



## PRAKRITI (BODY CONSTITUENCY) AND DIETARY DETERMINANTS OF OSTEOPOROSIS IN FEMALES: EVIDENCE FROM A SURVEY STUDY

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### ABSTRACT

**Introduction:** There is rising life expectancy in India over the years, and so the number of elderly females with related issues. In 2015, around 46 million females above 50 years of age were expected to be living with osteoporosis and figures may soar in coming years. Osteoporosis reflects dhatu-kshaya (tissue-depletion), often precipitated by ahara-dosha (improper-dietary-habits) which may be specific to particular rasa(taste) and Prakriti (body constituency), leading to vulnerability towards asthi-dhatu dushti (bone-vitiation) and compromised bone integrity. Therefore, this study was aimed to assess Bone-Mineral-Density (BMD) of the women to study prevalence of Osteopenia and osteoporosis in the region of study and co-relation between BMD, Prakriti and diet if any.

**Methodology:** Women attending OPDs of our Institute were screened. Calcaneal-BMD advised in females 40 years of age and above, and in 16 years and above with orthopaedic problems. Results were grouped normal, osteopenia and osteoporosis according to WHO T-score criteria. A specially designed Questionnaire was used to study Prakriti and dietary habits of participants.

**Observation and Results:** Over 251 patients were screened and 92 advised BMD test with overall prevalence of Osteopenia observed-34.78% and of Osteoporosis-5.43%. Vata-Pitta or Vata-kapha prakriti were observed more vulnerable for osteopenia while Vata-Pitta also for progression to osteoporosis. Intake of sweet and salty diet were observed to be predominant in osteopenic group while latter in osteoporotic as well.

**Conclusion:** Vata-Pitta Prakriti and predominance of sweet and salty diet are more vulnerable for osteoporosis formation. Adopting dietary and Prakriti-specific lifestyle modifications might be helpful in preventing bone deterioration and progression to Osteoporosis.

**Key Words:** Ayurveda, diet, osteopenia, osteoporosis and prakriti.

## Introduction

Osteoporosis is defined as deterioration in bone mass and micro architecture, with increasing risk for fragility fractures. Osteoporosis is said to be a common metabolic bone disorder, but is still under diagnosed and remains under-treated.<sup>[1]</sup> The World Health Organization (WHO) defines osteoporosis also as bone density falling 2.5 Standard Deviations (SD) below the mean for young healthy adults of the same sex and race—also referred to as a T-score of  $-2.5$ . Postmenopausal women at the lower end of the young normal range (a T-score  $<-1.0$ ) are defined as having low bone density and are also at increased risk of osteoporosis.<sup>[2]</sup> Indians are genetically predisposed to have osteoporosis and a lower Peak Bone Mass average in comparison to their western counterparts. In 2013, 50 million people in India were estimated to be either osteoporotic or osteopenic.<sup>[6]</sup> Thus, increased number of elderly women may also see increased cases of Osteopenia and Osteoporosis.

Primary osteoporosis occurs in men and women of all ages, more often occurring in postmenopausal women. Secondary osteoporosis is result of chronic medication use like steroids and other conditions like vitamin D deficiency and various hormonal disorders.<sup>[7]</sup> This mainly seems due to lack of dietary intake with required nutrients and awareness regarding proper nutrition in different phases of life of a female including puberty, pregnancy, lactation and menopause. Low Calcium intake has already been reported in Indian females above 40 years,<sup>[8]</sup> post-menopause<sup>[9]</sup> and even in adolescents and lactating mothers.<sup>[10]</sup> Moreover, sufficient amounts of milk and milk products in daily diets are still unaffordable in majority of lower socioeconomic strata of the country. In Ayurveda, diet including different tastes and prakriti have been linked to vitiation of asthi and related disorders. Therefore, this study was done to assess Bone Mineral Density of the women to study prevalence of Osteopenia and osteoporosis in area of study and any co-relation between BMD, Prakriti, dietary pattern and others if any.

