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## A SYSTEMATIC REVIEW ON CALCIUM SUPPLEMENT

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### Abstract

Calcium is mineral essential to build and maintain bone and teeth, it also aids number of other body process. Calcium plays important role in blood clotting, blood vessel and muscle contraction, enzyme and hormone secretion, and also in central nervous system function. Calcium rich diet keeps bones healthy and strong. Bone remodeling is the process in which bone is broken down and calcium is deposited to replace the bone material that is lost. When the amount of calcium in the bloodstream is low, calcium stored in bones is broken down and used in bloodstream which leads to calcium deficiency diseases like cardiovascular diseases, kidney diseases, rickets, and calcification of soft tissues, memory loss, brittle bone, hallucination, depression, eye diseases and spinal fracture. Calcium deficiency makes the bone weak, raising the risk of fracture and increasing the risk of osteoporosis, the condition in which bone mineral density goes on decreasing and makes the bones fragile. This bone easily breaks and a lead to fracture it's all due to deficiency of calcium. Osteoporosis is occurring in men as well as women but mostly occur in women after the menopause over the age of 50 years. This condition is treated by using hormonal and estrogen replacement therapy, biphosphonates, estrogen agonist and antagonist, using anti-inflammatory agent, calcium supplement etc. but all these shows severe side effects and has high cost. The most effective, ideal, novel and beneficial treatment for osteoporosis with low cost and negligible side effects is by using eggshell as calcium supplement. Eggshell is rich source of calcium up to 95%, has 60% more bioavailability than purified calcium carbonate, and increases bone mineral density in osteoporosis patient.

**Keywords:** Calcium, vitamin D, osteoporosis, estrogen and hormonal replacement therapy, eggshell.

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## INTRODUCTION

Calcium is one of the nutrients essential for human body for formation, metabolism and strengthening bone. Around 99 % of calcium is found in bone and teeth to provide hard tissues as well as strength. Calcium present in circulatory system, extracellular fluid, muscle and other tissues. Calcium plays important role in vascular contraction, vasodilatation, regulating heart beat, muscle function, nerve transmission, intracellular signaling, hormonal secretion and it also help blood clotting. It is suggest that eating calcium rich food may decrease the risk for overweight and obesity. It require in great amount during the period of growth such as childhood, during pregnancy and for lactating mother. During pregnancy and lactation, there is greater depletion of Ca from mother and the intake needs to be increased. Calcium absorption increases during pregnancy and there is emerging evidence that the calcium required for fetal bone mineralization can be obtained with no detectable mobilization of bone material. High calcium intake by a pregnant woman is beneficial for fetus. During lactation, loss of calcium from maternal skeleton is occurs. This loss of calcium cannot be prevented by increasing dietary calcium. Calcium supplement are provided to overcome this calcium loss.

Hormones which regulate level of calcium in blood are parathyroid hormone and calcitonin.

### **Parathyroid hormone**

it is produced by parathyroid gland, located around thyroid gland in the neck. Parathyroid gland produces more parathyroid hormone when the calcium level in the blood decreases. Parathyroid gland produces fewer hormones, when calcium level in blood increases. Parathyroid hormone does the following:-

- It causes kidney to excrete less calcium through urine.
- It causes kidney to activate vitamin D which is important for absorption of calcium.
- Stimulate bone to release calcium in blood.

It also stimulates digestive tract to absorb more calcium.

### **Calcitonin**

calcitonin is produced by cells of thyroid gland. Calcitonin lowers calcium level in blood and slows the breakdown of bone. Calcium shows its effect by interacting with target cells in bone and kidney. Calcitonin and parathyroid hormone shows antagonist action on bone resorption but it shows synergistic action on decreasing the renal tubular reabsorption of calcium. Hypocalcemic effect of calcitonin is the result of decreased entry of calcium from the skeleton into plasma,

resulting from the temporary inhibition of parathyroid hormone- stimulates bone resorption. Direct action of calcitonin develop hypophosphatemia which increases the rate of movement of phosphorus out of plasma into soft tissues and bone and inhibit bone resorption stimulated by parathyroid hormone and other factor. As the calcitonin concentration changes ultimately serum calcium concentration also changes [1,2].

