas et al., 2017). The study found that while physician-led care had higher rates of completed lab tests and initiation of osteoporosis medication treatment, both groups had similar completion rates of bone mineral density testing indicating that either model was effective in the identification of re-fracture risk.

Finally, the importance of educating patients about the link between their fracture risk due to osteoporosis and subsequent fractures was found to increase adherence to anti-resorptive medicine although it did not affect their willingness to participate in exercise programs (Luc et al., 2018).

Gaps in literature

More studies of primary fracture prevention care models for community-dwelling adults are needed. Most care models or interventions are focused on reducing risk factors such as falls

but are not explicitly focused on the prevention of fractures. Fracture liaison services are implemented for secondary prevention. The literature is also lacking in studies of nurse practitioner-led models of care.

Summary of literature review

The studies evaluated indicate that comprehensive and multifactorial interventions are most successful at reducing falls and preventing both primary and secondary fractures (Nakayama et al., 2015). Inter-professional teams to address fracture prevention are recommended with a focus on testing, pharmacological treatment and fall prevention. The populations studied, older adult females, were representative of the patients most afflicted by fracture. Care models that incorporate exercise as a primary technique are also effective at fall prevention and thus, fracture prevention (Karinkanta et al., 2015; Senderovich et al., 2017). Patient education was integral to the success of all models reviewed and varied*;* some focused solely on exercise; other models incorporated other lifestyle changes such as diet and smoking cessation. Initiatives that reduce the risk and rate of fracture should continue to be developed, implemented and studied. The summary of the evidence indicates that patient education can assist patients to partner with their healthcare providers to get the right preventative and/or follow-up care to maintain or achieve good bone health and avoid fractures.

Theoretical Framework

The conceptual framework that was used to guide the intervention is Pender's Health Promotion Model. The design and implementation of this project was based on Resnick's Theory of Self-Efficacy.

Pender's Health Promotion Model (HPM) is the conceptual framework that was used to guide the intervention. Pender's model "identifies background factors that influence health

behavior, and states that using the model, the nurse can work collaboratively with the patient and can assist the patient in changing behaviors to achieve a healthy lifestyle" (Pender, 2011, p. 2). Pender has used the model to research health behaviors in all ages from adolescents to older adults. The Health Promotion Model "focuses on three areas: individual characteristics and experiences, behavior-specific cognitions and affect, and behavioral outcomes" ("nursingtheory.org," n.d.). According to the theory, the way each person acts or reacts is based on their unique individual characteristics and experiences. Nursing can modify the variables that determine behavior. There are four assumptions that the model makes which were integral to the intervention: "1. Individuals seek to actively regulate their own behavior; 2.Individuals, in all their biopsychosocial complexity, interact with the environment, progressively transforming the environment as well as being transformed over time; 3. Health professionals, such as nurses, constitute a part of the interpersonal environment, which exerts influence on people through their life span; and 4. Self-initiated reconfiguration of the person-environment interactive patterns is essential to changing behavior" ("nursingtheory.org," n.d.).

As a framework for the intervention, Pender's model was used to guide the modification of variables such as the disconnect between perceived and actual risks through the provision of education explaining the commonality of fractures. The project also helped participants to make the connection between their healthy behaviors and the mitigation of those hazards.

Resnick's theory of self-efficacy is a middle range theory that is based on social cognitive theory. "Major concepts in the theory are self-efficacy expectations and outcome expectations" (McCarthy & Fitzpatrick, 2014, p.24). Self-efficacy and outcome expectations are explained as whether someone believes they can complete a task and whether they believe those behaviors will lead to desired outcomes. Resnick's theory posits that there are four sources of information

