

# **Prevalence of osteoporosis and associated factors among people aged 50 years and older in the Madhesh province of Nepal: a community-based cross-sectional study**

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# Outlines

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# Background and objective

- **Osteoporosis** is loss of **bone mass and microarchitectural deterioration** of bone tissue
- **Causes:** age, sex, ethnicity, race, heredity, lifestyle, dietary habits , chronic use of glucocorticoids and major depression
- A global public health problem because of its high global prevalence(18.3%), Asia has highest [1]
- A silent disease as no manifestation until the fracture occurs
- Most common sites of fracture: femoral neck, hip, lumbar and thoracic spine and distal wrist
- It is a clinical issue, worsening the quality of life

# Background (Conti....)

- Limited studies are available in the hospital setting
- Prevalence of osteoporosis is **37.3%** in adults aged 50 years and older through (Dual Energy X-ray Absorptiometry) **DXA** method [2]
- The prevalence of osteoporosis is **60.5%** in people aged 60 years and older according to the quantitative ultrasound (**QUS**) method [3]
- No studies in community setting in Nepal
- Therefore, this study aimed to determine the **risk of osteoporosis and its association with daily calcium intake and lifestyle behaviour** in a community setting

# Methodology

- **Study design:** a community-based cross-sectional analytical approach
- **Study area:** *Saptari* district of *Madhesh* Province, Nepal
- **Study population:** Individuals aged 50 years and older having an active life and good cognitive status
- **Sampling:** multistage cluster sampling;
  - Selection of **four urban** and **four rural** municipalities through **convenience sampling**
  - Selection of any **one wards from the selected urban and rural municipalities** through the **lottery method**
  - Subsequently, selection **50 households** from each designated ward.
  - Recruitment of **one eligible participant** from each household through **simple random sampling technique**

# Sample size:

- By using **single proportional formula**,

$$\text{Sample size } (n_0) = Z^2 \times p (1-p)/d^2$$

Where

Z= Confidence interval at 95% (standard value of 1.96)

P= Prevalence of osteoporosis (37.3% ) [2]

d= Margin of error (5%)

Now

$$\begin{aligned} n_0 &= 1.96^2 \times 0.373 \times (1-0.373) / (0.05)^2 \\ &= \mathbf{359} \end{aligned}$$

With **10 %** non-response rate, the total sample size= **395**.

# Data collection technique

- Face to face interview with an structured questionnaire based on published paper [2] and modified on our context
- Socio-demographic information, anthropometric information (BMI), 24-hour recall (calcium intake), food frequency questionnaire of calcium-rich food for one week and lifestyle behaviour-related factors
- **A pilot study among 10 % of the total sample size in the neighbouring municipality**

# Study Variables

## Predictor variables

- **Socio-demographic information** (Age, sex, educational level, ethnicities, religion and occupation)
- **Body Mass Index (BMI)= Weight in Kg/Height in meter square**
- **Lifestyle behaviour-related factors** (smoking, alcohol intake and physical activity)
- **Dietary calcium intake**



# Outcome variables

- **Risk of osteoporosis:** Low risk, intermediate risk and high risk
- Osteoporosis Self-assessment tools for Asians (**OSTA**) = *(Weight in Kg- Age in years) X 0.9* [4, 5]
- For men, low risk  $>-1$ , intermediate risk  $-1$  to  $-6$  and high risk  $<-6$ .
- For women, low risk  $>-1$ , intermediate risk  $-1$  to  $-4$  and high risk  $<-4$ .
- For the sake of analysis: **Osteoporosis** (high risk) and **No osteoporosis** (low and intermediate risk)

# Data Management and Analysis

- Data entry in EpiData version 3.2 and analysis on the basis of the intention-to treat (ITT) approach using Stata/MP version 14.1
- Estimation of incidence of osteoporosis by **descriptive statistical** tools
- Chi-square test for the associations of the socio-demographic profile, lifestyle behavior and dietary calcium intake with osteoporosis
- Binary logistic regression analysis was applied for multivariate analysis
- Applied Mann–Whitney U test to associate the prevalence of osteoporosis with the median daily dietary calcium intake score.
- All probability values  $p < 0.05$  were considered as statistical significant

# Ethical consideration

- Ethical approval from the Ethical Review Board (ERB) of the Nepal Health Research Council (**NHRC**), Kathmandu, Nepal (*Reference number: 2909, approved on 02/05/2023*)
- Written informed consent from participants

# Result Table1. Socio-demographic characteristics (n=395)

Variables	Frequency (n)	Percentage (%)
<b>Socio demographic characteristics</b>		
<b>Gender</b>		
Male	219	55.4
Female	176	44.6
<b>Age</b>		
50-59	185	46.8
60 and above	210	53.2
<b>Age in years, mean ± SD</b>	<b>61.78 ±9.44</b>	
<b>Education</b>		
No formal education	256	64.8
Primary education	92	23.3
SLC or above	47	11.9
<b>Ethnicity</b>		
<i>Tharu</i>	221	55.9
<i>Dalit</i>	142	35.9
Others	32	8.1
<b>Religion</b>		
Hindu	368	93.2
Non-Hindu	27	6.8
<b>Occupation</b>		
Farming	368	98.2
Others	7	1.8
<b>Anthropometric measurement and osteoporosis status</b>		
<b>Height in cm, mean ± SD</b>	<b>124 ± 28.52</b>	
<b>Weight in kg, mean ± SD</b>	<b>27 ± 12.26</b>	
<b>BMI, mean ± SD</b>	<b>21.17 ± 3.76</b>	
<b>BMI categories</b>		
Normal	230	58.2
Underweight	102	25.8
Overweight/obese	63	15.9
<b>OSTA value</b>	<b>-1.93 ± 3.671</b>	
<b>OSTA classification</b>		
No Risk	153	38.7
Moderate Risk	154	39.0
High Risk	88	<b>22.3</b>
<b>OSTA value</b>		
Male	-0.99 (3.77)	
Female	-3.09 (3.17)	
<b>Daily Calcium intake in mg</b>		
360.87 ± 362.39		
<b>Calcium intake</b>		
Sufficient	112	28.3
Not sufficient	283	71.7
<b>Behaviour related factors</b>		
<b>Physical activity</b>		
No	37	9.4
Yes	358	90.6
<b>Smoking</b>		
No	255	64.5
Yes	140	35.5
<b>Alcohol</b>		
No	320	81.1
Yes	75	18.9

**Table 2. Associations of osteoporosis risk with socio-demographic, anthropometric and lifestyle behaviors (n=395)**

Variables	Risk of osteoporosis		Bivariate analysis		Multivariable analysis	
	No Number (%)	Yes Number (%)	cOR (95% CI)	P value <sup>1</sup>	aOR (95% CI)	P value <sup>2</sup>
<b>Socio-demographic characteristics</b>						
<b>Gender</b>						
Male	108 (49.3)	111 (50.9)	Ref		Ref	
Female	45 (25.7)	131 (74.3)	2.83 (1.84-4.35)	<0.001*	5.18(2.10-12.75)	<0.001*
<b>Age</b>						
50-59	129 (69.7)	56 (30.3)	Ref		Ref	
60 and above	24 (11.4)	186 (88.7)	17.85 (10.55-30.27)	<0.001*	32.49 (14.02-75.28)	<0.001*
<b>Education</b>						
No formal education	63 (24.6)	193 (75.4)	10.02 (4.81-20.86)	<0.001*	1.79 (0.57-5.54)	0.311
Primary education	54 (58.8)	38 (41.2)	2.30 (1.04-5.08)	0.039*	1.26 (0.40-3.90)	0.301
SLC or above	36 (76.6)	11 (23.4)	Ref		Ref	
<b>Ethnicity</b>						
Tharu	97 (43.9)	124 (56.1)	Ref		Ref	
Dalit	36 (25.4)	106 (74.6)	2.30 (1.45-3.56)	<0.001*	1.86 (0.86-4.02)	0.112
Others	20 (62.5)	12 (37.5)	0.46 (0.21-1.00)	0.052	0.06 (0.003-10.35)	0.301
<b>Religion</b>						
Hindu	138 (37.5)	230 (62.5)	2.08 (0.94-4.58)	0.068		
Non-Hindu	15 (55.5)	12 (44.5)	Ref			

# Table2 (Conti...)

<b>Occupation</b>						
Farming	149 (38.4)	239 (61.6)	2.13 (0.47-9.68)	0.324		
Others	4 (57.1)	3 (42.8)	Ref			
<b>Anthropometric and behaviour related factors</b>						
<b>BMI categories</b>						
Normal	90 (39.1)	140 (60.9)	Ref		Ref	
Underweight	6 (5.8)	96 (94.1)	10.28 (4.32-24.45)	<0.001*	13.42 (4.58-39.30)	<0.001*
Overweight/obese	57 (90.5)	6 (9.5)	0.06 (0.02-0.16)	<0.001*	0.04 (0.01-0.15)	<0.001*
<b>Calcium intake</b>						
Sufficient	57 (50.9)	55 (49.1)	Ref		Ref	
Not sufficient	96 (33.9)	187 (66.1)	2.01 (1.29-3.14)	0.002*	1.72 (0.85-3.55)	0.127
<b>Behaviour related factors</b>						
<b>Physical activity</b>						
No	13 (35.1)	24 (64.9)	1.18 (0.58-2.40)	0.637		
Yes	140 (39.1)	218 (60.9)	Ref			
<b>Smoking</b>						
No	101 (39.6)	154 (60.4)	Ref			
Yes	52 (37.1)	88 (62.9)	1.10 (0.72-1.69)	0.631		
<b>Alcohol</b>						
No	105 (32.8)	215 (67.2)	Ref		Ref	
Yes	48 (64.0)	27 (36.0)	0.27 (0.16-0.46)	<0.001*	1.02 (0.37-2.80)	0.955
<sup>1</sup> Unadjusted model: <i>cOR</i> : Crude Odds Ratio; <sup>2</sup> Adjusted model: <i>aOR</i> : Adjusted odds ratio; In the multivariable analysis, only significant variables from the bivariate model were adjusted.						

**Table 3. Association of daily dietary calcium intake with osteoporosis**

	Daily dietary calcium intake		
Osteoporosis	Frequency	Median (IQR) <sup>a</sup>	P value
No	153	300 (115, 450)	<0.001 *
Yes	242	225 (100, 386)	

<sup>a</sup> Mann–Whitney U test

# Discussion

## Prevalence of osteoporosis

- Prevalence of osteoporosis was found as 22.4%, consistent with other studies
- Lower prevalence compared to DXA method
- Sensitivity and specificity of OSTA compared to that of DXA is moderate [6]
- Reliable findings as most of the participants were older, and the sensitivity of the OSTA increases with age



# Associations of osteoporosis with different factors

## With socio-demographic status:

- **Age:** Prevalence increases with advancing age
- **Sex:** higher prevalence in female than male *because females start losing bone at an earlier age and at a faster rate than men*
- **Educational status:** higher the education level, lower the incidence of osteoporosis in bivariate analysis
- **Ethnicity:** *Tharus* had lower prevalence due to typical type of food consumption like fresh water snail (called *Ghonghi* in local language)
- **Religion and occupation:** No association

# Osteoporosis and calcium intake

- **Dietary calcium** consumption was negatively associated with **osteoporosis**
- Calcium helps to reduce the enlargement of the appendicular bones, which occurs due to the aging process, and slows bone turnover, reducing the number of active bone remodelling sites [7]
- Calcium reduces the parathyroid hormone secretion, which is the causing factor for bone turnover [8, 9]

# Osteoporosis and BMI

- Higher the BMI, lower the chance of **osteoporosis**
- High body weight experiences a large mechanical load on the bone increasing the bone mass to accommodate this load, hence prevents from osteoporosis [10]
- Underweight leads to vitamin D and protein deficiency; vitamin D deficiency impairs the mineralization of the collagenous matrix (colloids), and low protein intake affects bone remodelling by reducing the production of insulin-like growth factor [11]

# Osteoporosis and lifestyle behaviour

- **Physical activity:** physical activity was not associated with osteoporosis
- However exercise is related to osteoporosis
- Exercise is a planned, structured, repetitive activity that purposefully focuses on the improvement or maintenance of one or more components of physical activity, while physical activity simply refers to the daily activities of life that require the expenditure of energy
- Lack of exercise or physical fitness activity among the participants in this study.

# Smoking

- No association between osteoporosis and smoking was found in this study
- Less than half (44.6%) were female and smoking influences reproductive hormones in females, causing natural menopause an average of 1-2 years earlier; hence, females develop osteoporosis, which is not common among males [12]
- Effect of smoking on bone is cumulative & dose dependent
- Other confounding variables might have contributed to the lack of a significant association

# Alcohol consumption and osteoporosis

- Bivariate analysis revealed **protective effect of alcohol intake**
- It is dose dependent and Chronic alcoholism results in a disturbed level of vitamin D metabolism and the development of a low level of serum 25-hydroxyvitamin D [25(OH)D], ultimately leading to osteoporosis [13]

# Conclusion

- High prevalence of osteoporosis in *Madhesh* Province due to the combined effects of low BMI (underweight) and inadequate daily calcium intake
- Necessity of nutritional counselling services to encourage people to consume sufficient calcium-rich food and adopt appropriate lifestyle behaviours to maintain healthy body weight so that osteoporosis and osteoporotic fractures can be prevented
- Further research can explore the impact of socioeconomic status and medical comorbidities on a large scale.

# Reference

1. Salari N, Ghasemi H, Mohammadi L, Behzadi M hasan, Rabieenia E, Shohaimi S, et al. The global prevalence of osteoporosis in the world: a comprehensive systematic review and meta-analysis. *J Orthop Surg Res.* 2021;16(1).
2. Chaudhary NK, Timilsena MN, Sunuwar DR et al. Association of Lifestyle and Food Consumption with Bone Mineral Density among People Aged 50 Years and above Attending the Hospitals of Kathmandu, Nepal. *J Osteoporos.* 2019;2019.
3. Shrestha S, Dahal S, Bhandari P, Bajracharya S, Marasini A. Prevalence of osteoporosis among adults in a tertiary care hospital: A descriptive cross-sectional study. *J Nepal Med Assoc.* 2019;57(220):396–400.
4. Koh LKH, Ben Sedrine W, Torralba TP, Kung A, Fujiwara S, Chan SP, et al. A simple tool to identify Asian women at increased risk of osteoporosis. *Osteoporos Int.* 2001;12(8):699–705.
5. Muslim D, Mohd E, Sallehudin A, Tengku Muzaffar T, Ezane A. Performance of Osteoporosis Self-assessment Tool for Asian (OSTA) for Primary Osteoporosis in Post-menopausal Malay Women. *Malaysian Orthop J.* 2012;6(1):35–9.
6. Wang P, Abdin E, Shafie S, Chong SA, Vaingankar JA, Subramaniam M. Estimation of prevalence of osteoporosis using osta and its correlation with sociodemographic factors, disability and comorbidities. *Int J Environ Res Public Health.* 2019;16(13).
7. Warensjö E, Byberg L, Melhus H, Gedeberg R, Mallmin H, Wolk A, et al. Dietary calcium intake and risk of fracture and osteoporosis: Prospective longitudinal cohort study. *Bmj.* 2011;342(7808).
8. Reid IR. Should We Prescribe Calcium Supplements For Osteoporosis Prevention? *J Bone Metab.* 2014;21(1):2
9. Augustine M, Horwitz MJ. Parathyroid hormone and parathyroid hormone-related protein analogs as therapies for osteoporosis. *Curr Osteoporos Rep.* 2013;11(4):400–6.
10. Mazocco L, Chagas P. Association between body mass index and osteoporosis in women from northwestern Rio Grande do Sul. *Rev Bras Reumatol (English Ed.)* 2017;57(4):299–305.
11. Han S, Park J, Nah S, Jang HD, Han K, Hong JY. Severity of underweight and risk of fracture: a Korean nationwide population-based cohort study. *Sci Rep.* 2022;12(1).
12. Ward KD, Klesges RC. A meta-analysis of the effects of cigarette smoking on bone mineral density. *Calcif Tissue Int.* 2001;68(5):259–70.
13. Lee K. Sex-specific relationships between alcohol consumption and vitamin D levels: The Korea National Health and Nutrition Examination Survey 2009. *Nutr Res Pract.* 2012;6(1):86–90.



# Presenter's information



- Radiographer officer at Nepal Orthopaedic Hospital, Jorpati, Kathmandu since 24 years
- Involved in teaching/learning activities in 10+2 (Mass communication and Journalism) since 15 years, BN/BSc Nursing (Nutrition and Dietetics) and MSc. Nutrition and Dietetics (Thesis supervisor) at CAFODAT college.
- Involved in clinical research and published around 10 academic papers in international pubmed indexed journals.

**Thank you**

**and**

**Welcome for feedback**