iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** IX **Month of publication:** September 2022

DOI: https://doi.org/10.22214/ijraset.2022.46801

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

An Overview of Osteoporosis in the Elderly Population: Role of Nutrition and Physical activity

Nahia Hamda[1], Navaneetha R[2]
[1]*M.Sc Student,* [2]*Associate professor, Department of Food and Nutrition and Research Centre, Smt. VHD Central Institute of Home Science, Maharani Cluster University, Bengaluru, Karnataka, India*

Abstract: ***Osteoporosis is characterized by decreased bone mass and structural deterioration of bone tissue, leading to bone fragility and an increased susceptibility to fractures, especially of the hip, wrist and spine. Osteoporosis is a major public health issue. Calcium depletion in the bones is a natural process with ageing. A literature online search , was carried out on Osteoporosis using Pubmed and Google search engines and was reviewed to prepare an overview of Osteoporosis in the elderly population. This review paper discusses the following aspects of Osteoporosis in the elderly population; occurrence , types , causes, mechanism, nutritional correction and role of physical activity in prevention and management of Osteoporosis in the elderly. Factors influencing fractures due to fragility include malnutrition, decreased physical activity, macro and micro nutrient deficiency. Studies showed that fragility fractures occur due to insufficient intake of nutrition leading to deficiency of Vitamin D, Calcium, Vitamin K, Zinc, Magnesium etc. Osteoporosis can be prevented to a large extent with a calcium rich diet, exposure to sunlight (outdoor activity) and regular exercise. Osteoporosis when neglected is progressive, hampering day to day activities and puts the person at increased risk of fractures. There is a need further research in osteoporosis and efforts must be undertaken to create awareness about bone health; lifestyle modification to prevent Osteoporosis.***
Keywords: Osteoporosis, Elderly, Fractures, Calcium, Vitamin D, Physical activity, Bone mineral density.

I. INTRODUCTION

The terms “Osteoporosis” and “Poros” stem from the Latin words “Osteon” and “Poros”, which mean “porous bone” **(1).** Osteoporosis is a metabolic bone disease, defined by low bone mass and structural degeneration of bone tissue, which leads to bone fragility and increased susceptibility to fractures, usually involving the spine, hip and wrist. Elderly people with Osteoporosis often have a poor balance control and falls **(2).** Osteoporosis is often referred to as a “silent illness” because it is often not diagnosed until fractures occurs. Increased morbidity, death, reduced quality of life are all linked to osteoporotic fractures. Decreased bone mass is now recognised as a major risk factor for fracture **.** Physical activity interventions under professional guidance help in preventing and managing Osteoporosis**. (3).** Poor nutrition, a diet deficient in or excessive in key nutrients, may have a role in the development of Osteoporosis. Good Nutrition and supplementation when needed can help in delaying a number of degenerative changes that occur as people age. It is necessary to create awareness on daily intake of calcium, vitamin D, potassium and magnesium in recommended amounts (4).

II. MAIN TYPES OF OSTEOPOROSIS

Bone strength depends on bone density and bone mass. Based on the causative factors there are two types of Osteoporosis : Primary and Secondary. Osteoporosis can also be Idiopathic. In women it can be classified into two forms: Involutional Type 1 (postmenopausal) and Involutional Type 2 (premenopausal) **(1) .**

A. Primary Osteoporosis

1) *Juvenile Osteoporosis or Idiopathic Juvenile Osteoporosis:* Bone loss can happen at any age, from infancy to adolescence, as a result of genetic abnormalities that produce a decrease in the volume and quality of the fibrous component of bone, or as a result of a variety of other factors such extended immobility and chronic inflammatory disorders **(5) .**
2) *Senile (Type 2):* Senile Osteoporosis is a condition that affects women and men over the age of 70 and is characterised by a reduction in bone growth as well as a loss in the kidney’s ability to make 1, 25-dihydroxyvitamin D3. Vitamin D insufficiency causes decreased calcium absorption, which raises parathyroid hormone levels and, as a result, causes bone resorption. Hip, long bone, and vertebral fractures are the most common complications of Type 2 Osteoporosis **(1) .**

