

**Prevalence of low bone mineral density among middle aged adults of 50-59 years
and its association with different risk factors**

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ABSTRACT

Osteoporosis is systemic skeletal disease that increases that increases fragility of bones and susceptibility to fractures due to decreased bone density and micro-architectural degradation of bone components. It is caused by intricate relationships between environmental, metabolic, and genetic variables. Globally osteoporosis is prevalent among 200 million each year. Aging is a multidimensional process, which involves good health and wellbeing at each stage to participate in productive activities. The middle aged adults are people within the age group of 40 to 59 years. Within the demographic pyramid, the middle-aged adult group represents a significant portion of the population, making about 21% of the total. Furthermore, the middle aged adults are the future elderly population. Therefore, the present study was aimed to determine the prevalence of the osteoporosis among the middle aged adults of 50 - 59 years and analyze the relationship between the selected modifiable and non-modifiable risk factors. A well-structured interview schedule was developed and nutritional assessment was done among 120 middle aged adults of 50 - 59 years. Data on anthropometrics, biochemical, clinical and dietary status was collected. A rising prevalence of osteopenia was observed. About 65% of the subjects had osteopenia, 10.0% osteoporosis and 4.16% had a normal Bone Mineral Density. The results of the study projected a significant association between Bone Mineral Density and Body Mass Index, whereas poor association was observed with socio-demographics and BMD. Based on Mini Nutritional Assessment (short form), majority of the subjects were at risk of malnutrition. The osteopenia and osteoporosis prevalence were 55.69% and 75% among the subjects at risk of malnutrition respectively.

Key words: Osteoporosis, Osteopenia, Middle Aged Adults, Bone Mineral Density

Introduction

Osteoporosis is a progressive, systemic skeletal disease that increases fragility of bones and susceptibility to fractures due to decreased bone density and micro-architectural degradation of bone components (World Health Organization)¹. The condition is caused by intricate relationships between environmental, metabolic, and genetic variables^{2,3}. Globally osteoporosis is prevalent among 200 million each year.⁴ It is estimated that one in five men and one in three women over 50 will have an osteoporotic fracture globally.⁵ The most severe consequence of osteoporosis is Hip fracture. It precipitates in complications such as decreased quality of life, pain with distress, early death and disability.⁶

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Submission	18.07.2024	Revision	26.07.2024	Accepted	12.08.2024	Printing	30.09.2024
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Prior Publication: Nil; Source of Funding: Nil; Conflicts of Interest: None, Article #141/ 251

Osteoporosis is greatly influenced by gender differences. Women going through menopause account for a major portion of the disparities between the two genders. The bone health is influenced by several other factors such as aging, increased weight, female population, sedentary lifestyle, lack of formal education, androgen deprivation treatment, dairy consumption frequency and previous fracture history in past 10 years before the study.^{7, 8} Osteoporosis is claimed as an imminent threat to elderly, who are the world's fastest-growing population, since their fracture risk escalates with age. According to the population census in 2011, nearly 104 million people in India are over 60 years (53 million women and 51 million men), making up 8.6% of the country's total population. Moreover, it is stated that Indians have a 18-year life expectancy at 60 years of age (Elderly in India Profile and Programmes, 2016).

Aging is a multidimensional process, which involves good health and wellbeing at each stage to participate in productive activities, at all phases that alters throughout life cycle and reach old age smoothly.⁹ The middle aged adults are people within the age group of 40 to 59 years. Within the demographic pyramid, the middle-aged adult group represents a significant portion of the population, making about 21% of the total. Furthermore, they will be the ones to enter the old age period initially, making them the future elderly population.¹⁰ Globally, osteoporosis has a severe detrimental effect on economy and health of the aging population.¹¹ According to the World Health Organization (2020),¹ there is a deficiency of quantitative data about the incidence and prevalence of osteoporosis in developing nations. Therefore, the present study was aimed to determine the prevalence of the osteoporosis among the middle aged adult population (50 - 59 years) and analyze the relationship between the selected modifiable and non-modifiable risk factors.

