



## **A Study of The Relation Between Dietary Calcium Intake and Bone Health**

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**Abstract**

*Our bony skeleton provides support, protection and mobility for the body and is a major storage site for calcium. Bone health is intrinsically linked to calcium metabolism. To maintain normal physiological functions like conduction of nerve impulse, constriction and relaxation of blood vessels, the serum calcium levels must be maintained in a narrow range. Adequate calcium intake is most important in adolescence as peak calcium accumulation rate is attained at an average age of 12.5 years in girls and 14 years in boys. During the 3 – 4 year period of adolescence bone mass acquisition is at its peak as 40% of total lifetime bone mass is accumulated at this time and about a total of 90% of total bone mass is built up by the age of 20. The most important element for bone health is calcium, which has a direct link to the bone mass density (BMD) and calcium deficiency increases the risk of osteoporosis, specifically in the elderly.*

*The 82 adolescent girls who volunteered for the study were randomly divided into two groups – milk group and control group. The milk group was given one pint of milk every morning to be consumed during the day along with their normal diet while the control group consumed only their normal diet. Prior to the start of the study baseline measurement of height, weight, total bone mineral content and total bone mineral density was done and noted. Height in cm and weight in kg was recorded using the same scale at the same time each morning. Every 6 months the total bone mineral content and total bone mineral density was measured. Bone mineral acquisition throughout the 18 months was significantly greater in the milk group than in the control group. Increased milk consumption in adolescent girls resulted in greater total skeletal mineral accumulation over 18 months. This study proves that increase in milk consumption increases the bone mineral acquisition in adolescent girls.*

## Introduction

Our bony skeleton provides support, protection and mobility for the body and is a major storage site for calcium. Bone health is intrinsically linked to calcium metabolism. To maintain normal physiological functions like conduction of nerve impulse, constriction and relaxation of blood vessels, the serum calcium levels must be maintained in a narrow range. Since these functions are essential the body will try to maintain the calcium levels in that range by mobilizing the calcium from the bones when calcium intake becomes inadequate. This way our skeletal system gets affected and for it to function optimally our skeleton relies on adequate supply of nutrients, particularly large amounts of calcium that mainly comes from our diet [1,2]. Maintaining adequate calcium intake during childhood and adolescence is vital for development of peak bone mass which is essential for reducing the risk of fractures and osteoporosis later in life [2].

A balanced diet with low fat dairy products, fruits and vegetables and appropriate physical activity are important in achieving good bone health [2]. Adequate calcium intake is most important in adolescence as peak calcium accumulation rate is attained at an average age of 12.5 years in girls and 14 years in boys. During the 3 - 4year period of adolescence bone mass acquisition is at its peak as 40% of total lifetime bone mass is accumulated at this time [2] and about a total of 90% of total bone mass is built up by the age of 20 [3,6].

Low bone mineral mass is the main factor underlying osteoporotic fracture and bone mass in later life depends on the peak bone mass achieved during growth. Osteoporosis is defined as a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, with a resultant increase in bone fragility and susceptibility to fracture. The World Health Organization has redefined osteoporosis according to bone mass, at least for women. Their diagnostic criteria for osteoporosis is based on bone mineral content (BMC) or bone mineral density (BMD) [3].

The most important element for bone health is calcium, which has a direct link to the bone mass density (BMD) and calcium deficiency increases the risk of osteoporosis, specifically in the elderly [4]. Undoubtedly, calcium is the most important nutrient for bone health as 99% of the calcium requirement of the body is stored in the bones. In general, 67% of the bone is made of mineral, specifically in the form of hydroxyapatite [4,5]. The recommended amount of calcium depends on age (1,000 mg/day for men and women, and 1,200 mg/day for people over 50 years). When calcium intake is insufficient, serum calcium levels start decreasing which increases secretion of parathyroid hormone (PTH) resulting in the resorption of bones and release of their content to the blood, which inhibits the reduction of the serum calcium level. Continuation of this phenomenon decreases BMD and increases the risk of osteoporosis [4].

## **Material and Methods**

### **Aim**

To study the relation between dietary calcium intake and bone health in otherwise normal and healthy individuals.

### **Sample**

82 healthy, adolescent girls in the mean age of 13 years, not on any calcium supplements or any special diet and with no medical history, were included in the study. The study was conducted over 18 months and the volunteers were randomly divided into two groups – milk group and control group.

One pint (500ml) of milk per day with calcium content 120mg/100ml was given to the milk group.