that will affect one's perception of their own self-efficacy: "enactive attainment (actual performance of the behavior); vicarious experience (watching others like themselves perform the behavior); verbal persuasion (encouragement by others); and physiological feedback (bodily experience while performing the task)" (McCarthy & Fitzpatrick, 2014, p. 24). Resnick has conducted research that found that "self-efficacy expectations influence adoption and maintenance of functional activities and... exercise behavior" among older adults (Smith & Liehr, 2014, p. 200). "The theory of self-efficacy has been used in nursing research focusing on clinical aspects of care, education, nursing competency, and professionalism" (Smith & Liehr, 2014, p. 200). The self-efficacy theory can be used to explain behaviors related to fracture prevention among older adults. For example, screening and treatment for osteoporosis lags and some studies suggest that there is a disconnection between patient's knowledge of the risk factors and their belief that it can be avoided. One study found that women thought of "osteoporosis as natural bone deterioration, fractures were disconnected to bone fragility, the effects of treatment were not tangible, and patients feared the side effects of medication. Aging rather than disease was perceived as the cause of normal, 'natural' deterioration of bones due to wear-and-tear, and this perception was reinforced by the silent, asymptomatic nature of PMO [post-menopausal osteoporosis]" (Alami, Hervouet, Poiraudeau, Briot & Roux, 2016, p.12). However, another study found that "women had a strong belief in PA [physical activity] as a possible way to maintain health in their life with osteoporosis, which also implied that they believed that they themselves had an important role in achieving this possibility" (Dohrn, Stahle, & Roaldsen, 2016, p.363). Both studies are examples of the results of belief (or disbelief) in self-efficacy to make changes in their health. The results of the writer's project reflect a population that believes in their own ability to affect their health through exercise and diet.

In conclusion, Resnick's theory of self-efficacy provided the foundation needed to understand the health behaviors that are inherent to the clinical problem stated above.

Project Design

Participants

Women between the ages of 65 and 75 not already diagnosed with osteoporosis were invited to participate. The following women were excluded from participation: women with a diagnosis of cognitive disorder or dementia; who reside in a custodial care setting; who have a diagnosis of osteoporosis or are being treated with anti-osteoporosis therapy within the last two years; or who are under the care of hospice or palliative care.

Information about the project, the pre-survey and screening questions about exclusion criteria were mailed to 1805 women from a convenience sample. A convenience sample was chosen due to access to the population and the short timeframe to conduct the project, with the understanding that the most motivated participants were likely to respond and thus the results could not necessarily be generalized to the entire population (Kandola, Banner, O'keefe-McCarthy, & Jassal, 2014). Potential participants were initially identified by the analytics department of the project site using a program that queried the electronic health record for women who met the age and location criteria and who were identified as current patients. Members were asked to complete a questionnaire with qualifying questions, and those who met inclusion criteria and who were willing to participate were asked to return the survey and signed consent. Once the survey and consent were received, the student investigator reviewed the questionnaire for positive responses to the exclusion criteria to verify eligibility. If they met criteria, they were enrolled and mailed the educational materials. Seventy women responded, and fifty women met the criteria for the project and were enrolled.

Setting

The project site is at a medical office in a suburb south of a major metropolitan area in the southeast US, located in a county with a population of 285,000 ("Quickfacts," 2018). It is one of 26 sites within an integrated health system. The health system serves a total of 356,000 people in the metro area; members at the project site have access to primary care doctors as well as providers in twenty different specialties including cardiology, rheumatology, oncology, pulmonology and general surgery ("Fast Facts," 2018). An onsite lab, pharmacy, radiology services, infusion therapy and a 24/7 urgent care center are also available. The demographics of the county where the facility is located: 72% African-American, 20% White, and 5% Asian. The population is approximately 53% female. The poverty rate in the county is 16.3% ("Quickfacts," 2018).

Instruments/Tools

The instrument used to collect the data was a questionnaire developed by the student investigator (SI), utilizing Qualtrics® research software, a tool that assists with the creation, distribution and data analysis of surveys. Feedback and assistance on the development of the questionnaire was provided by a member of the project team. The same questionnaire was used for the pre- and post-survey. The subjects' knowledge of risk factors for fractures and their current lifestyle was assessed utilizing 12 multiple choice questions. The questionnaires were mailed to participants to complete in their homes, and they were provided a self-addressed stamped envelope to return them to the project team. Questions were scored, and responses were compared for differences from the pre-and post-survey. Reliability of this tool is unknown to date. A lack of evidence about use of this tool in the population of interest warrants a reliability analysis upon data completion.