Methodology

The study was approved by the Institutional Human Ethical Committee (IHEC) of Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. Middle aged adults who participated in health care camps at different parts of Coimbatore was selected for the study. A well-structured interview schedule was developed and nutritional assessment was done. Data on anthropometrics, biochemical, clinical and dietary status was collected.

Selection of subjects: By using convenience sampling 120 middle aged adults were selected for the study. The inclusion criteria for selection of the subjects include apparently healthy mobile adults from the age group of 50 - 59 years. Participants with degenerative diseases like cancer and disability to walk were excluded from the study.

Assessment of Nutritional Status and Socio-demographic Study: The anthropometric parameters such as height, weight, mid upper arm circumference, mid calf circumference, waist and hip circumference were measured. Height and weight was measured in minimal clothing using a stadiometer and digital weighing scales (nearest 0.1 kg) respectively. A flexible fibre tape was used to measure mid upper arm, mid calf, waist and hip circumference. Using the waist, hip measurements the Waist Hip Ratio (WHR) was calculated. Using height and weight measurements, Body Mass Index (BMI) was calculated and the subjects were categorized as per the Asian cutoff for BMI in Indians.¹²

The socio-demographic details such as age, gender, marital status, family type, educational qualification, occupation and socioeconomic status were recorded. The socioeconomic status was calculated according to Modified Kuppuswamy Scale, 2023.¹³

Assessment of Bone Mineral Density (BMD): Dual-energy X-ray absorptiometry (DXA) is stated as the "gold standard" for measuring bone mineral density (BMD).¹⁴ Due to its cost and limited accessibility, it is unavailable and not much used in Indian population based osteoporosis studies.¹⁵ The commonly used bone mineral density assessment tool is the calcaneal quantitative ultrasound (QUS) as it is non-invasive and simple. Hence the calcaneal quantitative ultra-sound was used to measure the BMD of the selected subjects. It measures the peripheral BMD.

Research states that the peripheral BMD can be correlated with the central BMD.¹⁶ The BMD scores of the subjects were classified according to the standards given by the World Health Organization (WHO). The T score ≤ 2.5 was categorized as osteoporosis, -2.5 and -1 osteopenia and ≥ 1 was considered as normal.¹

Assessment of Nutritional Status using Pre-Validated Tool: The Mini Nutritional Assessment (MNA) short form was used to determine the nutritional status of the middle aged adults. The mini nutritional assessment is a validated self-report questionnaire technique designed to assess malnutrition¹⁷ among elderly people. It was demonstrated to be reliable when utilized in some research to evaluate the diet of older maintenance hemodialysis patients.^{18,19}

Results and Discussion

The results and discussions pertaining to the study is projected in the section. The Table-1 projects the number of study participants according to the gender.

Table –1: Age and Gender of the Study Population

Age group	Male (N = 54)	Female (N= 66)
50 – 54 (N=71)	30	41
55 – 59 (N=49)	24	25

Age and gender have a significant impact on bone health. Reduced strength, micro-architecture degeneration, low bone mass and mineral density and cumulative micro damages are all signs of poor bone quality that commonly characterize ageing. According to age, subjects were categorized into two groups and highest number of the subjects belonged to 50 - 54 years and majority were female (N=66).