## Need of Study

India is undergoing a demographic shift, with life expectancy projected to rise from 67 years in 2011 to 71 by 2025 and 77 by 2050.<sup>[3]</sup> Consequently, the proportion of the population aged  $>50$  years is expected to increase from 10% to 34% by 2050.<sup>[4]</sup> Notably, approximately 46 million Indian women over the age of 50 are estimated to be affected by osteoporosis.<sup>[5]</sup> Genetic predisposition, lower average peak bone mass, and limited access to nutritional resources contribute to this growing public health concern. In 2013, over 50 million Indians were reported to be either osteoporotic or osteopenic.<sup>[6]</sup> Social and financial barriers further limit regular consumption of dairy products among females, a key source of dietary calcium among poor, while disease being still prevalent in urban areas with no dietary restrictions.

Given these trends, this study aims to assess BMD among women, determine the prevalence of osteopenia and osteoporosis, and examine potential associations with Prakriti (Ayurvedic bodily constitution), dietary habits, and other influencing factors.

## Concept of Prakriti and Diet in Ayurveda

Prakriti (bodily constituency) is based on three doshas (constituents) namely, Vata, Pitta and Kapha. Vata possesses mainly light, dry, Sukshma (subtle), cold, rough and movement guna (properties).<sup>[11]</sup> Pitta mainly possesses hot, pungent, liquidity, sour, acrid properties<sup>[12]</sup> whereas, Kapha is heavier, oleative, stable, sweet and adhesive.<sup>[13]</sup> And thus, corresponding Prakriti possesses corresponding properties as per the involvement of doshas. It is thus said to be of seven types based on Doshik predominance, i.e. three single-Vataj, Pittaj, Kaphaj, three dual, ie, Vataj-Pittaj, Pittaj-Kaphaj and Vataj-Kaphaj while seventh is one samadoshaj Prakriti (all three dosha in equal proportions). Among these, samadoshaj is the best with optimum balance and health in the body while others have predominance of any one or two doshas bringing certain qualities pertaining to the doshas and also making body susceptible for certain diseases. Each prakriti is associated with its specific characteristics which affect physical and mental attributes of a person depending upon the involvement of doshas. For instance, individuals with Vata Prakriti are usually lean having harsh

voice, eat small portions of food but multiple times in a day, are hyperactive, talkative, quick learners but tend to forget quickly and are prone to several diseases<sup>[14]</sup> whereas people with, Pittaj Prakriti have better digestive power and thus they tend to eat large meals multiple times, may have early greying of hair, relatively loose muscles and joints, are more prone to skin diseases and have sharp memory.<sup>[15]</sup> Kaphaj constitution have better oleation and firmness in joints, clear complexion, more compact and stable body, better memory and concentration, strong immunity, more patient and others.<sup>[16-17]</sup> However, mostly people possess dual prakriti and Samadoshaj Prakriti is a bit unusual to find and thus they are affected by the dominance of both the doshas and also receive related qualities. Hence, it is also advised to adopt diet and lifestyle changes with properties opposite to doshik prakriti. Diet or dietary components also possess basic properties and qualities similar to the three doshas and thus, food consumption affects dosha constituency in body. Different rasas or tastes of food affect doshik predominance of the body and any imbalance created could bring about disturbance in physiological functions which may lead to different diseased conditions. As per six tastes in Ayurveda namely, madhur (sweet), amla (sour), lavana (salty), katu (pungent), tikta (bitter) and kashaya (astringent) also have vitiating and eliminating effects on doshas. For instance, consumption of first three rasas increases Kapha and decrease Vata dosha while last three increase Vata and decrease Kapha dosha whereas amla, lavana and katu increase Pitta dosha while consumption of sweet, bitter and astringent decrease it.<sup>[18]</sup> Moreover, excessive intake of food with light, dry and cold properties lead to vata prakop (outbreak increase) due to similarity of constituents and properties. Same way excessive intake of sour, salty, acrid, pungent and hot properties lead to vitiation of Pitta dosha and excessive intake of food with heavy guna and curd, raw or improperly cooked cereals (ama anna) and raw or improperly cooked certain leafy vegetables would cause excessive Kapha increase.<sup>[19]</sup>