Intervention

The intervention was administered in a series of mailings. Initially, participants received a letter describing the intervention and a pre-survey to gauge their knowledge of osteoporosis and fracture prevention, as well as current health behaviors such as exercise type and frequency, smoking, alcohol use, diet, and falls. A pre-stamped envelope was provided so they could return the survey at no cost. Qualified participants who returned the pre-survey were mailed educational material focusing on exercise, diet, fall prevention, and osteoporosis prevention and screening. There were four informational flyers. A list of resources that supplement the teaching was provided at the end of the project. Examples of resources were names of classes that improve balance and strength, prevent falls, and phone numbers and contact information so they can access nutrition services or schedule bone mineral density screening tests. The last mailing included the post-survey to assess if their knowledge increased and if they changed their behavior due to the education provided. As before, a pre-stamped envelope was provided so participants were able to return the survey at no cost.

The SI scanned, uploaded and stored consents and pre- and post-survey responses in separate subfolders of the project folder on a secured electronic drive at the project site. Only the SI has security access to the folder, which was granted by and is maintained by the IT at the project site.

Addresses were only used to mail information to the participants. The SI assigned a numerical code to the surveys and linked them to the participants' addresses. Addresses are stored in a separate subfolder in the project folder. All addresses and questionnaires will be destroyed at the end of the project.

No incentives were provided for this project.

Timeline

The consent forms and pre-survey were first mailed the last week of October. After 14 days, to allow for potential participants to review and return the material, questionnaires were gathered and sorted, and the information was uploaded to the secure drive. Participants were then mailed information weekly covering the subjects of diet, exercise, osteoporosis and bone mineral testing. The post-survey and a list of resources were mailed the second week of December.

Results

Information about the study was mailed to 1805 people. The target sample size was 317. Fifty people consented to the study and returned the pre-survey. An additional 21 respondents were disqualified due to exclusion criteria. Twenty-nine people returned the post-survey. The pre-survey results indicate a high level of knowledge in the areas of exercise and diet (see Figure 1). Respondents did not know the risk factors for fractures and did not know the severity of the risk. Participants also were also uncertain of the benefit versus the risk of taking osteoporosis medications. These findings are consistent with the literature.

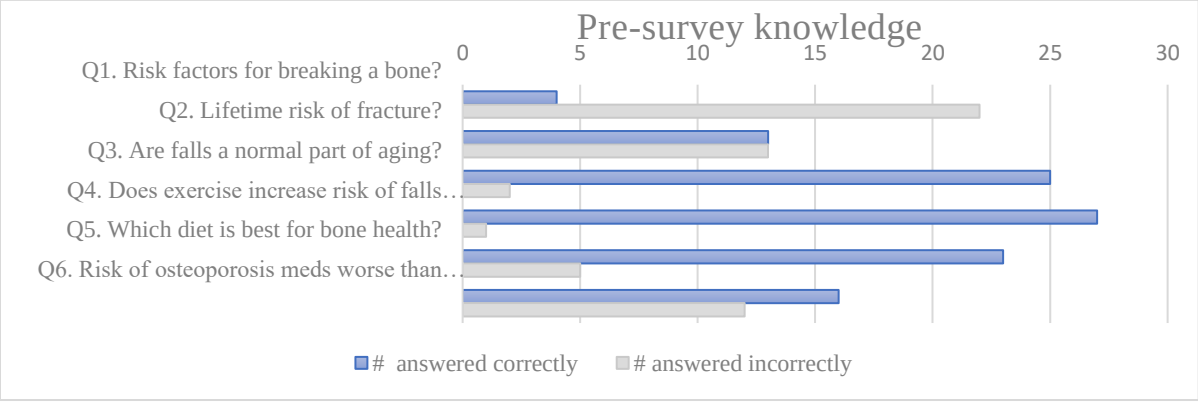

Figure 1

The post-survey did not indicate any significant knowledge attainment. Results were similar to the pre-survey; in many instances, respondents scored lower on the post-survey (see Figure 2).