### **Tests Done**

Height in cm and weight in kg

Total bone mineral content - done every 6 months

Total bone mineral density – done every 6 months

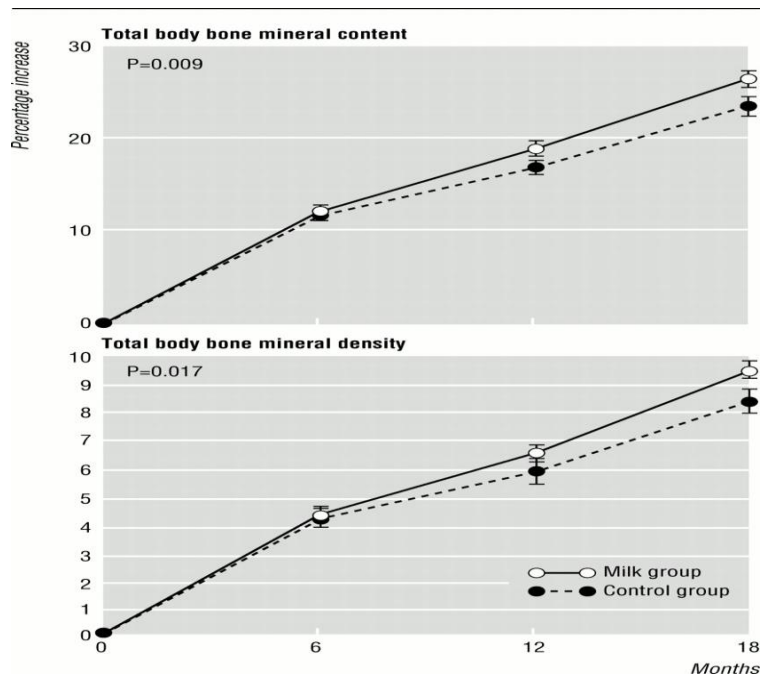
### **Procedure**

The 82 adolescent girls who volunteered for the study were randomly divided into two groups – milk group and control group. The milk group was given one pint of milk every morning to be consumed during the day along with their normal diet while the control group consumed only their normal diet. Prior to the start of the study baseline measurement of height, weight, total bone mineral content and total bone mineral density was done and noted. Height in cm and weight in kg was recorded using the same scale at the same time each morning. Every 6 months the total bone mineral content and total bone mineral density was measured.

Observations

CHARACTERISTIC	MILK GROUP	CONTROL GROUP
Mean age (years)	13	13
Height (cm)	151.7	152.9
Weight (kg)	45.1	45.3
Calcium intake(baseline) (mg)	739	753
Milk intake (normal diet in ml/day)	170	142
Milk intake (above the normal diet in ml/day)	480	160
Total bone mineral content (g)	1407	1454
Total bone mineral density (g/cm <sup>2</sup> )	0.89	0.90

**Table 1** shows there were no significant differences between the milk and the control groups at baseline for any of the variables measured.



**Figure 1** shows percentage increase in total bone mineral content and total bone mineral density.

Bone mineral acquisition throughout the 18 months was significantly greater in the milk group than in the control group as seen in fig 1. The milk group had greater percentage increase in the total bone mineral density of 9.6% versus 8.5% in the control group and total bone mineral content of 27% versus 24.1% in the control group. The milk group gained an extra 37 g of bone mineral during the 18 months. Both groups showed similar increments in height and weight.

The baseline milk intake levels was approximately 150ml in each group. The milk group had increased intake from 170ml to 480ml per day for 18 months. Milk consumption in the control group was unchanged. In the milk group, the milk supplement significantly increased intake of calcium. The two groups had similar levels of physical activity throughout the study.

### **Discussion**

The results of this trial indicate that increased milk consumption in adolescent girls resulted in greater total skeletal mineral accumulation over 18 months. Milk intake has a beneficial effect on bone mass which, if sustained throughout the pubertal period and into adulthood, could favorably affect peak bone mass [8,9]. The findings of this study are consistent with calcium supplement trials in children and adolescents [8,9] and dairy intake studies in prepubertal girls [10,11]. The study is also supported by evidence from retrospective studies that high calcium intake in the form of dairy products in early life is positively associated with high bone mass in adult life and supplementation with dairy products prevents bone loss in pre and postmenopausal women [12,13].

### **Conclusion**

This study proves that increase in milk consumption increases the bone mineral acquisition in adolescent girls. Retrospective studies have shown that higher calcium intake throughout early life is associated with greater peak in bone mass. This increase in bone mass has a positive effect in reducing the incidence of osteoporosis and associated fractures in later life and hence contributes to bone health [7,12,13]

Hence our hypothesis that increase in dietary calcium intake can result in healthy bones is proved.

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