### Concept of Asthi Dhatu in Ayurveda

Ayurveda believes in concept of seven dhatu pertaining to different systems or body constituents, namely, rasa (fluid), rakta (vascular system), mansa (muscular system), meda (fat and adipose), asthi (bone and cartilage), majja (marrow) and shukra<sup>[20]</sup> (reproduction). Asthi, the fifth dhatu, pertains to bone and cartilage in the body and is one of the main residing places of Vata dosha.<sup>[21]</sup> Asthi word is derived from 'As+kthin' meaning stability and has predominance of earth element (prithvi mahabhuta). These dhatu are formed in sequential manner, ie, food intake and digestion first forms rasa dhatu which is further divided into three parts, one of which forms next dhatu which is rakta and similarly other dhatu are formed sequentially forming asthi from meda and majja from asthi. Disorders of dhatu include Dhatu Kshaya (decrease), wherein, symptoms of Asthi Kshaya include pain in bone and joints, dryness, joint deformity,<sup>[22]</sup> brittleness or defects in teeth and nails,<sup>[23]</sup> lethargy, hairfall including that of face and body,<sup>[24]</sup> while that of decrease in attributes of Majja dhatu (formed from asthi) includes Asthisaushirya<sup>[25]</sup> meaning pores in bone indicating that Asthi Kshaya (or decrease in attributes of bone) further may lead to porotic bones as in progression of osteopenia to osteoporosis.

### Materials and Methods

Women attending Gynaecology OPD of All India Institute of Ayurveda, New Delhi, India from 1<sup>st</sup> to 8th March 2021 falling in inclusion criteria were recruited and advised BMD after verbal consent. Total of 251 females were screened and 92 were advised BMD. Calcaneal BMD was done and results were grouped as normal, osteopenia and osteoporosis according to WHO T-score criteria. A Questionnaire used to study Prakriti and dietary habits of the participating females was compiled from already pre-validated Questionnaires like, Modified Food Frequency Questionnaire, Ayurvedic Ahara Assessment Questionnaire, Standardized Prakriti Assessment Questionnaire, Ayusoft etc. Data was collected and assessed for any relation between these factors if so. **Inclusion Criteria:** i) All women of 40 years of age and above; ii) Female patients aged 16 years or above with pain, altered posture or H/o frequent low impact fractures; iii) Patients willing to participate. **Exclusion Criteria:** i) Patients

below 16 years of age; ii) Patients with injury or fractures of lower limbs; iii) Patients with injury or fractures of Pelvis; iv) Female patients with any comorbidities; v) Female patients on chronic medications.

Quality assurance for the device was done and tests performed by a single technician on all females included in the study. As per diagnostic categories of WHO (WHO BMD categories), T-score of  $>-1$  was considered Normal while that of  $\leq -1.0$  to  $>-2.5$  was designated osteopenia, and  $\leq -2.5$  as osteoporosis.<sup>[26]</sup>

## Results

After screening of 251 patients 92 patients were advised BMD test (Table 1 original: Overview). Based on BMD tests overall prevalence of Osteopenia in this study was observed to be 34.78% while that of Osteoporosis was 5.43% and 59.78% had normal BMD (Fig 1 BMD Test Result). Mean Hemoglobin (Hb) concentration was observed to be 11.65gm% however found low, 10.33gm %, in osteoporotic females. It was observed that all of the women were having Prakriti involving two Doshas and none was observed to possess single Doshik Prakriti. Majority of the women with Osteopenia in this study were either of Vata-Pitta or Vata-kapha Prakriti with 47.62% (Fig. 2 Prakriti in Osteopenic Patients) while 66.67% of women with Osteoporosis were of Vata-Pitta Prakriti and 33.33% were of Vata-kapha Prakriti (Fig. 3 Prakriti in Osteoporotic Patients). Preferred rasa or taste in women with Osteopenia was sweet 42.86% while 23.81% preferred salty taste followed by sour taste with 19.05% whereas all the women with Osteoporosis took salty taste predominantly in their diet. 47.62% of the participants with Osteopenia were taking rice, wheat and vegetables as main content in their diet while 66.67% of the females were taking rice only as main content or staple food (Table 2 original: Observation & Results). It was interestingly also observed that almost 85.71% of the females diagnosed with osteopenia and almost all Osteoporotic females were having milk in their daily diet. 72.46% of the total females screened for the study had included milk as regular dietary dairy product. Almost 14.28% of osteopenic and 33.333% osteoporotic women were having both milk and fruits in their daily diet and only 04.76% with osteopenia were taking milk, fruits, dryfruits and regular 8 glasses of water daily. 33.33% of osteoporotic women were taking fruits and dry fruits each along with milk daily in their diet. 66.67% females with osteoporosis were taking mixed diet (vegetables and meat both) while most of the women with osteopenia were vegetarian (42.85%) followed by 38.09% mixed diet. Majority of the females (57.14% osteopenia and 66.67% with osteoporosis) didnot feel enough energy to do daily activities and thus felt tired most of the times despite having meals three times a day. Frequency of junk food was also asked and it was observed that 33.33% osteopenic patients had junk food 2-3 times per week or more followed by 28.5% had it 2-3 times in a month while same percentage of females said they never had junk food. However, 33.33% of osteoporotic females had junk food 2-3 times/month while 66.67% accepted they never had it. Majority of the females with abnormal BMD didnot have any known chronic illness. However, majority of the osteoporotic females did not undergo any screening test for systemic illness before nor they had any medical insurance. However, 70.34% of the total screened women for the study accepted to have a medical insurance.