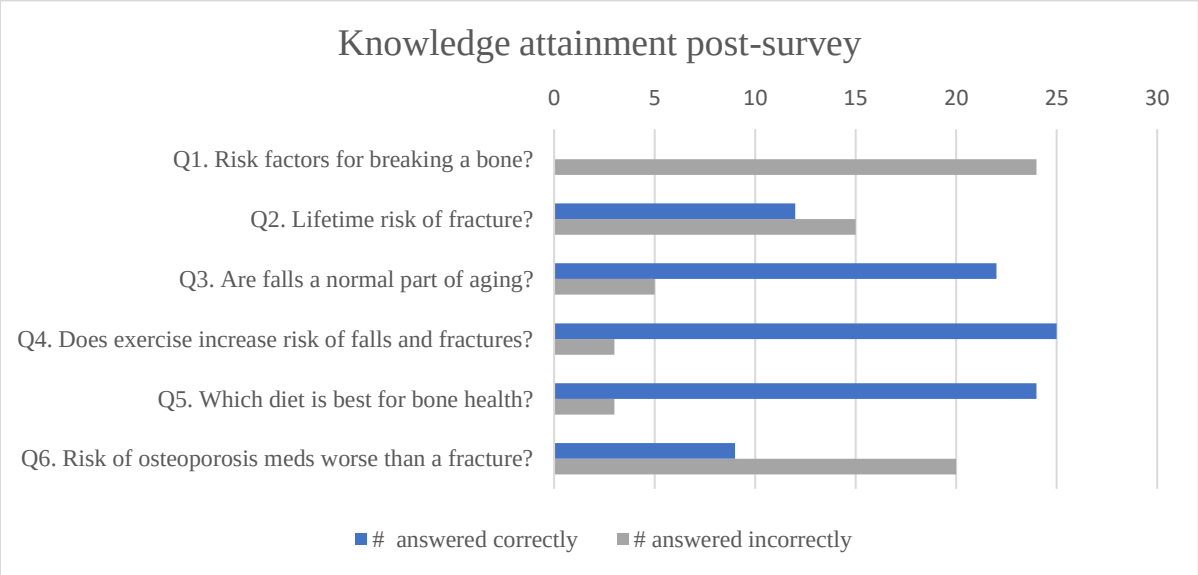

Figure 2

The lifestyle questions indicated that most respondents exercise regularly, do not smoke and either do not drink or drink rarely (see Figure 3). Approximately 60% of participants in the indicated that they eat a bone-healthy diet and have had bone density testing in the last 5 years. Approximately 28% of respondents have had a fall in the last 6 months.