B. Secondary Osteoporosis

Secondary Osteoporosis is described as low bone mass with microarchitectural abnormalities in bone leading to fragility fractures and occurs due to underlying disease or due to medication. Pre and postmenopausal women, as well as men, can develop Secondary Osteoporosis. When having an evaluation for underlying causes of Osteoporosis, up to 30% of postmenopausal women and 50 – 80% of men are found to have variables contributing to the illness. Endocrine Disorders – Glucocorticoid- induced Osteoporosis, Hyperthyroidism, Hypogonadism, Hyperparathyroidism, Diabetes Mellitus are some of the frequent disorders linked to Osteoporosis and increase the risk of fractures. Celiac disease, inflammatory bowel disease and chronic liver illnesses are examples of gastrointestinal, hepatic, and nutritional disorders causing osteoporosis. Osteoporosis causing Renal disorders include Idiopathic Hypercalciuria and Chronic Renal disease, while autoimmune disorders include Rheumatoid arthritis, Ankylosing spondylitis, and Multiple sclerosis. Certain medications may raise the risk of bone loss leading to fractures **(19) .**

III. ASSOCIATIONS OF FRAILTY WITH OSTEOPOROSIS, FRAGILITY FRACTURE AND MALNUTRITION

Osteoporosis causes bone fragility, which raises the chance of a fragility fracture in older people. Weakness, fatigue a sedentary lifestyle, and mobility impairment are common symptoms among aging population. Anorexia associated with a weight loss is also more commonly seen in the elderly population. All the above conditions raise the chances of falling and breaking a bone. Muscle and bone growth and decrease is governed by a variety of mechanisms. Pharmacological, dietary, and exercise based therapies could produce considerable benefits to the elderly. Early identification of persons at risk, nutritional supplementation and the development of care models based on complete geriatric evaluation and personalization of interventions can prevent fragility fractures. Given the link between poor nutrition and sarcopenia and frailty, assessing older persons nutritional status could lead to therapies that could delay or prevent these severe aging disorders. A low Mini Nutritional Assessment Score (MNA) score combined with a high Groningen Frailty Index (GFI) score was linked to an increased risk of mortality in cancer patients (6) .

A. Macronutrients in Osteoporosis

1) *Carbohydrate:* The majority of studies looking at a link between carbohydrate and bone density have focused on fiber intake. High fiber intake may obstruct calcium absorption and estrogen reabsorption from the intestine. Carbohydrate consumption was found to be inversely linked with bone mineral density in the distal end of the radius in a study. However total carbohydrate intake was linked to a lower incidence of osteoporotic fractures, particularly hip fractures **(7) .**
2) *Protein:* Dietary protein plays a key role in bone formation, development and maintenance of the bone health **(7) .** The skeleton and muscle mass make up around half of the bodies protein stores. High protein intake, according to research, can lead to increased calcium excretion in the urine, and may lead to negative calcium balance, and bone loss in both young and old persons. Animal proteins are more effective than vegetable proteins in lowering the risk of pelvic fractures **(8).** Dairy products contain the amino acid leucine as well as calcium, which helps in maintaining muscle and bone health **(9).** The European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) Suggest consuming 1.0 - 1.2 grams of high quality protein per kilogram of body weight per day, with at least 20 - 25 grams at each main meal. Meat, fish, poultry, eggs and dairy products are the main source of protein in a balanced diet. Consumption of dairy products is likely to be beneficial because they include both proteins and calcium, for example one liter of milk contains 32 grams of protein and 1200 milligrams of calcium **(10) .**
3) *Fat:* The ratio of omega-3 to Omega-6 among non saturated fatty acids is significant in the regulation of osteoblast and osteoclast activity **(8) .** Omega-6 fatty acids have been shown to promote eicosanoids and cytokines production, whereas omega-3 fatty acids (NSFA) decrease them. Furthermore, omega-3 fatty acids improve calcium absorption while lowering urine and feacal excretion. PUFA , particularly omega-3 fatty acids, are abundant in fish and shellfish, and are known to have an anti-inflammatory action that enhances bone health **(10) .**