### **Calcium absorption**

Calcium absorption varies with source of calcium as well as how much calcium consumed at one time. Body can only absorb 500 mg of elemental calcium at one time, it is best to take supplement three times during the day with 4 to 6 hours of interval between doses. Toxicity occurs with dose above 2500 mg of elemental calcium per day. Calcium absorption varies significantly depending on how it is formulated. Low calcium absorption lead calcium deposition in the arteries and joints, high blood pressure, kidney stone, fracture as well as osteoporosis. Excess calcium intake lead constipation, increase risk of developing calcium kidney stone, as well as it inhibits absorption of iron and zinc. Other nutrients also affect calcium absorption. Caffeine, alcohol, excess sodium decreases calcium absorption and increases calcium excretion from body. Calcium absorption from intestine occurs by two mechanisms: passive diffusion and active transport. In passive diffusion, calcium absorbed through intestinal mucosa by diffusion depending on concentration gradient of cation and it is non-saturable process. Active transport is saturable process and requires presence of vitamin D, transport protein and subsequent use of energy [3].

### **Factors affecting calcium absorption**

#### **Diet**

Calcium is present in food. It is an ideal way to obtain vitamin and mineral from dietary source. Some food contain substance decreases the absorption of calcium. Foods which is high in oxalic acid such as spinach, chocolate and chard decreases absorption of calcium. Oxalic acid reacts with calcium to form insoluble salt crystal, which is then carried out through digestive system and eliminated. Phytic acid found in whole grain food and high fiber food affect calcium absorption.

#### **Age**

As the body age increases the calcium absorption is less effective. Infant and children absorb calcium 50 – 70 % and adult, elders absorb 30 – 50 % of calcium.

#### **Pregnancy**

Pregnant women lend their vitamin and mineral directly to growing fetus. Any substance needed in womb is taken from mother and supplied to child. Calcium is very essential for both mother

and child so pregnant and lactating mother should take 1300 mg of dietary calcium every day. Bodily calcium is hard to replace in later years of aging, leading to decrease absorption, so this is an important time to ensure need are being met for baby and mother.

### Vitamin D

Sunlight exposure stimulates and increase production of vitamin D naturally in our body. Vitamin D shows its action in digestive tract to absorb calcium into blood stream from wall of duodenum. It also helps to maintain calcium level in blood and maintain cardiac function. 1 to 2 hour exposure of sunlight allows vitamin D to absorb calcium.

### Phosphors

Phosphors in diet lead to extra calcium loss in the urine. Calcium loss in body lead calcium to pull out of bone as body tries to compensate for missing calcium in blood circulation. Low bone density due to calcium depletion lead to osteoporosis.

### Hydrochloric acid and stress

During digestion, hydrochloric acid secreted in the stomach which causes breakdown of dietary fat. HCL is essential for absorption of calcium from duodenum. Stress shows negative impact on HCL production and normal digestive behavior of body as well as negative impact on calcium absorption.

### Amino acid

Supplemented calcium chelated with protein molecule called amino acid, which help body to absorb calcium during digestion. Lysine and arginine increases calcium absorption [3].

**Table 1: Calcium requirement of human**

Sr.No	Age	Calcium requirement mg/day
1	0-6 months	200
2	7-12 months	260
3	1-3 years	700
4	4-8 years	1000
5	9-13 years	1300
6	14-18 years	1300
7	19- 50 years	1000
8	51-70 years	1000
9	>71years	1200
10	Pregnant women	1300