## Discussion

This study is unique as unlike other studies, younger participants with symptoms (pain, altered posture, H/o frequent fractures and others) and requirement of BMD were considered for the study. Youngest participant was of 17 years, while, shockingly, T-score of  $\leq -2.5$  (Osteoporosis) was found in females as young as 35years. Low Hb concentrations have been consistently linked to high risk of osteoporosis in adult population,<sup>[27]</sup> though, mean Hb of the females in this study was recorded as 11.65gm% which also defies linking of vegetarian diet to Low Hb concentrations<sup>[28]</sup> and Anaemia, as majority participants had vegetarian diet. This could be a positive response due to continuous rigorous efforts of various awareness campaigns and nutritional programmes led by the Government over the past years. Majority of females with Osteopenia were either of Vata-Pitta or Vata-kapha

Prakriti while more than a third of the females with Osteoporosis were of Vata-Pitta Prakriti suggesting it to be more prone to develop Osteoporosis. Vata being predominant in all the cases Vata and Pitta combined tend to produce depletion, more if, there is dominance of light, dry, rough properties of Vata<sup>[11]</sup> and hot-pungent properties of Pitta.<sup>[12]</sup> Asthi being one of the main resident place of vata <sup>[29]</sup> is more prone to get affected and thus osteopenia thus producing symptoms of Asthi Kshaya, in form of pain, dryness and joint deformity along with brittleness or defects in teeth and nails and hairfall which if remains untreated may lead to Majja dhatu kshaya in form of Asthi-saushirya or Osteoporosis. Increased intake of salty and sweet tastes was noted. Relation of excessive salt intake and osteoporosis has already been established by certain studies. Calcium excretion is said to be increased by sodium and low BMD is associated with higher excretion of calcium and thus high sodium intake is also being considered as a risk factor of osteoporosis.<sup>[30]</sup> Increased sugar intake is also found to increase calcium and magnesium excretion<sup>[31]</sup> and reduction in osteoblast proliferation due to increased bone lactate formation and lactic acid so produced from osteoclast metabolism of glucose dissolving mineral salts from the bone.<sup>[32]</sup> Majority of females with osteoporosis had rice as their staple food which indicates contrary to certain researches that promote rice in bone formation and treatment of osteoporosis including experimental studies being done.<sup>[32-35]</sup> Despite daily milk consumption suggests, quality of milk is contentious and quantity of daily milk consumption is variable. According to Indian Council of Medical Research's report on the Nutritional Requirements and RDA for adult Indians 600mg/day calcium is recommended for which accounts for approximately two glasses of milk unlike UK, where it is 700mg, around a quint or 454 ml of daily milk and 1000-1200mg, approx. four glasses in US. However, possibility of affordability of such quantity of milk by lower socio-economic strata is also doubtful. Majority of affected females were taking meat and junk food, which may also be a contributor in increased bone deterioration. Junk food has heavy, dry, fatty diet that increases ama in body which may cause blockage of channels leading to reduced or faulty formation of rasa dhatu with compromised qualities and thus also affecting subsequent dhatu formation in similar ways. Hence, by subsequent dhatu formation, Asthi dhatu formed from meda dhatu is decreased both in amount and quality. Since, most females detected with osteoporosis did not previously undergo for any screening for systemic illness which is again a concern as timely screening could have led to early detection and intervention.