B. Role of Micronutrients in Osteoporosis

1) *Calcium:* Calcium is one of the most fundamental inorganic elements in the human body. The great bulk (> 99%) of total body calcium is found in bone tissue. The small intestine absorbs around 30% of ingested calcium; the remainder is conveyed to the large intestine, where another 10% is absorbed. To summarise, 60% of the calcium consumed in a typical diet gets eliminated in the feaces **(4).** Maintaining a nutritious diet is the greatest approach to ensure enough calcium intake **(10).** Women should take 1200mg of calcium per day, while males should take 1000 mg per day. Calcium intake boosts Bone mineral Density (BMD) during adolescence, slows BMD loss in the elderly, and lowers the risk of fractures . Calcium alone cannot ensure bone health

because adequate vitamin D availability is a key element in enhancing calcium absorption by the intestines **(9).** Dairy products (milk, yogurt, and cheese), fish (especially sardines with bones), lentils, and a few vegetables, fruits and nuts are the most essential calcium sources in the diet . When dietary calcium sources are insufficient or poorly tolerated, pharmaceutical calcium supplementation may be beneficial **(10).**

Upper limit for Calcium intake	
Age	Amount (mg)
Birth to 6 months	1000
7-12 months	1500
1-8 years	2500
9-18 years	3000
19-50 years	2500
Over 50 years	2000

(11)

2) *Vitamin D:* The fortification of foods may play a role in increasing vitamin D consumption. Vitamin D (10 to 20%) can be obtained from a limited number of foods, such as oily fish, mushrooms, and some fortified dairy products, whereas 80 to 90% is received via cutaneous synthesis following solar exposure. Diet alone cannot supply enough vitamin D to meet the daily needs. Vitamin D deficiency can be largely prevented and corrected with adequate sunshine exposure. Vitamin D deficiency can exacerbate osteoporosis in the elderly or post menopausal women. Certain vitamin D fortified foods, such as reduced-fat cheese and vitamin D biofortified eggs, have shown positive results in preventing osteoporosis **(10).** Vitamin D intake is currently recommended at 10 milligrams per day for persons age 50 to 70, and 15 milligrams per day for those aged 70 and above **(8) .** When compared to calcium or placebo, vitamin D intake of 700 to 800 IU per/day reduced the relative risk of hip fracture by 26% and in non-vertebral fracture by 23% **(12) .**
3) *Dairy Products:* Calcium, Protein, Magnesium, Potassium, Zinc, and Phosphorus are all found in higher concentrations in dairy products when compared with other foods **(13).** Fermented milk products like yogurt and soft cheese are good sources of calcium, phosphorus, including prebiotics as well as probiotics. Probiotics in the fermented dairy products help maintain calcium homeostasis. Egg yolks, fatty fish like salmon, mackerel, catfish, tuna, sardines, cod liver oil, and certain mushrooms are among the few foods that contain vitamin D **(11)** . A 200 ml glass of milk, or 180 gram of yogurt, or 30 grams of hard cheese contains around 250 mg of calcium. The RDI for calcium can be met with only three to four servings of dairy. To get the same amount of calcium one has to consume up to 24 servings of green vegetables or 48 servings of whole grain or refined grain foods would be necessary. Overall, dairy products can provide up to 52 to 65% of the recommended daily intake of calcium and 20 to 28% of the recommended daily intake of protein **(13).**
4) *Phosphorus:* Phosphate is the most common form of phosphorus in the body (PO4). Bone contains around 85% of the body's phosphorus. Phosphorus is an essential component of all living organisms and is found in many foods **(12)** . Phosphorus is found in abundance in dairy products, meat, and fish. Daily requirement of phosphorous is 1000 to 1200 mg (7). Phosphorus is also found as food additives, polyphosphate and phosphoric acid, in most soft drinks. High phosphate levels in the blood reduce the active form of Vitamin D (calcitriol) production in the kidneys, lowering blood calcium, and cause the parathyroid glands to release more PTH **(12) .**
5) *Vitamin K:* Vitamin K is required for the carboxylation of osteocalcin, a bone-specific protein made by osteoblasts which helps in bone mineralization. Those in the highest quartile of dietary Vitamin K intake (median: 254 µg/day) had a 65% lower risk of hip fracture than those in the lowest quartile (median: 56 µg /day). Adequate amounts of Vitamin-K intake showed that there was no loss of BMD at any of the sites studied in the Framingham Original Cohort (hip, spine, wrist) (14).
6) *Vitamin C:* Vitamin C is required for the hydroxylation of collagen in the bones. Enhanced Vitamin C consumption, whether from fruits and vegetables or through food supplements, has been linked to increased bone density. The protective effects of fruits and vegetables are most likely related to other substances like vitamin C, which has been linked to a lower fracture risk due to the decarboxylation of osteocalcin **(7).**

