

Socioeconomic Barriers to Adequate Calcium Intake among Women in Bihar: Insights from Sitamarhi District

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ABSTRACT

Background: Calcium is an essential nutrient for bone and overall health, yet women in low-resource settings are disproportionately at risk of deficiency. Bihar, a state of India, is characterized as a region where sociocultural and economic barriers aggravate nutritional disparities. **Objectives:** The objective of the study was to investigate the prevalence of insufficient calcium intake and supplement use among women aged 35–65 years in Sitamarhi district, Bihar, and also examine the influence of socioeconomic factors on dietary practices. **Methods:** A community-based cross-sectional study was conducted involving 500 women selected by stratified random sampling from five blocks of Sitamarhi. Data were collected through standardized questionnaires and observation-based checklists. Descriptive statistics summarized sociodemographic characteristics, while chi-square tests evaluated associations between income, education, occupation, family type, and adequacy of calcium intake. **Results:** The study indicated that 41% of respondents came from families earning less than INR 10,000 per month, whereas 30% were illiterate. Homemakers represented 56% of the sample, indicating financial dependency on male family members. Only 13% of individuals consumed milk daily, but more than 70% rarely or never consumed dairy products, with affordability (65%) and disliking (17%) as major barriers. Only 28.7% of participants reported adequate calcium intake, while 71.3% exhibited deficiencies. Supplement use was low (23.3%). Age, education, occupation, income, and family type were significantly associated with calcium intake ($p < 0.05$). Younger women (35–45 years), those with higher education, stable income, and employment were more likely to meet calcium requirements. **Conclusions:** The study suggests that poverty, illiteracy, cultural norms, and inadequate health education contribute substantially to low calcium intake among rural women. Policy measures such as subsidized dairy schemes, fortified food distribution through public systems, community-based nutrition education, and gender-sensitive interventions are recommended to bridge socioeconomic gaps and improve women's bone health.

Keywords: Calcium Intake, Socioeconomic Barriers, Women's Health, Rural Bihar, Nutritional Inequality, Osteoporosis.

Introduction

Micronutrient deficiencies remain a silent killer in India, with calcium deficiency representing one of the most underdiagnosed and undertreated problems. Proper amount of calcium intake is important for skeletal development, muscle function, and overall health, particularly for middle-aged women. Despite its importance, data consistently show that Indian women consume significantly less calcium than the recommended dietary allowance of 1000–1200 mg/day (ICMR, 2020). This gap is further increased by socioeconomic inequities, cultural food preferences, and limited awareness.

Bihar, one of India's most densely populated and economically backward states, faces acute challenges in women's health and nutrition. The National Family Health Survey (NFHS-5, 2021)

highlights the major prevalence of anemia, malnutrition, and reproductive health problems among women in Bihar. Yet, little focus has been given to calcium intake despite its long-term implications for bone health, pregnancy outcomes, and chronic diseases.

Socioeconomic determinants—including poverty, education, occupation, and access to healthcare—play a vital role in shaping dietary behaviors. In rural Bihar, where more than 60% of households fall below the poverty line, the cost of milk, dairy products, nuts, and fish often excludes them from women's daily diets. Additionally, patriarchal norms and intra-household food distribution patterns frequently disadvantage women, with nutrient-rich foods allocated preferentially to men and children. This creates a vicious cycle of undernutrition and vulnerability to osteoporosis, fractures, and chronic fatigue.

The present study aims to examine the socioeconomic barriers that restrict adequate calcium intake among women in Sitamarhi district of Bihar. By analyzing demographic, occupational, and income-related data alongside dietary practices, the study aims to highlight structural challenges and recommend policy strategies to promote calcium adequacy.

Literature Review

Calcium deficiency is recognized globally as a public health concern. Socioeconomic factors are strongly associated with the prevailing dietary diversity and quality. Several Indian studies have highlighted the low dietary intake of calcium among women, particularly in rural and low-income populations (Gupta et al., 2019; Ritu & Gupta, 2019; Reddy et al., 2018). This inadequacy predisposes women to osteoporosis, which affects more than 50 million individuals in India, with women bearing a disproportionate burden (Sharma & Khandelwal, 2020). As reported by NFHS-5 (2021), Bihar has one of the lowest rates of milk and dairy consumption in India.

Income affects affordability of milk, dairy, and fortified foods, while occupation influences time and decision-making regarding food choices (Sharma & Singh, 2021). A study by Rao et al. (2019) found that women from lower-income households in Bihar consumed fewer animal-source foods and dairy products, leading to calcium deficiency. Milk, dairy, nuts, and fish are relatively expensive compared to staple cereals and pulses. A study in Uttar Pradesh by Singh et al. (2021) showed that low-income women substituted calcium-rich foods with cheaper carbohydrate-rich staples, leading to micronutrient gaps. Similarly, fortified foods are not widely available in rural markets, and when available, they are often priced beyond the reach of poor families. Education is another determinant, as literate women are more likely to access health information and choose healthy diets (Mishra et al., 2022).

