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ASSOCIATION BETWEEN NUTRIENT INTAKE, PHYSICAL INDICES, AGE AND BMD REFERRED FOR QUALITATIVE ULTRA SOUND

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ABSTRACT
Aim To determine osteoporosis through bone mineral density and its association with nutrition and physical indices among the population in Coimbatore city, Tamil Nadu, India. The study population included 108 subjects between age groups 30- 85 years. Demographic profile and information on dietary intake was elicited using well-structured questionnaire. The Bone density of all the participants was measured by Quantitative Ultra Sound (QUS) method and the values were compared with World health organisation T – score and classified as normal or osteopenia / osteoporosis. The mean nutrient intake and anthropometric indices were correlated with levels of bone mineral density. Similarly a correlation was also analysed between mean nutrient intake and the anthropometric indices. The results were statistically analysed using SPSS Version 16. With reference to nutrients intake, the mean intake of calcium (669 ±174) and phosphorous (588 ±176) was found to be higher in the age group of 46- 60 years of the entire selected subjects. With regard to the levels of bone mass density, females were found to have a significant level ($p < 0.05$) of osteoporosis (37%) and only 34% of the male's subjects were osteoporotic. Pearson correlation assessed revealed mean protein intake had a significantly positive relationship with mean height, weight and BMI. Whereas, mean fat intake had significant positive relationship only with BMI. Similarly body weight and BMI had a highly significant positive relationship with the stage of osteopenia. Hence, age, gender and body mass index are found to be the determinants in the prevalence of osteopenia in the present study.

INTRODUCTION

Osteoporosis is a growing health problem recognized in both developed and developing countries associated with substantial morbidity and socio-economic burden worldwide [1]. Osteoporosis is a disease characterized by reduction in the bone mass and disruption of bone architecture leading to impaired skeletal strength and an increased susceptibility to fractures [2]. It is a 'silent disease' which does not have a dramatic clinical presentation except when fracture results due to trivial trauma. The hip, spine and distal forearm bones are the typical sites of osteoporotic fractures. These fractures lead to serious disability and the hip fractures are associated with high mortality. Osteoporosis is defined as a bone density less than 2.5 standard deviations of the mean BMD of a sex-matched, young healthy population, i.e. a T-score less than 2.5. Osteopenia is an intermediate category of bone loss defined as a T-score between1 and 2.5 [3]. Though many factors influence osteoporosis still age, gender and nutrition are the most contributing factors. Way back in 1995 itself, Randell et al (1995) stated 30%–50%

of women and 15%–30% of men suffer from osteoporosis-related fractures in their lifetime [4]. It is estimated 25 million Indians are affected with osteoporosis and osteoporotic fractures and it occurs in younger age in developing countries [5]. In most Western countries, while the peak incidence of osteoporosis occurs at about 70-80 years of age, in India it may afflict those 10-20 years younger, at age 50-60 [6]. Indeed, this was stated in the year 2000, conversely which is expected to afflict at a very young age in India as the youngsters are seldom concerned about their lifestyle and nutrition. Typical patients who have osteoporosis tend to be thin and possess less muscle mass [7-10].

Bone mineral density (BMD) is the best available means to assess bone strength and the only important tool in the early diagnosis of osteoporosis, so that effective preventive and therapeutic measures can be initiated at the earliest. The gold standard for measuring bone density however is the Dual Energy X-ray Absorptiometry (DEXA), useful tool for both the axial and appendicular skeleton as the detection rate of osteopenia and osteoporosis is higher with it in comparison to calcaneal quantitative ultrasound (QUS) method [11]. However, DEXA is non-portable, expensive and exposes to significant dose of ionizing radiation, therefore not ideally advocated for community based studies. Whereas the QUS method is portable, cost effective and free from radiation hazards and hence ideal for community based studies. And it should be a better and cheaper option especially for community based camps and awareness drives. Although the focus of attention in the past has been on the communicable diseases by public health authorities but recently, this focus has been shifted to non-communicable diseases which are associated with high morbidity and mortality. The present study was undertaken to determine osteoporosis in an awareness camp using calcaneal QUS method and uncover the probable associated risk factors.