## Conclusion

Osteopenia may be correlated with Asthi-kshaya and osteoporosis seems more like Asthi-saushirya in Ayurveda. Prevalence of osteoporosis in current study was observed to be 05.43% which is quite alarming while that of osteopenia was 34.78%. Vata-Pitta prakriti seems to be more vulnerable to develop osteopenia and progression to osteoporosis. Lavana rasa also seems to contribute in occurrence and progression of the disease. Dietary factors including staple food, meat and junk food may also be the factors affecting propagation and occurrence. Early screening and intervention may reduce the prevalence of osteoporosis. Thus, prakriti and diet found to have been related with osteoporosis. Knowing one's prakriti, rasa and dietary habits can act as a tool to help identify vulnerable group. Adopting lifestyle and food habits according to Prakriti as described in Ayurveda might be helpful in preventing such deterioration and progression to Osteoporosis. However, further researches may be required to strengthen these observations.

## Statements and Declarations

Informed consent was obtained from all subjects and/or their legal guardian(s).

All methods were carried out in accordance with relevant guidelines and regulations and approved by departmental authority.

All experimental protocols were approved by a departmental and/or licensing committee.

**Competing Interests:** None

**Funding:** None

**Acknowledgement:** The authors thank all the faculty members of the All India Institute of Ayurveda, New Delhi especially, Prof. Prof. (Dr) Tanuja Manoj Nesari, Director All India Institute of Ayurveda, for advise and support.

**Author Contribution Statement:** Conception and design of study: Author 2, 3 & 1.

Acquisition of data: Author 1. Analysis and/or interpretation of data: Author 2, 3 & 1.

**Category 2:** Drafting the manuscript: Author 1. Revising the manuscript critically for important intellectual content: Author 2& 3. **Category 3** Approval of the version of the manuscript to be published: Author 2, 3 & 1.

Author 2 accepts responsibility for the integrity of the work as a whole and is designated as the Guarantor.

**Declaration of generative AI in scientific writing-** None

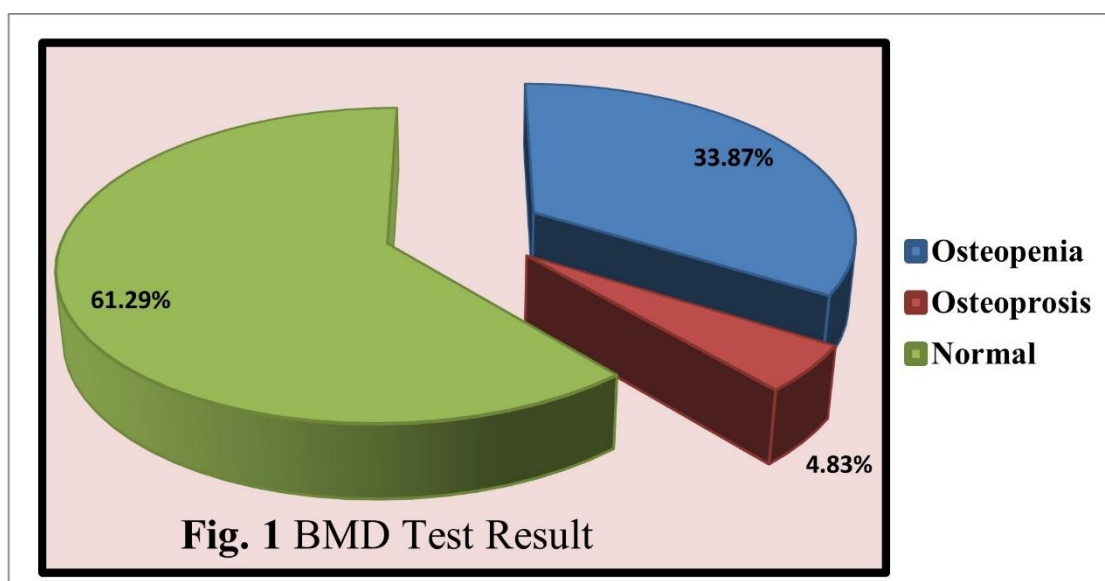
**Data Availability-** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