C. Trace Elements

1) *Magnesium:* Around 60% of Magnesium (mg) is stored in the bones.**(12)** Magnesium is essential for bone and tooth formation, and it functions as a cofactor in over 300 enzymes. Phosphorous is essential in kinase processes, permeability of excitable membranes, and neuromuscular transmission **(8) .** Magnesium is becoming more widely recognized as a vital component of bone health. Almonds, cashews and peanuts are good sources of magnesium. Raisins, bran, cereal, potato skins, brown rice, kidney beans, black eyed peas and lentils are also good sources. Roughly 25 mg of magnesium is present in 8 ounces of milk. For optimum health, a dietary intake of 320 – 420 mg is recommended. Magnesium supplementation of 250mg per day is sufficient to maintain bone health **(7).**
2) *Zinc:* Many metalloproteins involved in bone formation require zinc as a cofactor (7) . Zinc is an important component in over 200 enzymes and appears to be necessary for appropriate collagen synthesis and bone mineralization. According to these studies, poor Zinc intake is linked to low BMD in women; also, women with Osteoporosis have lower plasma zinc levels and higher urinary zinc excretion. (8). Natural sources of Zinc are: beans, nuts, and whole grains (10).
3) *Copper:* Copper is required for the action of numerous enzymes involved in the formation of linkages between collagen and elastin Macromolecules. Copper deficiency leads to defective formation of cartilage and bones **(7).** Studies have linked Osteoporosis to Menkes syndrome, a hereditary disorder that alters the body copper intake and leads to loss of bone mass **(8) .**
4) *Folate and Vitamin B12:* Vitamin B12, is only found in animal products and fortified breakfast cereals. Vitamin B12 can lower blood homocysteine levels. Vitamin B12 supplementation, especially in pure vegetarians enhances the bone health **(14) .**

IV. ROLE OF PHYSICAL ACTIVITY

Physical activity includes recreational physical activity (exercise, sports) and daily activities like home chores. Structured physical activities can be divided in to the following; a) Gait, balance, coordination, (for convenience, referred to as 'balance and functional exercise'); b) strength/resistance training (including power training; using resistance, referred to as 'resistance exercises'); c) Flexibility; d) Three dimensional (3D) exercise (with Tai Chi or dance subcategories); e) Endurance; f) Other types of exercises **(3) .** Osteoporosis is less common in those who are physically active. Exercise promotes balance as well as muscle mass and strength. Patients with osteopenia and osteoporosis are frequently advised to walk in order to preserve or improve their bone health. Exercises to an individual are advised based on their health and risk classification

1) Low risk individuals (normal BMD and functional status): Muscle strength and functional capacity are the primary goals. Increasing the intensity of impact activities and multidirectional weight bearing exercises is also recommended to avoid age-related decline. Balance exercises will be appropriate to this group of individuals.
2) Individuals at moderate risk (bone mass and/or clinical or functional risk): Perform weight bearing impact activities, moderate impact activities and increasingly more difficult balancing exercises.
3) High risk individuals (Osteoporosis, prior fracture, and/or multiple risk factors): Fall prevention programmes in high risk individuals, focusing on balance and mobility training, as well as Progressive Resistance Training (PRT) under professional guidance and supervision , will be beneficial to the individuals **(15) .**

In middle-aged and older persons, weight bearing exercises and walking are advised for boosting bone density. Falls and fractures can be reduced by doing weight-bearing and muscle strengthening activities on a daily basis. In physically inactive people aged 70 and above, a 6 months Tai Chi programme was demonstrated to be successful in reducing the number of falls, the danger of falling, and the fear of falling, as well as increasing functional balance and physical performance. **(16).** In people who have had a vertebral fracture, osteoporotic fracture, or hip fracture surgery, structured exercise of various kinds, balance training, and progressive resistance exercise (PRE) were among the interventions. Decreased mobility, knee-extension strength, and decreased balance were associated with higher risk of falling **(17).**

V. DRUG TREATMENTS APPROVED BY FDA

Some of the FDA approved mdications for the prevention and treatment of Osteoporosis are Bisphosphonates, treatment with calcitonin, treatment with Estrogen (agonist/antagonist),Parathyroid hormone (PTH) treatment **(18).**

VI. CONCLUSION

This article gives a brief summary of osteoporosis and prevention of its occurrence in the aging population. The prevalence of Osteoporosis and the resulting osteoporotic fractures is rising as the population ages. Over the age of 50, it is projected that 50% of women and 20% of men may experience osteoporosis-related fracture over their lifetime.