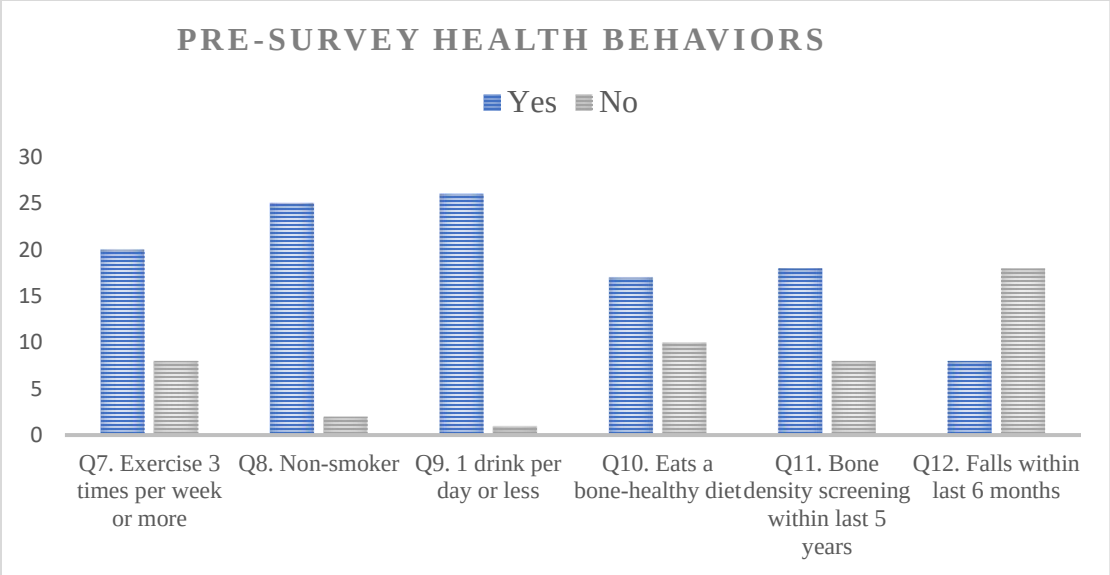

Figure 3

As with the knowledge attainment questions, there were few to no changes in the respondents' health behaviors on the post-survey (see Figure 4).

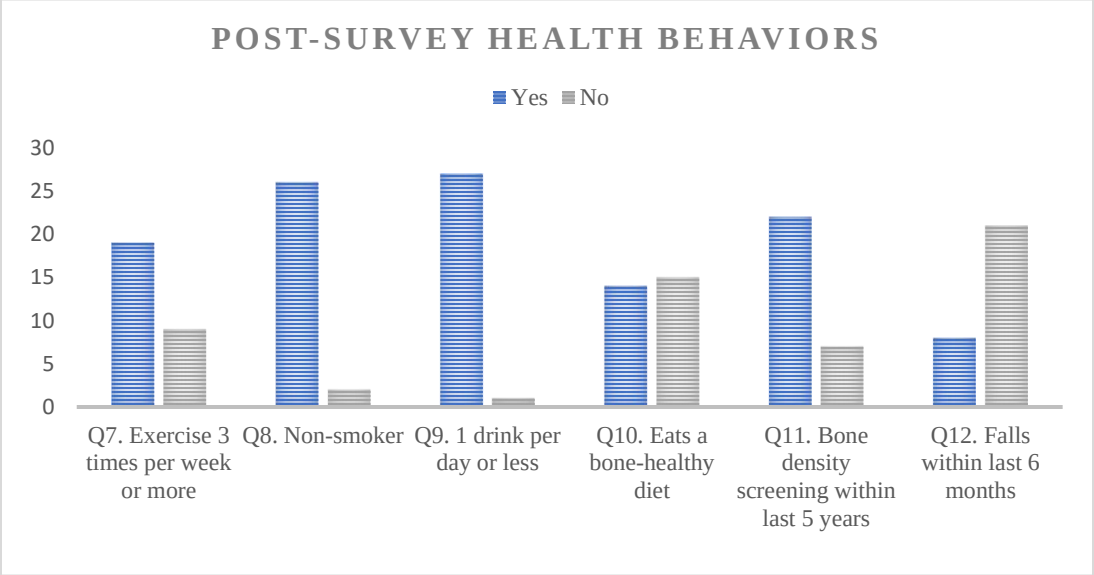

Figure 4

Analysis

The results of the pre- and post-surveys were analyzed with the paired samples t-test using the SPSS® statistical software version 25. The results are displayed in Table 3, (see appendix B). The paired-samples t-test was conducted to compare the effects of education on participant's knowledge of risk factors and bone health. There was a significant difference in the scores for the pre-test (M=63.79, SD=19.95) and the post-test (M=52.87, SD=21.39); t (28) =2.932, p = 0.007. These results indicate that education via this method did not increase participants' knowledge.