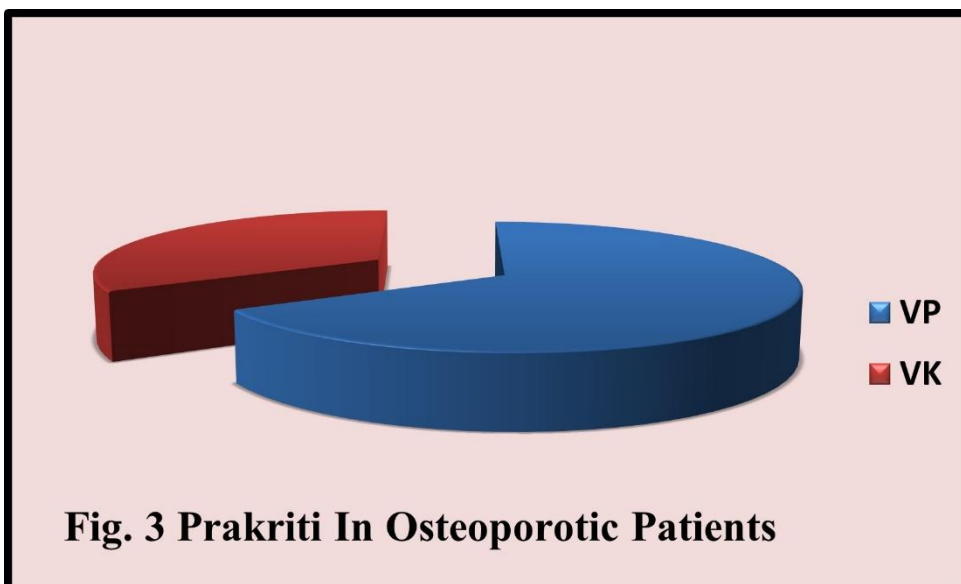
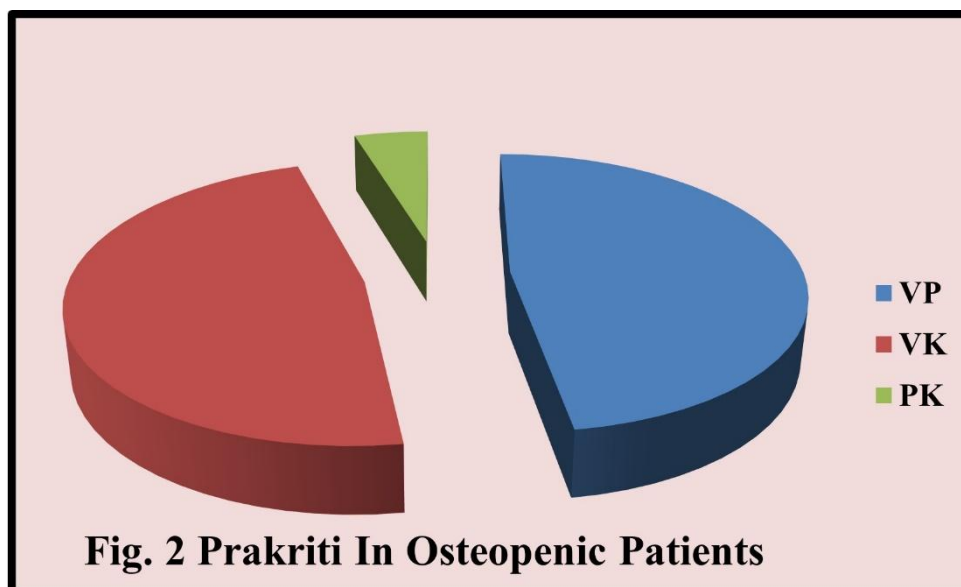
| Total Patients Screened | BMD Advised | Prevalence of Osteopenia | Prevalence of Osteoporosis |
|-------------------------|-------------|--------------------------|----------------------------|
| 251                     | 92          | 34.78%                   | 5.43%                      |

**Table 1** (Original): Overview

| ATTRIBUTE                                     | OSTEOPENIA               | OSTEOPOROSIS             |
|-----------------------------------------------|--------------------------|--------------------------|
| <b>Doshik Prakriti</b>                        | Vata-Pitta or Vata-kapha | Vata-Pitta (majority)    |
| <b>Predominant Taste</b>                      | Madhur- Lavana           | Lavana                   |
| <b>Lethargy</b>                               | 57.14% with osteopenia   | 66.67% with osteoporosis |
| <b>Diet</b>                                   |                          |                          |
| <b>Vegetarian</b>                             | 42.85%                   | 66.67%                   |
| <b>Mixed</b>                                  | 38.09%                   | 33.33%                   |
| <b>Staple Food</b>                            | Rice                     | Rice-Wheat               |
| <b>Junk food (2-3 times per week or more)</b> | 33.33%                   | 33.33%                   |

**Table 2** (Original): Observation and Results





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