MATERIALS AND METHODS

Selection of Area and Subjects

The study population included 108 subjects from various parts of Coimbatore and the screening of bone mineral density was carried out at Awareness Corridor of Global Ortho and Traumatic Centre, Coimbatore, Tamil Nadu, India. The objectives and purpose of the research was well communicated to the study participants. The bone density of all the participants was measured by Quantitative Ultrasound with the help of well trained technicians under the supervision of ortho surgeons.

Inclusion criteria

- All age group

Exclusion criteria

- Those who were physically disabled
- Subjects on medication such as steroids, heparin, warfarin, thyroxine, hydrocortisone, phenytoin sodium, hormone replacement
- Pregnant women

Selection of Tools

The tools used for generating data in the current research work comprised of:

a) Questionnaire:

A well-structured questionnaire was used to elicit demographic and medical data.

b) Assessment of Bone Mineral Density

As QUS is apt for measurements at the field level, this was used for measurement of the bone mass of the selected subjects. The results obtained were compared with the standards given by WHO (2012) for classification as either normal or ostoepenic or/ osteoporotic.

c) Anthropometric Measures

Weight (kg) and height (m) were measured according to the recommendation of the World Health Organization (WHO).

d) Dietary Evaluation

Nutrient intake was determined using the average 24 hour diet recalls. The food questionnaire had two parts; the first identified all foods consumed for three different days previous to the interview(inclusive of one week end day); the second part; specified food frequency to appreciate food eating habits. The dietary intake of macro and micronutrients were assessed against the recommended dietary allowances (RDA) [8].

RESULTS AND DISCUSSION

From the above table it is evident that 21.3% of subjects were belonging to the age group of 30- 45 years and 26.9% of subjects were falling under 61- 85 years. The maximum number of subjects in the study population that is 51.9% was found to be between 46- 60 years

The above Table.2 depicts the mean nutrient intake among different age categories of the selected subjects. Consumption of macronutrients such as carbohydrates, proteins and fats was found to be almost similar in all the three age groups. But in the case of calcium, the mean intake was found to be higher (669 ±174) in the age group of 46- 60 in comparison with the other two groups, probably which poses a question whether this age category is already on any calcium supplementation or not? Similarly there was an increase in phosphorous intake (588 ±176) at the age group of 46- 60 years. However there was no much variation found in the intake of vitamin A, vitamin D and iron among all the three age groups. With regard to the prevalence of poor bone mass density among the gender of the selected population, males were found to have a significant level ($P< 0.05$) of

osteopenia (40%). Whereas, only 35.6% of the female subjects were osteopenic. However, there was no significant difference in the presence of osteoporosis between both the genders. Yet the prevalence was about 35% on an average. Among the study participants, 25.7% from males and 27.39% from females were certainly neither osteoporotic nor osteopenic but only fell under normal category.

From the above table no 4, it is sensibly understood that 37% (n= 40) of the subjects were found to be osteopenic with a mean T-score of (-1.60 ± 0.29) whereas almost equally another 36% (n= 39) of them were found to be osteoporotic too. However, these higher percentage of osteopenic and osteoporotic may not be considered as prevalence as the orthopaedic centre has organised the screening camp in which the subjects participated and probably already diagnosed individuals or people with poor BMD levels could have also participated thus rendering a higher percentage of osteoporosis and osteopenia cases.

The above table 5 reveals the mean anthropometric indices of the selected subjects. The mean height and weight of the respondents were 158.70± 4.68cms and 61.14± 7.70kgs respectively. However, BMI of the subjects were almost around the normal levels and certainly they were found not to be obese which otherwise would worsen the symptoms of osteopenia and osteoporosis

The above table 6 displays the overall mean nutrient intake of the selected subjects. On the whole, the mean macro nutrients intake of the all the selected subjects were found to fairly satisfy the RDA irrespective of the age categories. However, the mean minerals like (calcium and phosphorous) were found to be well around the RDA levels. Similarly beta carotene (vitamin A) and vitamin D are fairly adequate in satisfying the individual needs. Nevertheless, considering the bone mass density of the affected individuals with osteopenia or osteoporosis , these levels may not be satisfactory with regard to mean iron intake, consumption of 12.38 ± 2.46 mg/ day are age specific and yet to be considered as substantially inadequate.