Discussion

The decrease in scores on the knowledge attainment portion suggests that education via the method utilized by this project is inadequate for this population. It may also reflect the inadequacy of the educational material, but this is not clear. Verbal feedback from several participants indicated that they were unsure of how the information was relevant to them and they did not know what to do with it. In the future, it likely would be most effective if the teaching was delivered one-on-one or in group settings, allowing healthcare providers the opportunity to explain how the need for the education relates to them and giving participants the chance to ask questions and correlate the information to their specific health needs. There is ample evidence in the literature that education is a viable method of engaging patients to participate in their own health and improve health outcomes. However, in all the studies and models reviewed, the education was provided face-to-face, via telephone or in class settings. This afforded providers the opportunity to provide meaningful context to the patient regarding the relevance of the information to them personally. Based on the decrease in scores, it appears that participants were unable to understand the information provided to them; it is likely that

correct scores on the pre-test were good "guesses" and the materials provided were not enough to increase their knowledge to a certainty.

The limited changes in health behaviors reflect two observations derived from the data; (a) the group already enjoyed a high level of healthy behaviors especially pertaining to smoking, alcohol, exercise and diet, and (b) due to the short timeline of the project, it is unlikely that participants had a chance to make a lifestyle change. It might have been more beneficial to ask respondents if they were planning or considering making a lifestyle change as a result of the information given. Several health behavior theories propose that change occurs in stages. For example, the transtheoretical model of behavioral change posits that there are five stages of change; precontemplation, contemplation, and preparation are the precedents of any actual changes made (Fidanci, Ozturk, & Unal, 2017). Motivational techniques are considered key to assisting individuals move through the stages (Fidanci, Ozturk, & Unal, 2017). As this project was conducted in less than 5 weeks from initial outreach to final survey, it is unlikely that individuals had enough time to proceed through these stages. An additional factor influencing behavior change can be considered within the framework of Pender's Health Promotion theory. One of the theoretical statements forming the basis of Pender's theory is that individuals will commit to behaviors from which they anticipate receiving some benefit (Pender, 2011). In this instance, the participants already enjoyed a high level of functioning and likely did not see a need to make a change in the few areas where improvement may have been beneficial such as increased bone density screening.

Practice Implications

The findings from this project suggest that providing educational materials alone is not enough to increase knowledge and inspire changes in health behavior by healthcare consumers.

This is significant because every day consumers receive health information from various sources such as social media, television, and internet. While most agree that well-informed consumers are empowered and engaged consumers, it is also believed that the most beneficence results from discussing the information with a healthcare professional to make an informed decision (Benetoli, Chen, & Aslani, 2018). More study is needed on the most efficient and effective way to deliver this information to the population of interest. As noted in the literature, the participants in this project were unaware of risk factors for fractures and their own personal risk. Making fracture prevention and education a priority is needed; healthcare providers need education about that as well.

Limitations

This project was limited by the use of a convenience sample. The convenience sample was an effective means of attracting participants who were highly motivated and already engaged in their own health as noted by their pursuit of healthy behaviors. It is possible that the people who could have benefitted most from the outreach did not respond.

Conclusion

Fragility fractures are a painful and burdensome condition that are very common in older adults. Identifying risk factors such as osteoporosis early may help mitigate the risk, but more study is needed to determine the most effective methods to address this problem.

