

## Prebiotic Effect on Bone Health Among Female Students, University of Dammam, Saudi Arabia



### Medical Science

**KEYWORDS :** Prebiotic, BMD, Saudi Arabia, Functional food, calcium, mineral absorption, oligosaccharide.

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### ABSTRACT

**Introduction:** Prebiotic has an enhancement effect on gastrointestinal (GI) digestion and absorption; however the impact on calcium (Ca) absorption has limited data among young female from 18 to 25 years old. Our study aimed to investigate if the consumption of 4 grams (g) of fructo-oligosaccharide (FOS) stimulates bone mineralization in undergraduate female on period of six weeks. Assess the overall intake of fiber (prebiotic) sources and examine the bone mass of undergraduate students of UoD.

**Material and Methods:** Twenty-five undergraduate female students at university of Dammam (UOD), healthy free from acute and chronic disease, body mass index (BMI) between 17.2-38.2 and aged 18-25 years, received 4g FOS/day (SOURCE NATURALS) for six weeks. Bone mineral density (BMD) was measured before/after six weeks by dual energy X-ray absorptiometry (DEXA, Discovery). Self-administered questionnaire to estimate the usual intake of fiber (prebiotic).

**Results:** The number of participants who completed the study were 23 participants, 52% of them were osteopenia, 44% normal and 4% osteoporosis. The majority of participants did not meet the individual serving requirement of fiber (prebiotic). BMD results showed a significant increase ( $P$  value 0.017) with FOS supplementation within 6 weeks.

**Conclusion:** Our study showed an enhancement of Ca absorption with 4 g of FOS supplementation, which might be good candidate for functional food ingredients to bone health.

### Introduction

Nutrition science forged ahead today from the classical idea of avoiding nutrition deficiency and aiming for nutritional adequacy to the concept of functional food. There are many definitions for functional foods, but until now there is no commonly recognized one. The European commission proposed an acceptable definition of functional food " a food that beneficially affects one or more target functions in the body beyond adequate nutritional effects in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease". Clinically proven that functional food improve bone health, early development and growth, immune function, GI health, mental health, diabetes mellitus (DM), physical performance, health and well-being aging, obesity, and cardiovascular diseases (CVD) (Functional Food Science in Europe, 2010). Broad spectrum of functional food is developed; prebiotic is essential part defined as "a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon" (Cashman, 2006). Prebiotic is linked to well-being & health by stimulating the growth and/or activity of intestinal bacteria (Gibson, 2004) the researcher found significant benefit of prebiotic in reducing duration of agents of infections and antibiotic accompanying in travelers' diarrhea. Furthermore, a symbiotic has reduced GI symptoms & inflammation related to IBD. Other study suggests that a prebiotic has a protective effect against cancer, especially, colon cancer. Also it has a role in regulating lipoprotein profile, consequently, lowering the risk factors of CVD. Additionally, prebiotics have also been reported to reduce the risk of hypertension (THN) by improving the absorption of mineral such as Ca in the GI tract. (Streppel, M.T

et al, 2005) Similar to this, it enhance the absorption of Ca, magnesium (mg), and possibly iron (Fe) from the intestinal, thus improve the bone health and mineralization (Drakoularakou A et al, 2010; Furrrie E et al, 2005; Rafter J et al , 2007; Wong JM et al, 2010 ). Most studies use Inulin, oligofructose, and galacto-oligosaccharides (GOS) with regard to mineral absorption and retention. One of the most common clinical conditions associated with bone mineralization is osteoporosis, which represent as a major public health worldwide. The present population in Saudi Arabia have high incidence of osteoporosis and osteopenia in both gender, Osteoporosis was dominant among female than male (34%, 30.7%) respectively. While male has a higher incident of osteopenia by 46.3% than female 36.6%.

### Material and Methods

#### Study design: Randomized controlled trial.

**Participants:** Twenty-five subjects' age between 18 to 25 years old have been recruited conveniently from female undergraduate students in UoD, Dammam, Saudi Arabia, during January to April 2015 by an announcement through social media (Path and Whatsapp).

**Inclusive criteria:** Saudi undergraduate female students, aged between 18-25 years old, in a good physical and mental condition.

**Exclusive criteria:** Subject will be excluded if pregnant or under a drug therapy or taking any supplement, that could alter calcium metabolism or gut microbial profile.

**Ethical approval:** Every subject has assigned a consent form (appendix 1) before participating in the study. The approval of this study had taken from UoD, institutional

review board IRB: serial Number (N2015011). All records had collected by data sheet (appendix2).

**Data Collection:** Data Collection was done using a pre self-administered questionnaire requiring data about sociodemographic state, Dietary intake of food containing prebiotics (appendix 3), each serving of food was presented in a specified amount, e.g. 1 cup of milk, a cup of raw vegetable and piece of fruit and whole grain. Frequency of its consumption was suggested, i.e. More than 4 serving, 3-4 serving per day, 1-2 serving per day, less than once a day and not at all. Participants were informed to maintain their dietary intake; also they were subjected to a physical examination, including measurement of weight by bioelectrical impedance (ADE), height by Stedimeter (ADE), waist-hip circumference and calculate the BMI in nutrition assessment lab, collage of applied medical sciences. The participants signed for non-pregnancy verification DEXA Form (Appendix 4) prior to be scheduled to measure the BMD by DEXA in two weeks before the intervention and two weeks after. (Discovery).