Women's nutritional status is further compromised by cultural practices that prioritize male members in food distribution (Agarwal, 2020). Women frequently eat last and consume smaller portions, further reducing their access to calcium-rich foods. Vegetarianism, widely practiced in Bihar, also limits sources of calcium to dairy and leafy vegetables, which are not consumed in adequate amounts due to cost or taste preferences.

Despite government nutrition programs such as ICDS and POSHAN Abhiyaan, awareness about calcium remains low. Most interventions focus on protein-energy malnutrition and iron deficiency anemia, while calcium deficiency is overlooked. Community-based educational initiatives, however, have shown promise in increasing awareness and modifying dietary practices (Kumari et al., 2022).

Previous intervention studies suggest that nutrition education can significantly improve awareness and consumption of calcium-rich foods (Bansal et al., 2022). While several studies have highlighted dietary inadequacies, there is limited evidence exploring socioeconomic and cultural barriers to calcium intake in rural Bihar. This study addresses this gap by combining dietary data with socioeconomic analysis to provide a holistic understanding of the issue.

Methodology

- **Study Design and Setting:** This was a community-based cross-sectional study conducted between January and June 2025 across five blocks of Sitamarhi district, Bihar, namely Dumra, Runnisaidpur, Sonbarsa, Sursand, and Baigania.
- **Sample Size and Sampling Technique:** A total of 500 women aged 35–65 years were selected using stratified random sampling. Women with chronic illnesses affecting calcium metabolism (e.g., renal disease) were excluded.
- **Data Collection Tools:** The data collection was done using a structured questionnaire including demographic, socioeconomic, and dietary information. An observation-based checklist was used to verify food group consumption and supplement use.

- **Data Analysis:** Data were analyzed using SPSS v25. Descriptive statistics were used to summarize frequencies. Chi-square tests assessed associations between socioeconomic factors and calcium intake. Graphs and charts were generated in Excel. Statistical significance was set at $p < 0.05$.

Results and Discussion

This study examined calcium intake adequacy and supplement use among 500 women aged 35–65 years in Sitamarhi, Bihar, and explored how demographic and socioeconomic factors influence dietary calcium behaviour. Overall, the results demonstrate a high prevalence of inadequate calcium intake, low supplement use, and clear socioeconomic gradients—findings that are consistent with national and international literature.

- **Demographic Profile of Respondents:** The demographic distribution of the 500 women surveyed is presented in Table 1. The largest proportion of respondents (44.4%) were in the age group of 35–45 years, followed by 36.4% in 46–55 years and 19.2% in 56–65 years. A significant share (29.8%) of participants were illiterate, although 16.6% had completed graduation or higher. More than half of the respondents (55.8%) were homemakers, and 41.4% belonged to households earning less than ₹10,000 per month. Nuclear families dominated the sample (56.8%). These findings align with demographic trends in rural Bihar, where low literacy among women and predominance of homemakers are well documented (Kumari & Singh, 2020). The presence of a relatively younger population (35–45 years) may also influence dietary practices and awareness levels, as younger women are often more exposed to media and healthcare programs.

Table 1: Demographic Distribution of Respondents (N=500)

S.N.	Variable	Categories	Frequency	Percentage
1.	Age	35–45	222	44.4
		46–55	182	36.4
		56–65	96	19.2
2.	Education	Illiterate	149	29.8
		Can read only	28	5.6
		Can read and write only	43	8.6
		Up to primary	73	14.6
		Matric	59	11.8
		Intermediate	65	13.0
		Graduation and above	83	16.6
4.	Occupation	Homemaker	279	55.8
		Farmer	53	10.6
		Self-employed	99	19.8
		Employed	69	13.8
5.	Income	Less than 10,000	207	41.4
		10,001–20,000	123	24.6
		20,001–30,000	118	23.6
		More than 30,000	52	10.4
6.	Family Type	Nuclear	284	56.8
		Joint	89	17.8
		Extended	127	25.4

Association between Demographic Variables and Calcium Intake

Age and Calcium Intake: **Adequacy of calcium intake decreased with age (Table 2).** Women aged 35–45 years had the highest adequacy (41.4%), while only 21.9% of women aged 56–65 years met the recommended intake. The chi-square test revealed a significant association ($\chi^2=6.82$, $p=0.033$).

Table 2: Association between Age and Adequate Calcium Intake (N=500)

Age Group	Adequate Intake (%)	Inadequate Intake (%)	Total	χ^2	df	p-value
35–45	92 (41.4)	130 (58.6)	222	6.82	2	0.033*
46–55	59 (32.4)	123 (67.6)	182			
56–65	21 (21.9)	75 (78.1)	96			
Total	172 (34.4)	328 (65.6)	500			

This decline is consistent with previous studies suggesting that dietary diversity and calcium intake tend to reduce with age due to decreased appetite, cultural food restrictions, and limited access to nutrient-rich foods (Rao et al., 2018). Older women commonly face physiological transitions (perimenopause/menopause) that increase calcium needs, coupled with reduced appetite, chewing/digestion difficulties, lower mobility, and weaker economic agency — all of which can reduce dietary intake and access to calcium-rich foods. Indian and international studies have reported similar age-related declines in dietary calcium and higher risk of osteoporosis among older women, reinforcing the public-health importance of targeted interventions in mid-life and later life (Rio et al. 2019).