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Appendix A

Appraisal of the Evidence

Table A1

Nakayama, A., Major, G., Holliday, E., Attia, J., & Bogduk, N. (2015). Evidence of effectiveness of a fracture liaison service to reduce the refracture rate. *Osteoporosis International, 27*, 873-879.				**Grade Level of Evidence:** Strong recommendation, high quality evidence (A)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Are fracture liaison services effective in secondary fracture prevention?	Historical cohort study	Patients >age 50 presenting to emergency departments with minimal trauma fractures N=931	Re-fracture rates	30% reduction in any re-fractures 40% reduction in major re-fractures Patients receiving lifestyle and dietary education and osteoporosis treatment through a formalized follow-up treatment program can reduce their risk of fracture
Eekman, D. A., Van Helden, S. H., Huisman, A. M., Verhaar, H. J., Bultink, I. E., Geusens, P. P., ... Lems, W. F. (2014). Optimizing fracture prevention: The fracture liaison service, an observational study. *Osteoporosis International, 25*, 701-709.				**Grade Level of Evidence:** Strong recommendation, moderate quality evidence (C)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Does a fracture liaison service improve the percentage of patients undergoing BMD testing? Why do patients fail to respond to follow-up outreach?	Observational study	Fragility fracture patients ≥50, N=2207	Rate of BMD testing after fracture Adherence to drug treatment after 12 months	Osteoporosis was diagnosed and treated in 30.1% of respondents 88% of patients started on drug therapy persisted after 12 months Hip fracture patients were less likely to respond or follow-up Hip fracture patients may be more affected by decreased mobility and may need alternate methods of outreach to improve follow-up treatment
Ruggiero, C., Zampi, E., Rinonapoli, G., Baroni, M., Serra, R., Zengarini, E., ... Brandi, M. L. (2015, June 25). Fracture prevention service to bridge the osteoporosis care gap. *Clinical Interventions in Aging, 10,* 1035-1042.				**Grade Level of Evidence:** Strong recommendation, high quality evidence (A)

Hypothesis/ Questions	Design	Sample	Measurement	Results/Implications
Does a fracture prevention service improve adherence to treatment post-fracture?	Prospective observational study	Patients age > 65 who suffered hip fracture and underwent surgical repair, N=132	Increased adherence to osteoporosis treatment	More patients received BMD testing, osteoporosis med treatment and follow-up in a fall and fracture clinic An integrated, multidisciplinary team is an effective method of treatment and follow-up after fracture to improve treatment adherence and prevent future fractures.
Fojas, M. C., Southerland, L. T., Phieffer, L. S., Stephens, J. A., Srivastava, T., & Ing, S. W. (2017). Compliance to the Joint Commission proposed Core Measure set on osteoporosis-associated fracture: Review of different secondary fracture prevention programs in an open medical system from 2010 to 2015. *Archives of Osteoporosis, 12*.				**Grade Level of Evidence:** Strong recommendation, moderate quality evidence (B)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Which fracture prevention program (NP v. MD) is most compliant to the proposed JCAHO core measure on osteoporosis-associated fractures?	Retrospective review	Patients discharged with fracture (women=80.9 %), avg age=71	completion of five laboratory tests, BMD testing, osteoporosis treatment with meds.	Lab tests and initiation of osteoporosis medication treatment was higher in physician-led programs Completion of BMD testing was similar with both programs More studies are needed to determine differences between two groups that led to different outcomes.
Senderovich, H., Tang, H., & Belmont, S. (2017). The Role of Exercises in Osteoporotic Fracture Prevention and current care gaps. Where are we now? Recent updates. *Rambam Maimonides Med Journal, 8*. https://doi.org/10.5041				**Grade Level of Evidence:** Strong recommendation, high quality evidence (A)

Hypothesis/ Questions	Design	Sample	Measurement	Results/Implications
Can exercise prevent osteoporotic fractures? What are the risks and benefits of high-force exercise? What is the best exercise to prevent osteoporosis?	Systematic review	16 systematic reviews, literature reviews and RCTs; all studies reviewed except two were of post-menopausal women	BMD Fracture rates	Strength training increased BMD, muscle mass and reduced fractures. Balance exercises improved mobility High-force exercise increased BMD Women at risk of fractures should be encouraged to participate in regular, weight bearing exercise
Jones, J. J., & Henry, K. (2017). Early identification and treatment of osteoporosis in a rural internal medicine clinic: A quasi-experimental approach to quality improvement. *Orthopaedic Nursing, 36*, 147-152.				**Grade Level of Evidence:** Strong recommendation, low quality evidence (B)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Does an osteoporosis treatment/guideline tool result in improved treatment of osteoporosis?	Retrospective chart review	Female patients over age 65	Identification and treatment of osteoporosis	Utilization of an evidence-based osteoporosis guideline tool led to 40% improvement in identification and treatment of osteoporosis Clinicians may benefit from tools to help improve their treatment of osteoporosis

