Additional Research is Needed to Determine the Effects of Soy Protein on Calcium Binding and Absorption

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Dr. Tessem

Osteoporosis is a public health problem in all stages of life. Many people drink calcium-fortified soy milk to compensate for the loss of cow’s milk in their diets. While some studies show potential benefits and protective effects of soy protein against bone resorption in postmenopausal women, additional studies have shown that soy protein is not protective against bone breakdown and osteoporosis. While Canadaby-Rochelle and Mellema found that calcium binding ability was increased with soy protein isolate supplementation, Evans et al. found that over nine months, soy protein isolates were protective against bone resorption but did not impact total bone mineral density (BMD). Brink et al. both showed no significant changes between women who ate soy proteins and their BMDs. However, Kenny et al. found a negative correlation between total protein intake and bone turnover markers. In comparison, Arjamdi et al. found and increase in bone formation models when soy protein isolates were supplemented. The research studies reviewed were inconclusive and showed that there may be some benefit to supplementing calcium intake with soy protein. More research is needed. This paper proposes a study that would further investigate the role of soy protein in calcium binding and absorption by looking at specific variables that were overlooked in other studies. These overlooked variables need to be investigated to provide a better conclusion to the question, “does soy protein help or hinder calcium binding and absorption in post-menopausal women?”.

Key Words: Soy Protein, Osteoporosis, Bone Mineral Density, Calcium, Bone Turnover.
Rates of osteoporosis are rising. By 2020, it is estimated that more than 61 million men and women will be affected by osteoporosis (1). The primary cause of osteoporosis is a low calcium intake, which results in resorption of the bones to release calcium into the blood stream. One of the primary sources of dietary calcium is cow’s milk. However, there are many alternatives to drinking cow’s milk, one of which is drinking calcium-fortified soy milk. However, researchers are not sure how interactions between soy protein isolates and calcium affect calcium absorption and overall bone mineral density (BMD).

Canadaby-Rochelle and Mellema’s study (2) investigated the calcium binding abilities to milk proteins, non-hydrolyzed soy proteins, and hydrolyzed soy proteins. This experiment found that calcium and protein interactions and calcium binding was similar in all three groups. The study proposed that non-hydrolyzed soy proteins could be a vector for calcium supplementation (2). This research shows soy milk as a promising solution for individuals to add calcium back into their diets.

Brinks, et al.’s study used 237 subjects in early menopause. These subjects consumed an average of 110 mg of soy protein isolate enriched foods or similar placebos for one year. After the study, BMD of lumbar spine and body were measured, as well of markers of bone formation and bone resorption (3). Results of this study showed that soy protein isoflavone supplements do not affect overall BMD nor do they affect bone resorption markers when measured (3). Markers of bone resorption included parathyroid hormone (PTH), and 1,25-dihydroxyvitamin D or 25-hydroxyvitamin D. Brinks et al. also mentioned that the amount of time that women have been postmenopausal may have an effect on bone resorption and soy protein isolate and calcium binding activities (3).
However, other studies have shown a decrease in bone resorption markers when calcium is supplemented with soy protein, but found that soy protein does not affect overall BMD (4,5). Urine N-telopeptide crosslinks of collagen normalized for creatinine (NTX/CRT) is a metabolite of bone resorption that is excreted out of the urine. When osteoclasts bind to bone and break it down, the calcium is released into the blood stream. When the crystallized calcium is broken down, it leaves the collagen matrix. Because the matrix is not being used, it is also broken down by collagenases. The metabolites of collagen are excreted through the urine and measured as NTX/CRT markers. Kenny, et al.’s clinical controlled trial recruited 97 postmenopausal women and placed them into 1 of 4 intervention groups: an 18 g soy protein and 105 mg isoflavone tablet intervention group, an 18 g soy protein and placebo tablet intervention group, a control protein and 105 mg tablet group, and a control protein and placebo tablet group (4). After 1 year of conducting this study, results showed that NTX/CRT urine levels were decreased after supplementing with soy protein isolates in post-menopausal women (4). However, even though bone resorption markers had decreased, overall BMD had not changed significantly (4).