Calcium absorption occurs by following way

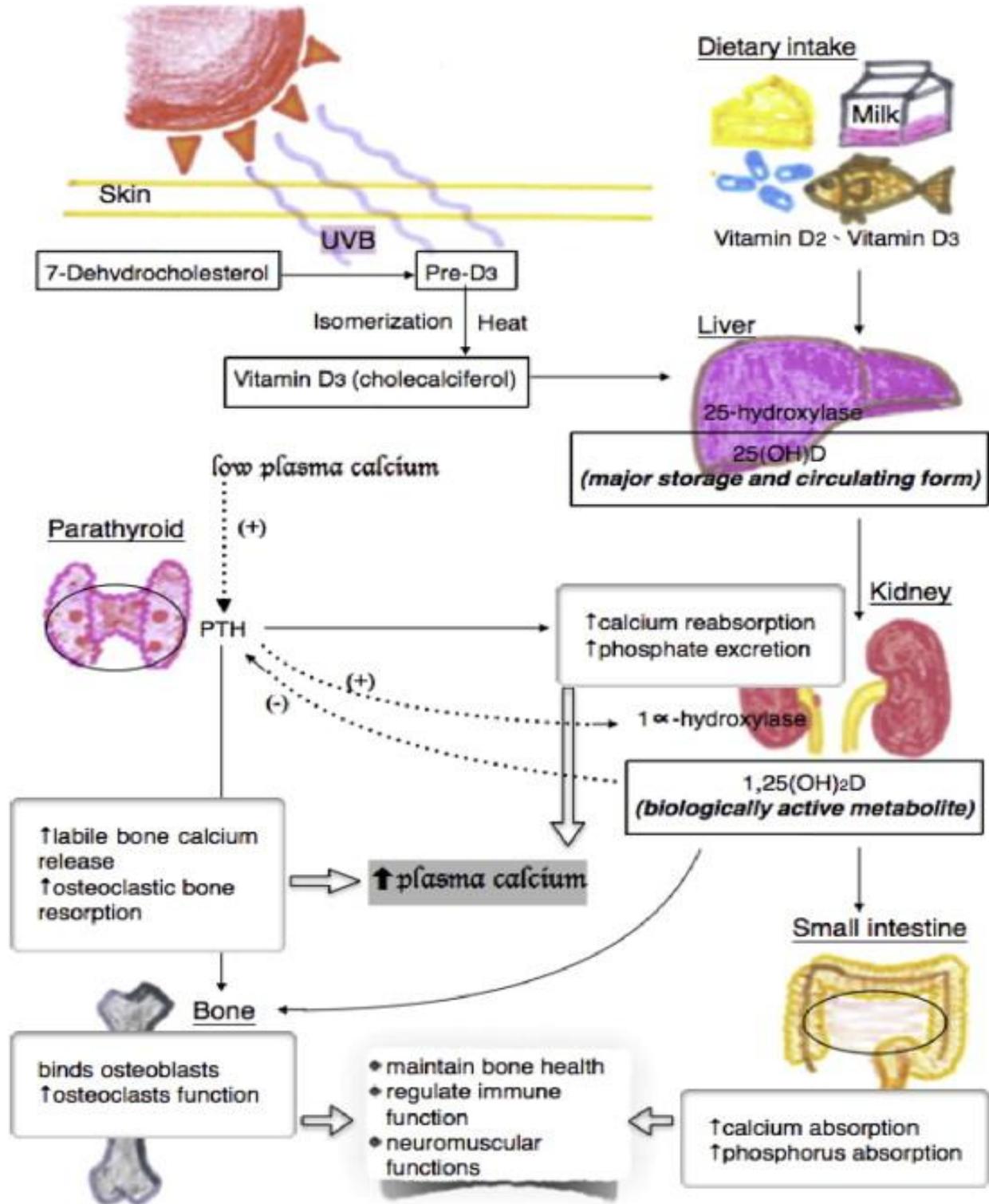


Fig.1: Calcium absorption

## Sources of calcium [4]

### Dairy sources

Several of food contains calcium. Milk and other dairy product contain a lot of calcium. Low fat and fat free milk and dairy products are richest source calcium because

- They contain no or fat.
- They easily absorb in body.
- Milk and milk product provides essential nutrients which are important for optimal bone health and development.

Other sources of milk product are

- Butter milk.
- Cheese.
- Plain or fruity yogurt
- Chocolate milk or flavored milk.
- Lactose free milk.

Non- dairy milk sources:-

- Almond and banana.
- Green snap bean.
- Sesame seed.
- Vegetables e.g. tomato, carrot, spinach and okra etc.
- Chinese cabbage.
- Nuts and seed.
- Meat, fish and poultry. E.g. canned fish, oyster, sardines etc.
- Egg shell calcium.

### Role of calcium in human body [2-5]

- Nerve transmission:-  
Cell uses calcium to activate certain, transport ion across cell membrane, send and receive neurotransmitters during communication with other cell. With the help of central nervous system it conducts nerve impulse and sends the message.
- Tissue and bone formation:-  
Bones constantly formed and broken down this process is called as remodeling. Calcium reduces the resorption i.e. breaking of bones and increases deposition of new bone to replace that which has been broken down.
- It is necessary to maintain movement muscle.

In the muscle calcium ions are trigger the chemical reaction between actin and myosin. Then this reaction releases energy in the form of adenosine triphosphate i.e. ATP which causes contraction of muscle. Ions that were released are retracted and then muscle relaxes. This calcium also helps for contraction and relaxation of heart muscle.