Table-2: Anthropometric measurements of the middle aged adults

Variable	Male (N= 54)			Female (N=66)		
	Mini	Max	Mean & SD	Mini	Max	Mean ± SD
Age (Years)	50	59	53 ± 3.16	50	59	53.5 ± 3.03
Weight (Kg)	51	92	68.8 ± 8.4	49	86	62.6 ± 7.8
Height (cm)	154	175	163.5 ± 6.7	148	170	156.5 ± 4.5
BMI (Kg/m ²)	20.3	33.8	25.8 ± 3.0	20.7	35.8	25.5 ± 2.9
Waist Circumference (cm)	74	89	80.69 ± 3.4	72	90.0	83.4 ± 4.3
Hip Circumference (cm)	79.8	112	99.4 ± 4.1	91	120	107.4 ± 6.63
WHR	0.75	0.88	0.80 ± 0.02	0.69	0.88	0.77 ± 0.04
MUAC (cm)	25	31	28.4 ± 1.6	23	35	28.5 ± 2.1
MCC (cm)	27.8	36	31.8 ± 1.7	20	39	31.0 ± 2.7
BMD (T Score)	-2.9	1	-1.37 ± 0.98	-3	1	-1.26 ± 1.10

*BMI - Body Mass Index, WHR - Waist-Hip Ratio, MUAC- Mid Upper Arm Circumference, MCC – Mid Calf Circumference, BMD- Bone Mineral Density

The measured anthropometrics of the study population is projected along with BMD in the table-II. A gender specific minimal and maximal value of the variables is projected as mean and standard deviation (SD). The association between BMD and different anthropometric measurements was studied.

Table-3: Bone mineral density of the middle aged adults according to age group and gender

Age Group (Years) / Gender		Normal T Score (≥ 1)		Osteopenia T Score (-1 to -2.5)		Osteoporosis T Score (≤ -2.5)		Total	
		No	%	No	%	No	%	No	%
50 – 54 (N=71)	Male	10	14.08	20	28.1	0	0	30	42.2
	Female	12	16.90	25	35.2	4	5.63	41	57.7
55 – 59 (N=49)	Male	1	2.04	19	38.7	4	8.16	24	48.9
	Female	6	12.24	15	30.6	4	8.16	25	51.0

The Table-III projects the Bone Mineral Density (BMD) of the Middle Aged Adults according to Age Group and Gender. In comparison to the different category of BMD, the number of osteopenia was higher than osteoporosis and normal BMD. The highest prevalence (38.7%) of osteopenia was observed among male at the age group of 55-59 years. This may be due to decrease in bone mass after the age of 30.^{20, 21} The causes of low peak bone mass include genetics, nutritional disorders, endocrine disorders, chronic diseases of childhood or adolescence, medications, and idiopathic factors.²²

Table-4: Correlation between Age and Bone Mineral Density

Variable	Mean \pm Std Dev	Pearson’s Correlation	P value
Age vs. BMD	-1.3181 \pm 1.04	-266	0.003

Pearson’s Correlation between the age and the Bone Mineral Density (BMD) was determined and the results are projected in Table-4. A significant negative correlation was obtained as the value was -266. Hence it is understood that an increase in age leads to decrease in BMD. The Aging process along with certain intrinsic and extrinsic factors precipitates decreased bone mass and leads to fractures.²³

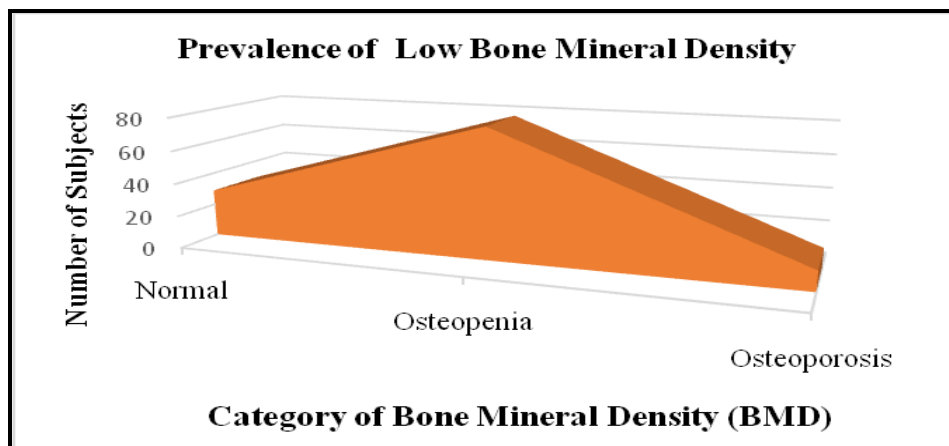


Figure -1: The Rising Prevalence of Osteopenia among Middle Aged Adults

The figure -1 projects the rising prevalence of osteoporosis irrespective of gender among the middle aged adults of 50 - 59 years. About 65% of the subjects had osteopenia, 10 % osteoporosis and 4.16% had a normal Bone Mineral Density. The middle aged adults are the population who enter into old age initially or claimed as the future elderly