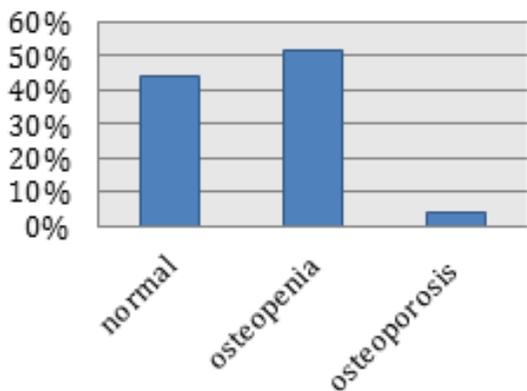
**Results**

A total of 25 subjects met the criteria of the study. The mean age of the 25 participants was -year old. According to world health organization (WHO) classification of bone status, the participants were categorized as osteoporosis n=1(4%), Osteopenia n=13(52%) and normal n=11 (44%) (table1). Twenty-five subjects enrolled in the study, 23 completed the six weeks intervention. Two of the participants dropped the study due to the intolerance of FOS supplement.

**Table1: BMD of participant according to the WHO classification**

	Frequency	Percent
Normal	11	44.0 %
Osteopenia	13	52.0 %
Osteoporosis	1	4.0 %
Total	25	100.0%

**WHO classification**



**History of prebiotic intake:**

A pre self-administered questionnaire showed that the number of participants habitually consumed their requirement of dairy product, approximately 20 participants. While vegetables and fruit groups were poor intake, illustrated by 7 and approximately 13 participants respectively. Additionally, the whole grain group showed similar results 2 participants.

**Bone mineralization results:**

BMD was examined twice via DEXA. A comparison between pre and post results in a significant increase of BMD. (P= 0. 017) (Table 2)

**Table2. The Wilcoxon Signed Ranks Test:**

Test Statistics <sup>a</sup>	
P value.	.017

**Discussion**

Our study showed that the majority of participants classified as osteopenia with a percentage of 52% followed by 44% normal and 4% osteoporosis. This anticipated by a recent study that indicated similar incidence reported at Umm Alqura University, Makah. The study reported the prevalence of osteopenia was 39.70%, 58.09% normal and 1.04% osteoporosis with no age differences (Youssef, 2015). Another study by Aliet al.Supported these findings with 36.6% of osteopenic among a sample of female college students.

A comparison between United States Department of Agriculture (USDA) recommendations and overall intakes of prebiotic source, in the present study revealed a poor dietary intake, since the assessment of vegetables and fruit categories 4% and 12%, respectively. Moreover, the whole grain grouped gave similar result with 8%. While the diary product category displayed 80% of subjects met the requirement. As a result, the main group sources of prebiotic, did not meet the individual serving requirement, therefore the participant’s prebiotic intake is insufficient, and this might contribute to the complications that have been occurred. Robinson et al. describes a suddenly fiber addition to the diet can sometimes cause side effects such as abdominal cramps, bloating, or diarrhea.

Adaptation to the FOS supplementation for six weeks, significantly affect the BMD among undergraduate students. However, through phone interviewing, we noticed a variation in the improvement rate. The BMD enhancement is more significant with the consumption of high Ca source (butter milk) compared to water. Previous research has suggested that the supplementation of 200 mg/d of Ca, prior to supplementation with oligofructose-enriched inulin, improved the plasma Ca level, possibly increased the bone formation. (de Souza, 2010). Moreover, Van den Heuvel et al. found that women who drank yogurt drink along with the supplement was significantly (p<0.05) increase the Ca absorption by 16 %.

The slightly increases in BMD enhancement might result from the short duration of the intervention. AS Genny found a supplementation of 8 g FOS and inulin over one year, indicate 45% increase in BMD. Additionally, a reviewer describes conflicting results of prebiotics effects in literature may be due to the experimental design because the effect of non-digestible oligosaccharides (NDOs) depends on the dosage, the administration duration and the calcium content in the diet studied (Scholz-Ahrens et al, 2008).

Some of the participants noticed an improvement in the bowel movement during the intervention course. Lee et al. describes the habitual bowel movement tended to improve in FOS group.

One of the limitations of our study is that we could not function the correlation test between the previous history of fiber intake and complications that have been aroused, due to the non-continuous monitoring, the degree of severity and the approximate episodes of complication. Furthermore, recording the mean of three BMD readings by DEXA for pre and post intervention can produce more accurate result. Based upon the errors that have been appeared it led two participants to repeat the DEXA test.

Needless to say, further research need to have a case-control to

generalize the results. Besides, it is recommended to increase the duration and dosage of the supplement, and combine it with rich Ca drink/food to enhance the Ca absorption. Also, there might be relation between fiber intake in previous dietary history and complication associated with the sudden increase in fiber consumption; these findings suggest further investigation on this correlation. Finally, further studies could be done to specify the mechanisms of how the prebiotic affect the Ca absorption, through test specially done to find fractional Ca absorption that is determine from urinary Ca excretion by using dual stable isotope method, fecalmicrobiota and bifidobacteria assessed by PCR denaturing gradient gel electrophoresis and quantitative PCR.

## Conclusion

In conclusion, the recent findings showed persistent enhancement of Ca absorption with 4 g of FOS supplementation in a group of young females 20-23 years old, these findings suggest that the addition of prebiotics to food represents an opportunity for increasing the absorption of Ca present in the diet. Thus, these FOS supplementations might be good candidates for functional food ingredients for bone health.

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