- It is most essential for maintaining tone and contractility of heart:-

As an electrolyte or particle calcium help to conduct electricity in the body, calcium also plays important role in maintaining regular heart beat.

- Helps lower high blood pressure.

Calcium regulates heart function by dilating blood vessels and sending chemical nerve single from brain to heart. Calcium is important in regulating heart rhythm, blood pressure and circulation. Calcium supplement prevent hypertension. Dietary calcium help to lower the level of high blood pressure where as restricted calcium diet tend to elevate blood pressure. Calcium decreases systolic high blood pressure.

- Triggers the formation of blood clot.

Calcium plays an important role in blood clotting by maintaining solidity of fibrin.

- Help to prevent diabetes:-

Calcium along with vitamin D is beneficial in glucose metabolism and help to prevent diabetes. Calcium and vitamin D shows direct effect on pancreatic cell which control insulin secretion as well as blood sugar level. Calcium is necessary component of cellular processes that occur in insulin responsive tissues like skeleton muscle and fat tissues.

- Defend against cancer:-

Calcium shows anti-carcinogenic effect due to its participation in regulating cell proliferation, cell differentiation, and including cell death in cancerous cell.

- Decreases risk of colorectal cancer:-

Increase in consumption of calcium may lower the risk of colorectal cancer.

- Dental health:-

Calcium is also stored in teeth and which is needed for tooth health and maintenance. Calcium prevents tooth decay and improves dental health.

- Helps indigestion:-

In over the counter antacid tablets calcium is used. It helps digestion by reducing heartburn and symptom of upset of stomach.

### Sign and symptoms of calcium deficiency [6,7]

- Numbness or tingling fingers.
- Poor appetite.
- Muscle cramp.
- Difficulty in swallowing.
- Brittle fingernails.
- Lethargy.
- Mental confusion, irritability, depression and anxiety.
- Tooth erosion.
- Insufficient blood clotting.
- Osteopenia or osteoporosis, bone fracture.
- Growth and development delays in children.
- Heart problems involving blood pressure and heart rhythm.

### Causes of calcium deficiency [7,8]

- **lack of calcium**

Low calcium intake over a long period of time is the primary cause of calcium deficiency. The diet should fulfill daily requirement of calcium needed for body as per the age and gender.

- **Dietary intolerance**

People who is having lactose intolerance or dairy allergy are missing out on whole calcium rich food group and may struggle to find adequate dietary source of calcium. So plant based or animal based calcium food source is best.

- **Prescription medication**

Some medication decreases calcium absorption by interfering with body's ability to absorb calcium. Particular drugs like PPIs, lipid lowering statins, diuretic anticonvulsant and corticosteroids reduces calcium and vitamin D level.

- **Malabsorption**

Calcium absorption or calcium bioavailability means amount of calcium that is absorbed from digestive tract into body's circulatory system. Calcium absorption can be affected by amount of calcium in body, vitamin D, vitamin K, magnesium, age, pregnancy and certain

plant substance in your diet. Amount of calcium consumed at one time also affect absorption of calcium. Efficacy of calcium absorption decreases as the amount of calcium consume at meal time.

- **Age**

Infant and children absorb 60% of calcium they consume. In adult absorption slowly decrease to about 15-20%.

- **Genetic factor**

Vitamin D resistance syndrome is caused due to hereditary defect or mutation in the vitamin D receptor. Impaired vitamin D receptor shows direct impact on body's ability to absorb calcium. Inherited disorder of calcium and phosphate homeostasis also causes bone loss and calcium deficiency.

- **Hormonal changes**

During menopause, the estrogen level decline in a woman which causes loss bone density more rapidly. Postmenopausal women have about one-tenth amount of estrogen level as premenopausal women. Low parathyroid hormone level also impact on body's ability to absorb calcium.

### Deficiency of calcium causes [4,7]

- **Hypocalcaemia**

Calcium level in the blood decreases. Hypocalcaemia result in tetany it means uncontrolled muscle spasm. Hypocalcaemia also arises dental problems.

- **Osteoporosis and fracture**

Calcium plays important role in mineralization of bones to keep them strong as you old. Low calcium deficiency shows effect on bone density and increases susceptibility to fracture and osteoporosis.

- **Muscle cramp**

Muscle cramp is strong, painful contraction of muscle that lasts from few seconds to several minutes. Muscle cramp occurs due to decrease amount of minerals such as calcium, magnesium, especially in later months of pregnancy, exercise, injury, exposure to cold temperature etc.