population.^{24, 10} The osteopenia often progresses to osteoporosis. Research states the progression of normal BMD to Osteopenia / Osteoporosis was 35.7% and the inter-querterile time of progression from normal to osteopenia was 6.7 years. The research also highlights that 23.7% of the subjects progressed from osteopenia to osteoporosis in 2.7 years.²⁵

Table -5: Association between Body Mass Index (BMI) and Bone Mineral Density (BMD)

Variables	Normal T Score (≥1)	Osteopenia T Score (-1 to -2.5)	Osteoporosis T Score (≤2.5)	Statistic	Sig
Normal range (18.5 to 22.9 kg/m ²)	7	15	0	$\chi^2= 46.085$	0.000*
Overweight (23-24.9 kg/m ²)	18	19	0		
Obese I (25- 29.9 kg/m ²)	4	41	7		
Obese II (>30 kg/m ²)	0	4	5		

Pearson’s χ^2 was used to find the association between BMI and BMD in Table-IV. And the results highlight a significant association between the variables as the p value was 0.000*. The highest prevalence of osteopenia was observed among the class-I obese followed by overweight subjects.

Table -6 : Bone Mineral Density and Waist-Hip Ratio of the Middle Aged Adults

Variables		Normal T Score (≥1)	Osteopenia T Score (-1 to -2.5)	Osteoporosis T Score (≤2.5)
Waist-Hip Ratio (WHR)	No Risk	14	53	4
	At Risk	15	26	8

The waist-hip ratio is a measure of abdominal obesity. According to Table-V, No significant association was observed between the waist-hip ratio and Bone Mineral Density. Whereas correlation between the variables was present. In accordance to this reports that, an increase in waist-hip ratio decreases bone mineral density in post-menopausal females.²⁶

Table -7: Nutritional Status of the Middle Aged Adults

Mini Nutritional Assessment				
	50-54 Years (N= 71)		55-59 Years (N= 49)	
	No.	%	No.	%
Normal Nutritional Status	30	42.5	14	28.5
At risk of malnutrition	36	50.7	31	63.26
Malnourished	5	7	4	8.16

The Table - VI projects the nutritional status in accordance to age group of the selected middle aged adults. In both age groups highest numbers of the subjects were at risk of malnutrition, which was 63.26% and 50.7% among 50-54 years and 55-59 years respectively. The numbers of malnourished subjects were less in comparison to the subjects with normal nutritional status.

Table –8: Nutritional Status and Bone Health of the Middle Aged Adults

Nutritional Status	Normal T Score (≥1) (N=29)		Osteopenia T Score (-1 to -2.5) (N=79)		Osteoporosis T Score (≤2.5) (N=12)	
	No.	%	No.	%	No.	%
Normal Nutritional Status	14	48.27	30	37.97	0	0
At risk of malnutrition	14	48.27	44	55.69	9	75
Malnourished	1	3.44	5	6.32	3	25

The nutritional status and bone health of the Middle Aged Adults is projected in Table-VII. It is highlighted that the subjects with risk of malnutrition are mostly osteopenics (55.69%) and osteoporotics (75%). The poor nutritional status may be due to poor consumption of nutritious foods, malabsorption, aging, poverty or lack of awareness.