The above table shows the Pearson correlation between mean nutrient intake and anthropometric indices. Most of the micronutrients have a positive relationship with fat, however there are no positive/negative relationship between the other nutrients. Fat as an important determinant of body weight, BMI and as it may influence the BMD levels too, here in the present study was found to have a series of significant positive relationship with BMI and most of the micronutrients. The mean fat intake had a significant positive relationship with BMI ($p< 0.01$) which indicates when fat consumption increases BMI would also increase. Similarly, the next nutrients which highly correlates positively with the macronutrient fat intake, are calcium and phosphorous (Calcium Vs fat $P<0.01$ and Phosphorous Vs fat $P<0.01$). Among macronutrients, protein which is considered as building block was positively correlated with height and BMI ($P<0.01$), obviously which is indicative that if protein increases the body weight and in turn BMI would also correspondingly increase.

Mean nutrient intake of macronutrients and micronutrients have significant positive correlation i.e., a positive relationship between these nutrients as explained in the previous table. However with reference to macronutrients and correlation to levels of BMD none of the nutrients had any positive or negative correlation with the stages of bone loss namely Normal, Osteopenic, and Osteoporosis. Body composition may be considered as an independent factor in influencing osteoporosis manifestations. As the physical dimensions such as weight, fat mass and overall BMI, increase the persons may have more chances of developing lifestyle disorders including osteoporosis. Particularly, obesity can attenuate symptoms of bone loss, thereby leading to higher degree of morbidity and immobility. In the present study, on applying Pearson correlation analysis it clearly depicts that both mean height and BMI had a significant positive relationship ($P<0.01$) with that of osteopenia which is quite imperative that when body weight or BMI increase obviously could pave way for acquiring osteopenia or may at least favour its manifestations. However, mean height is only significantly related to osteopenia at 5% level ($P<0.05$).

Table 1. Distribution of age among the selected subjects

Age	Frequency	Percentage
30- 45	23	21.3
46-60	56	51.9
61- 85	29	26.9
Total	**108**	**100**

Table 2. Mean nutrient intake of the selected subjects

S. No	Nutrients	Age range	frequency	minimum	maximum	Mean ± standard deviation
1	CHO	30- 45	23	210	520	366 ± 83
2	Proteins	30- 45	23	40	73	58 ± 8
3	Fat	30- 45	23	25	75	40 ± 14
4	Calcium	30- 45	23	220	920	564 ± 158

5	Phosphorous	30- 45	23	180	870	490 ± 184
6	Vitamin A	30- 45	23	210	590	338 ± 107
7	Vitamin D	30- 45	23	210	570	339 ± 112
8	Iron	30- 45	23	9	15	12 ± 2
9	CHO	46- 60	56	180	420	336 ± 65
10	Proteins	46- 60	56	45	89	59 ±9
11	Fat	46- 60	56	20	75	41 ±14
12	Calcium	46- 60	56	350	980	667±174
13	Phosphorous	46- 60	56	310	910	588±176
14	Vitamin A	46- 60	56	190	560	338 ±90
15	Vitamin D	46- 60	56	217	600	382 ±102
16	Iron	46- 60	56	8	17	12 ±2
17	Cho	61-83	26	210	435	347±65
18	Proteins	61 - 83	26	45	77	58±7
19	Fat	61- 83	26	20	70	40±12
20	Calcium	61- 83	26	320	950	624±160
21	Phosphorous	61- 83	26	280	1020	526±151
22	Vitamin A	61- 83	26	210	550	347±86
23	Vitamin D	61- 83	26	200	580	369±101
24	Iron	61- 83	26	9	18	12±2

Table 3. Distribution of gender wise BMD scores indicating the levels of bone porosity

S.No	Osteo classification	Male	Number of subjects	Percentage (%)	Female	Number of subjects	Percentage (%)
1	Normal	0.16± 0.45	9	25.7%	0.29± 0.77	20	27.39
2	osteopenia	-1.744± 0.36	14	40%	-1.52± 0.22	26	35.6
3	osteoporosis	-3.33± 0.51	12	34.2%	-3.04± 0.45	27	36.98