- **Premenstrual cramp**

Women having calcium deficiency suffer through a lot of pain during menstruation. Calcium deficiency causes irregular menstruation and excessive bleeding in women. Calcium plays important role in normal development of uterus and ovarian hormones in women.

- **Fatigue**

Fatigue is a condition in which individual feel lack of energy and motivation that can be physical or mental. Low level of calcium causes insomnia, fear and mental derangements that increase stress and fatigue.

- **Frequent illness**

Calcium maintains healthy immune system. Calcium deficiency causes the respiratory and intestinal infection as well as deficiency of calcium reduces body's resistance against pathogen attack.

- **Dental problem**

About 99% calcium is stored in tooth and bones. If calcium level in blood is low it causes dental problem like toothache, dental decay as well as delayed and defective teething.

- Other calcium deficiencies are as follows;

Numbness in fingers and toes, convulsion, lethargy, loss of appetite, cardiovascular diseases, kidney diseases, rickets, calcification of soft tissues, memory loss, brittle bone, hallucination, depression, eye diseases, spinal fracture and inability to walk etc.

### **Osteoporosis [9-11]**

Normal healthy bones composed of proteins, collagen and calcium. All this gives strength to bones or skeleton and essential nutrient for proper growth of body. Due to unbalanced diet, lifestyle leads the deficiency of calcium. Calcium require in high amount when growth is completed because absorption efficiency from food calcium sources is poor and excretory conservation is weak. Calcium deficiency leads to osteoporosis. Osteoporosis is the condition characterized by low bone density, decreases strength of bones and makes them fragile. This causes porous formation of bones that is compressible like sponge. Osteoporosis is the disorder of skeleton weakens bones and results in frequent fracture in bones. The spine, ribs, hips and wrists are common areas of bone fracture and mostly occur in skeletal bones. Osteoporosis is most common chronic metabolic bone disease related to factors like menopause and aging. Now days it

is estimated that 200 million people suffering from osteoporosis. As per the international osteoporosis foundation, worldwide survey shows those 1 in 3 women over the age of 50 years and 1 in 5 men experiences osteoporotic fracture in their lifetime.

Osteoporosis occurs when there is an imbalance between new bone formations and old bone resorption. Calcium and phosphate both is essential mineral for bone formation in our body. Calcium is not only essential for proper functioning of heart, brain and other organ but also it is useful for strengthening bones and skeleton system. For the proper functioning of this critical organ body reabsorb calcium that is stored which are stored in bone for maintaining calcium level in blood. If the diet is insufficient supply daily requirement calcium to a body then it will directly affect on bone production and bone tissues. Thus the bone becomes weaker, resulting in brittle and fragile bones that can break easily.

#### **Causes of osteoporosis [9,10]**

Causes of osteoporosis are lack of certain hormone like estrogen in women and androgen in men. Women over the age of 60 are frequently diagnosed for this disease. After the menopause, level of estrogen lower in women and increases risk of osteoporosis. Inadequate intake of calcium and vitamin D causes bone loss. Lack of weight bearing exercise and age related changes in endocrine system also causes osteoporosis. Overuse of corticosteroids, thyroid problem, bone cancer, lack of muscle use, certain genetic disorder, use of certain medication, low calcium in diet are the causes of osteoporosis.

- **Excesses consumption of alcohol**

Small amount of alcohol is beneficial to body. Increase the alcohol intake it will increases bone density. Chronic heavy drinking i.e. alcohol intake greater than three units per day probably increases fracture risk despite any beneficial effect on bone density.

- **Tobacco smoking**

Smoking decreases bone health. Tobacco smoking inhibits the activity of osteoblasts and it is an independent factor of osteoporosis. Smoking increases breakdown of exogenous estrogen lower body weight and earlier menopause. All these contribute to lower bone mineral density.

- **Vitamin D deficiency**

Mild vitamin D insufficiency is associated with increase in parathyroid hormone production. Parathyroid hormone increases bone resorption, leading to bone loss.

- **Malnutrition**

Nutrition plays an important and complex role in maintenance of good health. Identified risk factor includes low dietary calcium, phosphorus, zinc, magnesium, boron, iron, fluoride, copper, vitamin A, D, E, C and D provided from sunlight to skin. High blood acidity may be diet related is a known antagonist of bone. Low protein intake shows low bone mass as well as low mineral density.