Evans et al.’s study had similar findings as Kenny et al.’s. In this study, researchers recruited 43 postmenopausal women as subjects and gave each subject either a soy protein isolate intervention or a milk protein intervention for 9 months (5). Similarities between these two studies were found with Serum C-terminal cross-linked telopeptides of type 1 collagen (S-CTX) (5). S-CTX is a similar metabolite to NTX/CRT, except that it is measured in the serum instead of the urine. Evans et al. found that S-CTX levels decreased after a soy protein isolate supplement was given over a nine-month period (5). These studies show that there may be protective effects of soy protein against bone resorption.
Arjmandi et al.’s study had 87 postmenopausal women that were assigned to eat soy products or control foods for one year. At baseline and at the end of the study, a Dual X-ray Absorptiometry (DXA) was completed to assess BMD and bone resorption markers were measured and compared between the two groups. This study did not show any significant differences in BMD or bone resorption markers, but showed an increase in bone formation markers when soy protein was supplemented in post-menopausal women (6). These markers included osteocalcin, insulin-like growth factor (IGF-1), and IGF-binding protein 3 (6). IGF-1 stimulates bone formation when growth hormone (GH) binds to the GH-receptor. One of the actions of GH binding to the receptor is the secretion of IGF-1 (7). When these two hormones are released together, they work together synergistically. Osteoblasts have membrane receptors for GH, and when GH binds to these, it increases cell proliferation and differentiation (7). IGF-1 affects osteoblasts through decreasing apoptosis and increasing osteogenesis (7).

Overall, research on soy protein affecting BMD and osteoporosis is inconclusive (2-6). Multiple studies have shown contrasting results. More research needs to be done on this subject that has longer periods of interventions and greater amounts of soy protein isolates.

With more research focused on specific aspects of menopause, soy protein isolate amounts, and longer interventions, researchers could support the theory that soy protein can increase calcium absorption and be protective against osteoporosis.

A potential study that could be done to explore these specific aspects of soy protein and bone health would hypothesize that soy protein isolates will improve BMD and decrease bone turnover markers in post-menopausal women who have been diagnosed with osteoporosis.

This study would give 50 post-menopausal women with a diagnosis of osteoporosis a supplement of soy protein isolates to be taken with a calcium supplement for two years. The
women’s bone mineral density would be taken before the study using a DXA scan along with a Magnetic Resonance Imaging scan (MRI) of the lumbar region of the spine and the femoral hip to check for fractures. A measure of bone resorption markers would be taken before the study.

Halfway through the study and at the end of the study, a DXA scan would be taken to assess BMD. An MRI would also be taken to look for new fractures and to see if previous fractures had healed correctly. Bone resorption markers would also be measured to assess if bone resorption had increased or decreased.

This study could effectively answer questions left by other studies, such as if the amount of time that a woman has been menopausal makes a difference in soy protein and calcium interactions, if a longer intervention makes a difference in soy protein and calcium interactions, and if higher amounts of soy protein isolates in supplements affect soy protein and calcium interactions.

In conclusion, studies show that soy protein isolates may be a good transport mechanism for calcium supplementation, but additional studies show that soy protein does not affect calcium transport. More studies need to be done to come to a conclusion about how soy protein isolates affect calcium intake and absorption. One proposed study that could address questions raised by other studies could investigate a soy protein supplement on women who have a diagnosis of osteoporosis, and investigate soy protein’s and calcium’s relationship exclusively during clinically diagnosed osteoporosis in post-menopausal women.
REFERENCES


CHANGES MADE TO MY PAPER BY PEER REVIEW AND TA REVIEW:

1. The connections between the introduction of my paper and the conclusion of my paper were unclear, so I changed the introduction of my paper so that it didn’t include an explanation of calcium intake in adolescents, and focused on calcium intake in adults.

2. I went through the paper and checked grammar and varied my sentence structure and wording throughout the paper. I also made my voice more assertive and direct in this paper.

3. My conclusion needed to be strengthened, so I strengthened it by recapping what I focused on in this paper and summarizing my proposed study.

4. I made sure that all abbreviations were defined before I used the abbreviations.

5. I added in more detail about each study, such as their methods and how they came to their conclusions.

6. I added in more detail to my proposed study, such as how many subjects I will have and more detailed methods to my study.

7. I fixed the formatting of my paper so that it went along with the guidelines given in the rubric.

8. I added in a sentence about my proposed study and how it will affect the current research or calcium and soy protein into the abstract.