Fractures due to osteoporosis cause long-term impairment, decreased quality of life, and higher death rate, putting a huge medical and personal load on both the patients and the country's economy. The primary, secondary, and tertiary prevention of osteoporosis, as well as osteoporotic fractures are discussed. Fragility fractures can be avoided if osteoporosis is treated properly. Osteoporosis prevention and treatment can be accomplished by having a good diet. A nutritious diet rich in calcium (1200 mg per day), Vitamin D (600 IU), and adequate amounts of protein, magnesium and vitamin K can help in maintaining bone health. For people with osteoporosis , exercises which exert unnecessary force against weak bones is not advised. Prevention of osteoporosis is the key for good health and wellbeing in the elderly. To conclude the following help in the prevention and treatment of osteoporosis; optimal nutrition and calcium intake with exposure to sun for proper vitamin D synthesis, being physically active, appropriate exercises, avoiding smoking and excessive alcohol consumption and Food and Drug Administration (FDA) approved medications under medical supervision.

REFERENCES

[1] Osteoporosis: A social problem in the elderly population : Kucharska, E. (2017). Horizons of Education, 16 (40), 37-57. DOI: 10.17399/HW.2017.164003. www.researchgate.com

[2] Balance control in elderly people with Osteoporosis. Wei-Li Hsu, Chao-Yin Chen, Jau-Yih Tsauo, Rong-Sen Yang. (March 2014) Journal of the Formosan Medical Association
Volume 113, Issue 6, June 2014, 334-339.www.sciencedirect.com

[3] Evidence on physical activity & osteoporosis prevention for people aged 65 plus years: A systematic review to inform the WHO guidelines on physical activity and sedentary behavior.Marina B. Pinheiro, Juliana Oliveria, Adrian Bauman, Nicola Fairhall, Wing Kwok and Catherine Sherrington (2020) , Int J Behav Nutr Phys Act. 2020 Nov 26;17(1):150. doi: 10.1186/s12966-020-01040-4. PMID: 33239014; PMCID: PMC7690138.https://ijbnpa.biomedcentral.com

[4] Calcium consumption in diet of elderly patients-literature review. Maja Warzecha, Edward Czerwinski. (22 September 2016). Post N Med 2016; XXIX(10): 777-78 www.pnmedcznych.pl.com

[5] Clinical guidelines for the Prevention and Treatment of Osteoporosis: Summary statements and recommendations from the Italian Society for Orthopedics and Traumatology.Umberto Tarantino, Giovanni Iolascon, Luisella Cianferotti, Laura Masi, Gemma Marcucci, Francesca Giusti, Francesca Marini, Simone Parri, Maurizio Feola, Cecilia Rao, Eleonora Piccirilli, Emanuela Basilici Zanetti, Noemi Cittadini, Rosaria Alvaro, Antimo Moretti, Dario Calafiore, Giuseppe Toro, Francesca Gimigliano, Giuseppina Resmini, Maria Luisa Brandi. (20th October 2017). J Orthop Traumatol (2017) 18 (Suppl 1):S3–S36, DOI 10.1007/s10195-017-0474-7. www.jorthoptraumatol.springeropen.com

[6] Osteoporosis in frail Older Adults: Recommendations for Research from the ICFSR Task Force 2020.Y. Rolland, M. Cesari, R.A. Fielding, J.Y. Reginster, B. Vellas, A.J. Cruz-Jentoft and The ICFSR Task Force. (2nd November 2021). The Journal of Frailty & Aging Volume 10, Number 2, 2021, www.springer.com

[7] Nutritional aspects of bone health & fracture healing. Athanasios Karpouzos, Evangelos Diamantis, Paraskevi Farmaki, Spyridon Savvanis and Theodore Troupis. (31st December 2017), J Osteoporos. 2017;2017:4218472. doi: 10.1155/2017/4218472. Epub 2017 Dec 31. PMID: 29464131; PMCID: PMC5804294. www.hindawi.commuscle