Table -9: Association of Bone Mineral Density and Socio-demographic Profile

Variables		N = 120		Normal T Score (≥1)		Osteopenia T Score (-1 to -2.5)		Osteoporosis T Score (≤ 2.5)		χ2	Sig
		No.	%	No.	%	No.	%	No.	%		
Gender	Male	54	45	11	20.37	39	72.22	4	7.40	1.854	0.396
	Female	66	55	18	27.27	40	60.60	8	12.12		
Marital Status	Married	109	90.8	26	23.85	73	66.97	10	9.17	8.481	0.75
	Unmarried	5	4.16	3	60	2	40	0	0		
	Widowed	6	5	0	0	4	66.6	2	33.3		
Type of Family	Nuclear	107	89.16	25	23.36	72	67.28	10	9.34	1.004	0.605
	Joint	13	10.8	4	30.7	7	53.84	2	15.38		
Religion	Hindu	101	84.16	24	23.7	67	66.33	10	9.90	1.230	0.873
	Christian	14	11.66	4	28.5	8	57.14	2	14.2		
	Muslim	5	4.16	1	20	4	80	0	0		
Socio Economic Status	Upper	0	0	0	0	0	0	0	0	4.8650	0.561
	Upper Middle	7	5.83	2	28.5	4	57.14	1	14.28		
	Lower Middle	34	28.33	12	35.29	19	55.88	3	8.82		
	Upper Lower	72	60.0	14	19.44	50	69.4	8	11.11		
	Lower	7	5.83	1	14.28	6	85.7	0	0		
Educational Status	Professional degree	0	0	0	0	0	0	0	0	9.001	0.342
	Graduation	0	0	0	0	0	0	0	0		
	Intermediate or diploma	1	0.83	0	0	1	100	0	0		
	High School	6	5	3	50	3	50	0	0		
	Middle School	23	19.16	9	39.13	13	56.5	1	4.34		
	Primary School	66	55	14	21.2	45	68.18	7	10.60		
	Illiterate	24	20	3	12.5	17	70.83	4	16.6		
Occupation*	I	17	14.16	2	11.76	12	70.5	3	17.6	19.435	0.35
	II	19	15.83	2	10.52	17	89.4	0	0.0		
	III	4	3.33	0	0.0	4	21.05	0	0.0		
	IV	13	10.83	2	0.0	10	76.92	1	7.69		
	V	31	25.83	8	25.8	17	4.8	6	19.35		
	VI	36	30	15	41.66	19	52.77	2	5.55		

**I-Technicians Associate Professionals; II- Skilled worker, shop and market sales workers; III-Skilled Agricultural and Fishery Workers; IV- Plant and Machine Operators and Assemblers-Elementary Occupation; VI-Unemployed*

The Table-8 projects the association of bone mineral density and socio-demographic profile. The Pearson's chi-square shows no significant association between the socio-demographics and Bone Mineral Density. In consideration to gender the number of female subjects (N=66) was high. Majority of the middle aged adults were married (90.8%) and belonged to a nuclear family (89.16%). In religion the number of Hindus were high (N=101). Majority of the subjects belonged to the upper lower (60%) socio economic category. Highest number of subjects had an educational qualification of primary school (55%) and was unemployed (30%).

Conclusion

Lower BMD levels indicate osteopenia, underlying disturbance in the micro-architecture of bone and osteoporosis. The pathology of bone mineralization is quantitative, not a qualitative measure. Aging, diet, hormone drugs, environment and several other factors influence the bone density of a person. The peak bone mass is to be attained by the age of 30 and failure to its attainment also leads to osteoporosis. It is essential to study the prevalence of adults who are to be the elderly population in future. The prevalence study aids to analyze the risk factors and determine the preventive measures for effective management of the condition.

Acknowledgement: The investigators acknowledge the funding granted by Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore for the conduct of study.

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Citation: Tinu D, Radha R. Prevalence of Low Bone Mineral Density among Middle Aged Adults of 50-59 years and its Association with Different Risk Factors. *Indian J Prev Soc Med*, 2024; 55 (3): 182-189.