- **High dietary protein from animal source**

Diet with high animal protein increase urinary calcium and have been linked to increase in bone fracture. Higher protein diet increases absorption of calcium from diet and shows higher bone density. Lower protein diet causes poor bone health.

- **Soft drinks**

Soft drink containing phosphoric acid increases risk of osteoporosis.

- **Endurance training**

In female induced athletes, large volume of training leads to decreased bone density and increased risk of osteoporosis.

- **Under weight**

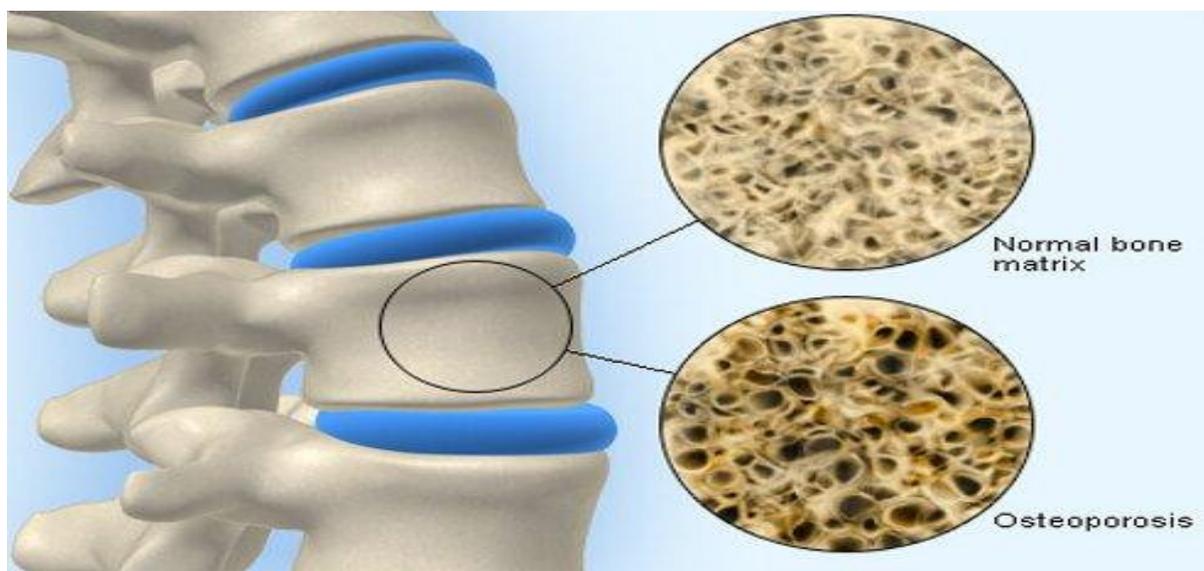
Bone remodeling occurs in response to physical stress. Physical activity can lead significantly to bone loss. Weight bearing exercise increases peak bone mass achieved in adolescence and highly significant correlation between bone strength and muscle strength.

- **Heavy metals**

Cadmium and lead associated with bone diseases. Low level of cadmium causes increase in bone mineral density in both genders, leading to pain and increase risk of fracture. Higher cadmium exposure results in osteomalacia i.e. softening of bone.

### **Risk factors of osteoporosis are as follows**

- Women are at a greater risk than men, especially women who are thin.
- Women who is having family member with osteoporosis, have greater risk of developing osteoporosis than other women.
- Women suffering from postmenopausal and absence or abnormal menstrual periods have greater risk of osteoporosis.
- Rheumatoid arthritis it is also the risk factor for osteoporosis.
- If the parents have osteoporosis then offspring may have risk of osteoporosis.



**Fig.2**

### **Medication used for treatment of osteoporosis [12-14]**

Medications used for treatment of osteoporosis are antiresorptive includes bisphosphonates, hormone replacement therapy, estrogen replacement therapy and estrogen antagonist/agonist.

Hormone replacement therapy and estrogen replacement therapy:

These are initially used for treatment of symptoms of menopause but now a day they are approved for prevention and treatment of postmenopausal osteoporosis. This is because declining estrogen and progesterone levels do not just affect women's reproductive capacities, they also cause bone density to decrease and risk of fractures as estrogen replacement therapy and hormone replacement therapy, bone loss can be slowed. Hormonal replacement therapy have efficacy to reduce fracture risk but it shows adverse effects such as breast cancer, cardiovascular diseases and uterine bleeding etc. alternative to this method some therapeutic agent that stimulates bone formation and retard bone resorption have been suggested but the cost of this treatment is very high.