Karinkanta, S., Kannus, P., Uusi-Rasi, K., Heionen, A., & Seivanen, H. (2015). Combined resistance and balance-jumping exercise reduces older women's injurious falls and fracture: 5-year follow-up study. *Age and Ageing, 44*, 784-789. https://doi.org/ https://doi-org.ezproxy.gsu.edu/10.1093/ageing/afv064				**Grade Level of Evidence:** Strong recommendation, moderate quality evidence (C)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Does a combined resistance and balance-jumping exercise program reduce injurious falls and fractures after 5 years?	Experimental; Random controlled trial	Community dwelling Finnish women ages 70-78 n=149	Rates of injuries due to falls Rates of fractures due to falls	Participants in the intervention group had 51% fewer falls and 74% fewer fractures Exercise programs reduce risk of fractures over a 5- year period
Zou, J., Hampton, M. D., Shade, K., & Kaku, L. (2017). A bone health intervention for Chinese immigrants in Santa Clara county. *Orthopedic Nursing, 36*, 293-300				**Grade Level of Evidence:** Strong recommendation, low quality of evidence (B)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Determine the effectiveness of an osteoporosis prevention education program on participants' self-efficacy	Single group pre- and post-test	Community dwelling Chinese immigrants at risk of osteoporosis	Participants' confidence in the ability to participate in self-care behaviors related to physical activity and calcium intake	Osteoporosis Self-Efficacy Scale (OSES) scores increased Multi-faceted educational interventions can improve patients' ability to improve their own health
Blekkenhorst, L.C., Hodgson, J.M., Lewis, J.R., Devine, A., Woodman, R.J., Lim, W.H., …Prince, R.L. (2017). Vegetable and fruit intake and fracture-related hospitalizations: A prospective study of older women				Grade Level of Evidence: Strong recommendation, high quality evidence (A)
Hypothesis/ Questions	**Design**	**Sample**	**Measurement**	**Results/Implications**
Does fruit and vegetable intake influence fracture rates?	Double-blind randomized controlled trial	Community-dwelling women > age 70 not taking medicines for bone health	Fracture-related hospitalizations	≥3 servings/day of vegetables were associated with a 27% lower hazard for all and a 39% lower hazard for hip fractures Higher intake of fruits was not associated with lower rates of fractures
Luc, M., Coriveau, H., Boire, G., Filiatrault, J., Beaulieu, M., & Gaboury, I. (2018). Patient related factors associated with adherence to recommendations made by a fracture liaison service: A mixed-method prospective study				Grade Level of Evidence: Strong recommendation, moderate quality evidence (A)

Hypothesis/ Questions	Design	Sample	Measurement	Results/Implications
What is the relationship between patient's understanding of fragility fracture and their adherence to fracture liaison service recommendations?	Prospective observational study	Community-dwelling men and women who sustained a fragility fracture in the 3 months prior to the intervention, n=384, 86% female	Adherence to medication or vitamin D supplementation, engagement in physical activity	Participants who understood the link between osteoporosis and their fragility fractures were more likely to adhere to medication (odds ratio (OR) 2.5; $p = 0.001$) and vitamin D supplementation (OR 2.3; $p = 0.01$). The same participants were less likely to engage in physical activity (OR 0.5, $p = 0.01$). Feedback from FLS coordinators helped participants understand the underlying cause of their fragility fractures

Appendix B
Statistical Analyses of Knowledge Attainment

Table B1

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Test Score	63.7931%	29	19.95479%	3.70551%
	Post-Test Score	52.8736%	29	21.39433%	3.97283%

Table B2

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre-Test Score & Post-Test Score	29	.531	.003

Table B3

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pre-Test Score - Post-Test Score	10.91954%	20.05739%	3.72456%	3.29012%	18.54896%	2.932	28	.007