[8] Nutrition and Osteoporosis Prevention and Treatment. Jalal Hejazi, Ali Davoodi, Mohammad Reza Khosravi, Sedaghat, Vahideh Abedi, Sima Hosseinverdi, Elham Ehrampoush, Reza Homayounfar, Layla Shojaie. (26th April 2020), Biomed. Res. Ther 7(4):3709-3720.www.bmrat.com

[9] The role of calcium in human aging.Judith A. Beto, Loyola University Healthcare System, Maywood, IL 60153, USA Department of Nutrition Sciences, Dominican University, River Forest, IL 60305, USA. (2015), Clin Nutr Res. 2015 Jan;4(1):1-8. doi: 10.7762/cnr.2015.4.1.1. Epub 2015 Jan 16. PMID: 25713787; PMCID: PMC4337919.
www.ncbi.nim.nih.gov

[10] Nutrients and Dietary Patterns Related to Osteoporosis. Araceli Munoz-Garach, Beatriz Garcia-Fontana and Manuel Munoz-Torres. (3rd July 2020), 2020 Jul 3;12(7):1986. doi: 10.3390/nu12071986. PMID: 32635394; PMCID: PMC7400143. www.ncbi.nlm.nih.gov

[11] Krauses-food-the-nutrition-care-process-mea-edition, L. Kathleen Mahan, Janice I. Raymond. (2017), 14 th edition , Elsevier, St. Louis, Missouri. www.elsevier.com

[12] Bischoff-Ferrari HA, Willett WC, Wong JB, Giovannucci E, Dietrich T, Dawson-Hughes B. Fracture prevention with vitamin D supplementation: a meta-analysis of randomized controlled trials. JAMA. 2005 May 11;293(18):2257-64. doi: 10.1001/jama.293.18.2257. PMID: 15886381.

[13] Nutrition and bone health in women after the menopause. Rene Rozzoli, Heike Bischoff-Ferrari, Bess Dawson-Hughes & Connie Weaver. (1st November 2014) , Womens Health (Lond). 2014 Nov;10(6):599-608. doi: 10.2217/whe.14.40. PMID: 25482487 https://journals.sagepub.com

[14] Dietary Approaches for Bone Health: Lessons from the Framingham Osteoporosis Study, Sahni S, Mangano KM, McLean RR, Hannan MT, Kiel DP. Curr Osteoporos Rep. 2015 Aug;13(4):245-55. doi: 10.1007/s11914-015-0272-1. PMID: 26045228; PMCID: PMC4928581.www.ncbi.nim.gov