Table 4. Over all classification of bone mass density of the selected groups

S No	Indices	Number of Subjects	Mean ± SD
1	Height	108	158. 70 ± 4.68
2	Weight	108	61.14 ± 7.70
3	BMI	108	244.27 ± 2.89

Table 5: Over all mean anthropometric indices of the selected subjects

S No	BMD category	Number of Subjects	Mean ± SD
1	Normal	29	0.14 ± 0.71
2	Osteopenia	40	-1.60 ± 0.29
3	Osteoporosis	39	-3.13 ± 0.48

Table 6. Over all mean nutrient intake of the selected subjects

S No	Nutrients	Number of Subjects	Mean ± SD
1.	Carbohydrates	108	345.60 ± 69.88
2.	Proteins	108	59.20 ± 84.87
3.	Fat	108	41.16 ± 13. 98
4.	Calcium	108	634.03 ± 169.54
5.	Phosphorous	108	550.79 ± 168.64
6.	Vitamin A	108	341.06 ± 92.47
7.	Vitamin D	108	369.76 ± 104.61
8.	Iron	108	12.38 ± 2.46

Table 7. Correlations between mean nutrient intake and anthropometric indices

Parametes	CHO	Protein	Fat	Ca	P	Vit.A	Vit.D	Fe	Height	Weight	BMI
CHO	1										
Protein	-132	1									
Fat	0.154	.193*	1								
Ca	0.142	0.092	.401**	1							
P	0.098	0.014	.468**	.793**	1						
Vit.A	0.059	0.017	0.386	.321**	.339**	1					
Vit.D	0.019	0.07	.448**	.618**	.618**	.644**	1				
Fe	0.054	0.018	0.171	.278**	0.176	.329**	.432**	1			
Height	-158	.349**	0.174	0.073	0	0.076	0.188	0.143	1		
Weight	-103	.867**	0.111	0.095	0.046	0.006	0.088	0.032	.353**	1	
BMI	0.031	.744**	.883**	0.029	0.065	0.051	-40	0.008	-40	-125	1

Table 8. Correlations between BMD levels and mean nutrient intake

Parameter	CHO	Protein	Fat	Ca	P	Vit.A	Vit.D	Fe	Normal	O.penia	O.porosis
CHO	1										
PROTEIN	-132	1									
FAT	0.154	.193*	1								
Ca	0.142	0.092	.401**	1							
P	0.098	0.014	.468**	.793**	1						
Vit. A	0.059	7	0.386	.321**	.339**	1					
Vit. D	0.019	0.07	.448**	.618**	.618**	.644**	1				
Fe	0.054	0.018	0.171	.278**	0.176	.329**	.432**	1			
Normal	-16	0.219	0.171	0.054	0.062	0.351	0.275	-60	1		
Osteopenia	-58	-74	-19	0.166	0.154	0.154	0.044	0.01	0.238	1	
Osteoporosis	0.156	-15	-47	-228	-214	214	-26	-38	0.248	-411**	1

Table 9. Correlation between anthropometric indices and stages of Bone Loss

Parameters	Normal	Osteopenia	Osteoporosis	Height	Weight	BMI
Normal	1					
Osteopenia	-58	1				
Osteoporosis	0.156	-15	1			
Height	-158	.349*	0.174	1		
Weight	-103	.867**	0.111	0.095	1	
BMI	-31	.744**	0.029	0.065	0.051	1

CONCLUSION

As osteoporosis is related to substantial mortality and increasingly higher costs of health care, screening for osteoporosis, particularly in high-risk populations is the need of the day as to prevent the increasing prevalence of this bone mineral disorder. Proper education about the disease can help, not only at individual level but also at community level. From the present study it was observed that age, gender and body mass index are found to be the determinants in the prevalence of osteopenia. Also, revealed that protein intake had a significant positive relationship with mean height, weight and BMI. Whereas, mean fat intake had significant positive relationship only with BMI. Similarly body weight and BMI had a highly significant positive relationship with the stage of osteopenia. The screening for osteoporosis showed that more men participants were found to have osteopenia than women but whereas among female candidates osteoporotic condition was very much prevalent.

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