Side effects of hormonal replacement therapy and estrogen replacement therapy are:

- Rapid weight gain.
- Stomach cramp.
- Bilateral swelling of legs and feet.
- Decrease appetite.
- Prolonged vaginal bleeding.

- Breast discomfort and swelling.
- Yellowing of skin indicates liver toxicity.
- Chest pain and shortness of breath.
- Mild diarrhea, dizziness, migraine.
- Darkening patches on skin.
- Acne, fatigue indigestion.

### **Biphosphonates**

Biphosphonates increases bone mineral density by slowing the rate at which osteoclasts absorb bone. Hence they help to prevent wrist, spine, hip and other bone fracture. Biphosphonates used for treatment of osteoporosis are

#### **Zoledronic acid**

It is given only to women through intravenously infusion. It increases bone mass and protects bone from fracture.

Alendronate and risedronate

It is given orally to both men and women. It is best for osteoporosis caused by use of steroid medication.

#### **Ibandronate**

It is given only to women through IV or orally. It helps to lower the risk of spine fracture.

Adverse effects associated with osteoporosis medication (biphosphonates)

- Ulcers of esophagus.
- Upper gastrointestinal irritation.
- Fracture of femur.
- Low calcium in the blood.
- Skin rash.
- Joint, bone and muscle pain.
- Jaw bone decay.
- Increased parathyroid hormone.

### **Estrogen agonist and antagonist**

These are also called as selective estrogen receptor modulators. These are only given to women and gives same benefits as estrogen therapy but without many of dangerous side effects. Possible side effects of estrogen agonist and antagonist are legs cramp, blood clots and hot flashes.

### Physical activity

Physical activity help to slow age related bone loss and improve bone density. Exercise strengthens the bones. Exercise also improves posture and balance of body also lowering risk of fall. Fewer falls means less fracture. Strength training benefits the bone in arms and upper spine. Weight bearing exercise like walking or jogging and low impact aerobic such as elliptical training or biking is beneficial. They help strengthen the bones in leg, hip and lower spine.

### Egg shell [15-17]

Egg shell is the natural novel dietary supplement contains richest source of calcium, proteins and elements like strontium, magnesium, selenium and fluorine etc. Egg shell shows positive effect in postmenopausal osteoporosis and stimulates chondrocyte differentiation and cartilage growth. Calcium in powdered form added to various mixtures e.g. mixed with alcohol or lemon juice is the supportive medication in the treatment of tuberculosis to increase calcification. Egg shell is the richest source of calcium and growth factors. Egg shell also contains small amount of insulin like growth factors 1 (12ng/g) and transforming growth factors  $\beta$  (0.75- 7.23 ng/g) were found in egg shell extracts. Small amount of calcitonin (10- 25 ng/g) and progesterone (0.33- 0.33ng/g) were found in eggshells. It has moderate immuno-stimulatory properties in- vitro. It stimulates T-lymphocytes and increases natural killer cell activity. Calcitonin is a hormone that slows bone loss and increases bone density. 1 gm of powdered egg shell contains 370gm calcium, 0.6 mg phosphorus, 5mg of magnesium and other elements.

Egg shell calcium is cheap and easily available natural source of calcium. It is most effective in reducing osteoporosis than purified calcium carbonate. It improves bone strength. Postmenopausal women found that egg shell powder improve bone mineral density. Calcium absorption was 64% greater from egg shell as compare to pure calcium carbonate.

There are many therapies used for treatment of osteoporosis but they have number of side effects. Proper intake of dietary calcium intake plays important role in preventing development of osteoporosis by reversing bone turnover. There is an increase in interest in finding suitable alternative source of calcium for bone metabolism. Egg shell is one of the best natural dietary sources of calcium that has potential to utilize as an alternative treatment for postmenopausal osteoporosis. Intake of calcium is insufficient and dietary intervention is needed to increase calcium consumption. Calcium intake from synthetic drug is not so accepted by physician due to low bioavailability and undesirable side effects. Egg shell is the natural source of calcium and other nutritional elements which are useful for treatment of osteoporosis. Egg shell also shows

positive effect on bone mineral density value of lumbar spine and hip in postmenopausal women with osteoporosis. Egg shell calcium has higher level of efficacy in increasing bone mineral density of neck bone. Matrix protein present in egg shell and it is effective in enhancing calcium transport across caco-2 cells in human intestine. Egg shell powder contains small amount of strontium that have anabolic effect on bone.

Eggshell membrane contains high amount of bioactive components, properties of moisture retention and biodegradability that have potential use for clinical, cosmetic, nutraceutical and nanotechnology application. Eggshell membrane is suitable for adherence of stromal cells and biological dressing for sunburn. On the basis of its composition and application it is used in clinical practices like wound dressing and tissue engineering. Eggshell membrane is non toxic and biodegradable. It may have great potential for nerve guide in studies of axonal regeneration in peripheral nervous system. Egg shell membrane protects fetus just as human amniotic membrane dose.

#### **Uses of egg shell [17-20]**

##### **Joint connective disorder**

Effective therapy by using egg shell membrane as an alternative therapy for joint connective disorders such as arthritis, lupus gout and back pain. Analgesic and anti-inflammatory drugs which have limited effectiveness and can create cardiac risk and gastrointestinal issues.

Egg shell relieves the pain and discomfort associated with joint connective tissues disorders without these complicating side effects.

##### **Protect tooth enamel and reduces dental erosion**

Egg shell can be used production of wallastonite, a material used in the synthesis of bioactive material like dental root prosthetics. It is best food for teeth.

Dental erosion is localized chemical dissolution of tooth surfaces without bacterial involvement. Dental erosion can be reduced by using egg shell calcium and also protect the enamel loss.

##### **Strengthens bones and help to treat osteoporosis**

Egg shell calcium is very useful in treatment of osteoporosis. Egg shell contain large amount of calcium as well as additional elements like strontium, fluorine. All these elements positively affect bone metabolism and stimulates cartilage growth. As the bone are growing and beginning to develop, calcium salt called hydroxyapatite crystallize on matrix of collagen. During the process of mineralization of crystal of calcium salt become denser which in turns gives strength and rigidity to the developing bones.

### **Bone grafting material**

Egg shell protein is source of natural calcium carbonate and it is used as bone grafting materials. Egg shell protein combined with a substance called hyaluronan and it is used in bone generation and tissue engineering.

Egg shell is less expensive and readily bio-available source of calcium so it is used for bone replacement.

### **Rickets**

Rickets is disease occur in children results in weak or soft bones. It caused due to the deficiency of calcium and vitamin D. with the help of ultraviolet light human skin cells convert vitamin D from inactive state to active state. In the absence of vitamin D dietary calcium not properly absorbed and results in hypocalcaemia, leading to skeletal and dental deformities and neuromuscular symptoms.

### **Obesity**

Daily intake of calcium rich food decreases the risk of overweight and obesity. High calcium, high dairy diet lost 70% more body weight than the individuals on low calcium diet when caloric intake was same. It prevents excessive fat accumulation by stimulating hormonal action that targets the breakdown of fat.

### **Postmenopausal women**

Drop in estrogen production after menopause result in increased bone resorption, and decreased calcium absorption. Adequate amount egg shell calcium in diet help to slow the rate of bone loss.

### **Anti- inflammatory activity**

Eggshell membrane is an effective and alternative therapy for joint connective disorder such as arthritis, lupus, gout and back pain. These conditions are treated by using anti- inflammatory drug which have limited effectiveness and can create cardiac risk and gastrointestinal issues. Eggshell membrane provided to relieve pain and discomfort related with joint connective tissues disorder without complicating side effects.

### **CONCLUSION**

Calcium is very essential for maintaining bone and teeth health as well as proper functioning of body. The therapy like hormonal replacement therapy and enzyme replacement therapy used for treating osteoporosis but all these shows severe side effects such as breast cancer, cardiovascular diseases and uterine bleeding etc. Alternatively some therapeutic agents that stimulate bone

formation and retard bone resorption have been suggested, but treatment cost is very high. Dietary calcium intake plays an important role in preventing development of osteoporosis by reversing bone turnover. Calcium intake from the synthetic source mostly not used by physician to patients because of low bioavailability and desired side effects. Eggshell is the chief, easily available and richest natural source of calcium (contain 95% calcium) and have 60% more bioavailability as compare to purified calcium carbonate. Egg shell is one of the best sources of dietary calcium that have a potential to be utilized as an alternative treatment for postmenopausal osteoporosis. Natural calcium in egg shell can have positive effect on bone mineral density and help to prevent and osteoporosis.

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