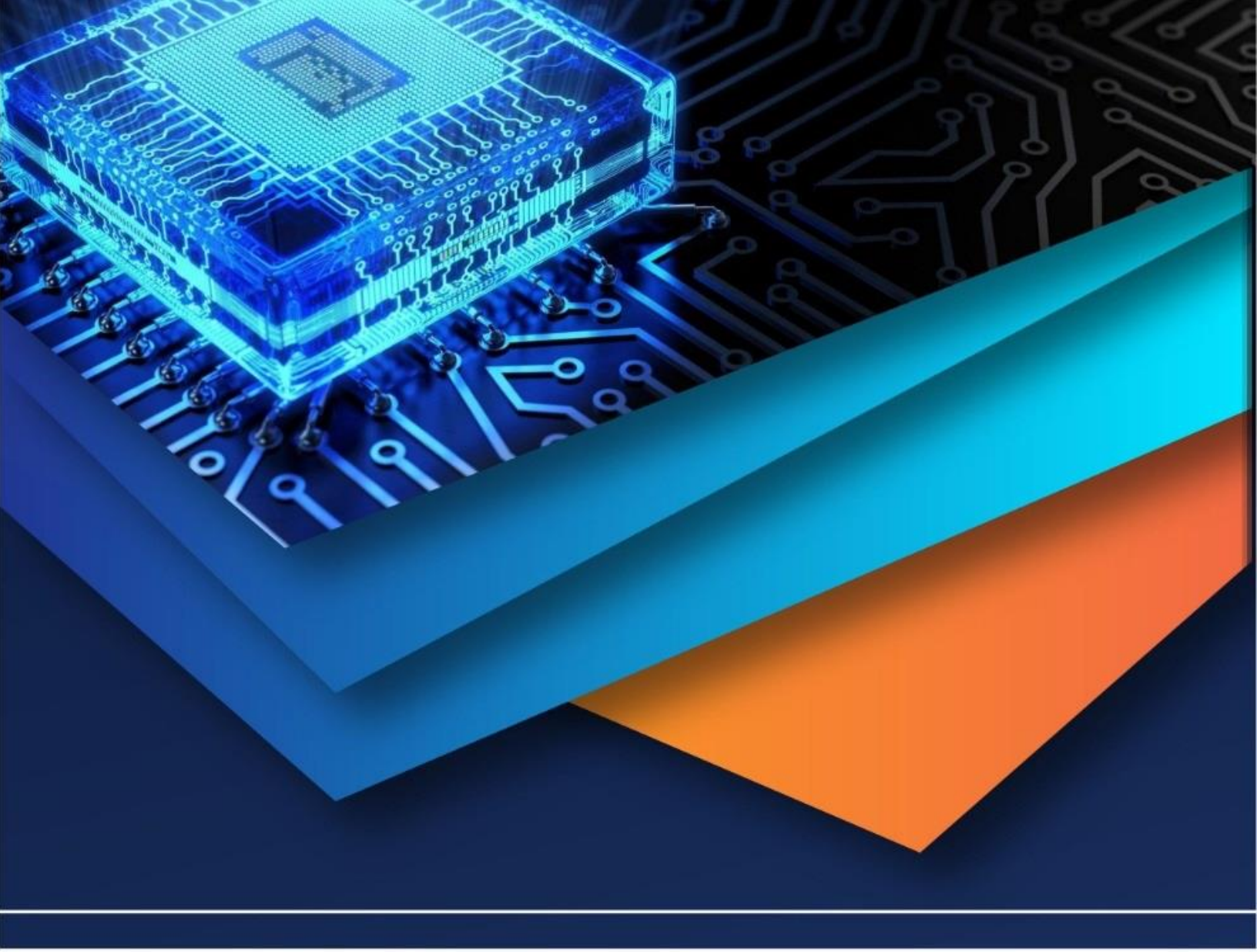
[15] Impact of Vitamin D3, Calcium and exercise in the management of Osteoporosis, De Nardo Barbara, Belardo Alejandra, Gelin Marina, Cavanna Malena. (7th March 2020), MOJ Women's Health. 2020;9(2):38–40. https://medcraveonline.com

[16] Muscle and Bone Mass Loss in the Elderly , Padilla Colón CJ, Molina-Vicenty IL, Frontera-Rodríguez M, García-Ferré A, Rivera BP, Cintrón-Vélez G, Frontera-Rodríguez S. Population: Advances in diagnosis and treatment. J Biomed (Syd). 2018;3:40-49. doi: 10.7150/jbm.23390. PMID: 30505650; PMCID: PMC6261527.www.ncbi.nim.nih.gov

[17] Prevention and management of Osteoporosis fractures by non-physician health professionals: A systematic literature review to inform EULAR points to consider. Nicky Wilson, Emailie Hurkmans, Jo Adams, Margot Bakkers, Petra Balazova, Mark Baxter, Anne-Birgitte Blavnsfeldt, Karina Briot, Catharina Chiari, Cyrus Copper, Razvan Dragoi, Gabriele Gabler, Williem Lems, Erika Mosor, Sandra Pais, Cornelia Simon, Paul Studenic, Simon Tilley, Jenney de la Torre, Tanja A Stamm. (2020). www.rmdopen.bmj.com

[18] Mahan, L.K. & Raymond J.L. (2017): Krause's Food and The Nutrition Care Process, 14th Edition, pp 456-465 , St.Louis , Missouri :Elsevier . www.elsevier.com

[19] Secondary Osteoporosis: Pathophysiology and Management. Faryal Mirza and Ernesto Canalis. (September 2015) , Eur J Endocrinol. 2015 Sep;173(3):R131-51. doi: 10.1530/EJE-15-0118. Epub 2015 May 13. PMID: 25971649; PMCID: PMC4534332. https://www.ncbi.nlm.nih.gov



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY