

# Dietary calcium intake and physical activity levels among urban South Indian postmenopausal women

Jeffrey Pradeep Raj<sup>1</sup>, Anu Mary Oommen<sup>2</sup>, Thomas V. Paul<sup>3</sup>

<sup>1</sup>CSI Hospital, Erode, <sup>2</sup>Departments of Community Medicine and <sup>3</sup>Endocrinology, Christian Medical College, Vellore, Tamil Nadu, India

## ABSTRACT

**Introduction:** Calcium is the most abundant mineral in our body with varied functions and its dietary deficiency leads to osteoporosis, besides playing a significant role in the pathogenesis of other diseases. The data regarding dietary calcium intake (DCI) among postmenopausal women in urban areas of South India is limited. **Objectives:** This study was aimed to assess DCI and physical activity among postmenopausal women. The risk factors for a low intake of dietary calcium were also assessed. **Materials and Methods:** A cross-sectional study was done among 106 postmenopausal women selected by systematic random sampling from the city of Erode, Tamil Nadu, India. DCI and physical activity were measured using validated questionnaires. **Results:** The mean DCI was  $632.72 \pm 28.23$  mg/day. The proportion of women consuming less than 800 mg/day of dietary calcium was 74.5%. Only 10.4% of the women studied (11 out of 106) were on calcium supplements while 55% had low physical activity. A low knowledge score [adjusted odds ratio (OR): 5.17; 95% confidence interval (CI): 1.31-20.42] and a low socioeconomic status (SES) score of the family (adjusted OR: 4.00; 95% CI: 1.32-12.11) were significantly associated with low DCI after adjusting the age, dietary preferences, and educational and occupational statuses. **Conclusions:** DCI was below the Recommended Dietary Allowance (RDA) and the majority of postmenopausal women were physically inactive, indicating the need for better education regarding DCI and the need for calcium supplements and physical activity, all of which can contribute to the prevention of the consequences of osteoporosis.

**Keywords:** Dietary calcium intake, physical activity, postmenopausal, supplements

## Introduction

Calcium is the most abundant mineral found in our body maintaining the strength and structure of bones and teeth, along with certain critical metabolic functions,<sup>[1]</sup> the serum level of which is tightly controlled by the parathyroid hormone, calcitonin, and vitamin D.<sup>[2,3]</sup> Dietary deficiency of calcium leads to osteoporosis<sup>[3,4]</sup> and calcium also plays a significant role in the pathogenesis of other diseases like metabolic syndrome<sup>[5,6]</sup> and cancer.<sup>[7]</sup> Various studies have shown that good dietary calcium and moderately increased physical activity, if maintained for long-term periods, considerably improve the mechanical competence of the skeletal system.<sup>[8,9]</sup> The data regarding dietary calcium intake (DCI) among postmenopausal women in urban South India is limited, with studies in Chennai, semiurban Vellore, and Tirupati revealing inadequate calcium intake in postmenopausal women and the general population.<sup>[4,10-12]</sup>

Therefore, this study was aimed to assess DCI and physical activity levels among urban South Indian postmenopausal women and to assess the risk factors of low DCI.

## Materials and Methods

This was a cross-sectional study done during July 2014 in the city of Erode, Tamil Nadu, India. All postmenopausal women (amenorrhea for at least 12 months) residing in Tamil Nadu for the last 5 years were eligible for this study. The exclusion criteria included surgical menopause, age above 75 years, bedridden state, comorbidities such as cancer with metastasis, chronic kidney disease, and thyroid disorders (disorders known to cause deficiency for which supplementation would have been a part of treatment). Assuming a standard deviation (SD) of 190 mg/day for calcium intake,<sup>[4]</sup> absolute precision (d) of 40 mg/day, and a design effect (DE) of 1.2, the sample size calculated using the formula  $N = (4 SD^2/d^2) \cdot DE$  was 108. Cluster sampling followed by systematic random sampling was done in the selected clusters (wards). Out of the 60 wards, 10 corporation wards were randomly chosen and equal numbers

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10.4103/2249-4863.161355

**Address for correspondence:** Dr. Jeffrey Pradeep Raj,  
49, Madhavi Street, Teachers' Colony, Erode - 638 011,  
Tamil Nadu, India.  
E-mail: jpraj.m07@gmail.com

of participants were chosen from each ward. One street was randomly chosen from the list of streets in each ward provided by the corporation authorities. From the center of the chosen street in each ward, every *n*th house (*n* was any number between two and five, chosen by picking a monetary note and noting the last digit of the number at the lower part of the rupee note) was approached and the women who fulfilled the criteria were enrolled in the study.

The DCI was measured using a validated calcium food frequency questionnaire<sup>[11]</sup> and the physical activity levels were calculated using the International Physical Activity Questionnaire (IPAQ).<sup>[13]</sup> Collection of the sociodemographic data and assessment of knowledge regarding DCI were done using a pretested questionnaire. The knowledge questionnaire included various questions on food items rich in calcium, their recommended dietary allowance, and their clinical significance. Data entry was done in Epi Info™ Version 7. Publisher: CDC, Atlanta, GA, USA, 2011 and analysis was performed with IBM SPSS Statistics for Windows, Version 20.0 (Publisher: IBM Corp. Armonk, NY, USA, 2011) Ethical approval was obtained from the Institutional Review Board and Ethics Committee of the tertiary institution supporting the study. Written informed consent was obtained from all the participants and after completing the study questionnaire, all of them were taught about calcium-rich food and the importance of adequate intake of calcium in diet.

## Results

The mean age of the study population was 58 years (range: 40-74 years). The majority of women (67%) were housewives or were currently unemployed and almost half (46.2%) were illiterate [Table 1].

The mean DCI was  $632.72 \pm 28.23$  mg/day (SD: 290.61), ranging 134.56-1424.98 mg/day. Of the 106 women in the study, 79 (74.5%; 95% CI: 70.3-78.7%) were taking less than 800 mg/day of dietary calcium. Of the remaining women who were taking adequate amounts of dietary calcium, only 11 (10.4%) were on calcium supplements.

Also, majority of the study participants (54.70%; 95% CI: 45.22-64.18%) were classified as having low physical activity, whereas 25.5% (95% CI: 17.2-33.8%) and 19.8% (95% CI: 12.21-27.39%) had high and moderate physical activity, respectively. Of all the women, 41% had low physical activity, along with low DCI.

Poor knowledge regarding DCI (OR: 6.083; 95% CI: 1.92-19.30) and a low Kuppaswamy's socioeconomic status (SES) score for the family (OR: 3.77; 95% CI: 1.51-9.38) were significantly associated with a low DCI [Table 2]. Other risk factors like age, employment, occupational status, and dietary habits were not significantly associated with a low DCI. Logistic regression analysis also revealed that a low knowledge score

**Table 1: Demographic characteristics of the study population (n=106)**

	Frequency (%)
Age (years)	
30-44	10 (9.2)
45-59	46 (43.4)
60-74	50 (47.2)
Education	
Illiterate	49 (46.2)
Primary school	12 (11.3)
Middle school	12 (11.3)
High school	19 (17.9)
Post-school diploma	1 (0.9)
Graduate	13 (12.3)
Profession	0 (0)
Occupation	
Unemployed	71 (67.0)
Unskilled	22 (20.8)
Clerk, farmer, shop owner	1 (0.9)
Semiprofessional	8 (7.5)
Professional	0 (0)
Family SES (modified Kuppaswamy class) <sup>[25]</sup>	
Upper	10 (9.4)
Upper middle	28 (26.4)
Lower middle	17 (16.0)
Upper lower	40 (37.7)
Lower	11 (10.4)

SES: Socioeconomic status

(adjusted OR: 5.17, 95% CI 1.31-20.42) and a low SES score for the family (adjusted OR: 4.00; 95% CI: 1.32-12.11) were significant risk factors after adjusting the other factors.

## Discussion

The mean DCI among our study participants assessed using a validated food frequency questionnaire was  $632.72 \pm 28.23$  mg/day, which was well below the Recommended Dietary Allowance (RDA) of 800 mg/day<sup>[14]</sup> as determined by the Indian Council of Medical Research for postmenopausal women, with 74.5% of the women having a low DCI. This was in accordance with similar studies done in Tamil Nadu and Andhra Pradesh among different population groups.<sup>[15]</sup> While the mean calcium intake in this study from Erode was similar to the mean intake of  $707.14 \pm 107.96$  mg/day among adults aged 40-70 years in Chennai,<sup>[11]</sup> the mean dietary intake in Tirupati and Vellore was much lower. Postmenopausal women from the semiurban region of Vellore district interviewed using a 24-h dietary recall had a mean DCI of 398.76 mg/day (SD: 190.13 mg).<sup>[14]</sup> Studies done among the women of Tirupati in Andhra Pradesh also revealed a low DCI of  $306 \pm 2$  mg/day among urban women,  $262 \pm 3$  mg/day among rural women,<sup>[10]</sup> and  $323 \pm 66$  mg/day among postmenopausal women.<sup>[12]</sup>

Besides osteoporosis,<sup>[3,4]</sup> studies have shown that low DCI may be a previously unrecognized risk factor for the development of

Table 2: Risk factors for low DCI

Risk factor	DCI < 800 mg/day (%)	DCI ≥ 800 mg/day (%)	Total (n=106) (%)	OR (95% CI)	Adjusted OR (95% CI)
Knowledge					
Score of 5 or less	73 (80.22)	18 (19.78)	91 (100)	6.083 (1.92-19.30)	5.17 (1.31-20.42)
Score of 6 and more	6 (40.0)	9 (60.0)	15 (100)		
Family SES					
Kuppuswamy's score of 15 or less	57 (83.82)	11 (16.18)	68 (100)	3.77 (1.51-9.38)	4.00 (1.32-12.11)
Kuppuswamy's score of 16 or more	22 (57.89)	16 (42.11)	38 (100)		
Age					
59 years or more (median)	40 (80.0)	10 (20.0)	50 (100)	1.744 (0.71-4.28)	1.784 (0.64-4.96)
Up to 59 years	39 (69.6)	17 (30.4)	56 (100)		
Participant's educational status					
Up to 10 <sup>th</sup> standard	72 (77.42)	21 (22.58)	93 (100)	2.94 (0.89-9.70)	0.620 (0.12-3.33)
Above 10 <sup>th</sup> standard	7 (53.85)	6 (46.15)	13 (100)		
Participant's employment status					
Unemployed	55 (77.5)	16 (22.5)	71 (100)	1.58 (0.64-3.90)	1.561 (0.48-5.08)
Employed	24 (68.6)	11 (31.4)	35 (100)		
Diet					
Vegetarian	6 (54.5)	5 (45.5)	11 (100)	0.36 (0.10-1.30)	0.401 (0.08-1.95)
Nonvegetarian	73 (76.8)	22 (23.2)	95 (100)		

DCI: Dietary calcium intake; OR: Odds ratio; CI: Confidence interval

hypertension,<sup>[16,17]</sup> insulin resistance, worsening glycemic status, and increasing body weight.<sup>[18,19]</sup> Large numbers of normal and neoplastic human cells like human renal, gastric, colon, mammary, ovarian, prostate, and pancreatic duct cells are sensitive to calcium concentration<sup>[7]</sup> and improving calcium and vitamin D intake substantially reduces the risk of all forms of cancer in postmenopausal women.<sup>[20]</sup> The majority of women (74.5%) studied, both in our study and in similar studies conducted in India, had a poor intake of calcium in their diet and are therefore, at an increased risk for these conditions. Though calcium supplementation in elderly postmenopausal women has proven benefits for bone density,<sup>[21]</sup> only 11 women (10.4%) were taking calcium supplements.

Multiple studies have shown that poor DCI, along with low physical activity are the two major risk determinants for osteoporosis and fracture.<sup>[22-24]</sup> In this study, 41% of postmenopausal urban women had both these risk factors together. Health education on the importance of calcium in the diet and knowledge on calcium-rich dietary sources would go a long way in improving the current scenario, as those with poor knowledge and a lower SES were at a four to five times higher risk for consuming low calcium in their diet when compared to the others. Therefore, every physician ought to advise a calcium-rich diet to all postmenopausal women, especially those from the lower SES.

One of the important limitations of this study was that the DCI was assessed using a food frequency questionnaire that is not an objective method as compared to dietary record analysis or measures of body calcium. Moreover, as it solely depends on the previous week's diet, it may not be representative of the long-term dietary habits of the participant.

## Conclusion

In conclusion, the average DCI of  $632.72 \pm 28.23$  mg/day was below the RDA for calcium, with 74.5% of postmenopausal women in this South Indian city having dietary deficiency of calcium. This supports the need for increased education regarding dietary calcium and need for calcium supplements during the perimenopausal period in order to prevent morbidity and mortality associated with osteoporosis and other disorders associated with calcium deficiency.

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**How to cite this article:** Raj JP, Oommen AM, Paul TV. Dietary calcium intake and physical activity levels among urban South Indian postmenopausal women. *J Family Med Prim Care* 2015;4:461-4.

**Source of Support:** Christian Medical College and Hospital, Vellore, Tamil Nadu, India; CSI Hospital, Erode, Tamil Nadu, India.  
**Conflict of Interest:** None declared.