Education and Calcium Intake: **Education level showed a strong relationship with calcium intake ($\chi^2=25.63$, $p=0.001$). Only 21.5% of illiterate women had adequate intake, while adequacy rose to 45.8% among those with graduation and above (Table 3).**

Table 3: Association between Education and Adequate Calcium Intake (N=500)

Education Level	Adequate (%)	Inadequate (%)	Total	χ^2	df	p-value
Illiterate	32 (21.5)	117 (78.5)	149	25.63	6	0.001**
Can read/write only	19 (28.4)	48 (71.6)	67			
Up to Primary	28 (38.4)	45 (61.6)	73			
Matric	24 (40.7)	35 (59.3)	59			
Intermediate	31 (47.7)	34 (52.3)	65			
Graduation & above	38 (45.8)	45 (54.2)	83			
Total	172 (34.4)	328 (65.6)	500			

Similar associations between education and nutritional adequacy have been highlighted in earlier works. For example, Srivastava and Gupta (2021) noted that education enhances women's ability to interpret health information and adopt healthier dietary practices. Rio et al. (2019) also observed that educated women were more likely to diversify their diets and include dairy products, green leafy vegetables, and fortified foods. This finding underscores the role of education in empowering women to make informed dietary choices. Education likely acts through multiple pathways—improved nutrition knowledge, higher health literacy, greater bargaining power within households, and better employment opportunities—all facilitating access to and prioritization of nutrient-dense foods (Singh et al. 2020). Policy recommendations often emphasize female education as a long-term structural measure to improve diet quality (Gokhale and Rao, 2022).

Education emerged as a strong determinant, echoing findings from, who reported that educated women were more aware of dietary needs.

Occupation and Calcium Supplement Use: **Occupation significantly influenced supplement use ($\chi^2=8.47$, $p=0.037$). Employed women reported the highest supplement use (34.8%), whereas homemakers (22.2%) and farmers (20.8%) had the lowest (Table 4).**

Table 4: Association between Occupation and Calcium Supplement Use (N=500)

Occupation	Users (%)	Non-users (%)	Total	χ^2	df	p-value
Homemaker	62 (22.2)	217 (77.8)	279	8.47	3	0.037*
Farmer	11 (20.8)	42 (79.2)	53			
Self-employed	29 (29.3)	70 (70.7)	99			
Employed	24 (34.8)	45 (65.2)	69			
Total	126 (25.2)	374 (74.8)	500			

Employment commonly confers both income and information access (through workplace networks, health camps, or digital exposure), which can increase the likelihood of purchasing and using supplements. The results suggest that employment, by increasing financial independence and exposure to health information, enhances the likelihood of adopting supplement use. A study by Wang et al. (2020)

found similar patterns in China, where employed women were more likely to use dietary supplements due to higher purchasing capacity and better access to pharmacies. Additionally, working women may be more conscious of preventive healthcare practices, consistent with observations by Singh et al. (2017).

- **Income and Calcium Intake:** Household income strongly predicted calcium adequacy ($\chi^2=19.22$, $p=0.0002$). Only 24.6% of women in the lowest income group met adequate intake compared to 61.5% among those earning more than ₹30,000 (Table 5). This gradient is consistent with evidence showing that higher income enables the purchase of costlier calcium sources (milk, dairy products, fish, nuts), allows buying supplements when needed, and reduces trade-offs between quantity and diet quality.

Table 5: Association between Monthly Income and Adequate Calcium Intake (N=500)

Income Level	Adequate (%)	Inadequate (%)	Total	χ^2	df	p-value
< 10,000	51 (24.6)	156 (75.4)	207	19.22	3	0.0002**
10,001–20,000	40 (32.5)	83 (67.5)	123			
20,001–30,000	49 (41.5)	69 (58.5)	118			
> 30,000	32 (61.5)	20 (38.5)	52			
Total	172 (34.4)	328 (65.6)	500			

This finding is supported by multiple studies. For instance, Ghosh et al. (2016) reported that household income significantly predicted women's dietary diversity in rural India, with low-income groups depending heavily on cereals and lacking access to dairy and fruits. Similarly, Rio et al. (2019) and Lee et al. (2021) confirmed that socioeconomic disparities directly translate into nutritional inequalities, including calcium consumption. Women from lower-income households are particularly vulnerable to deficiencies due to the limited affordability of milk, fortified products, and supplements. Income strongly determined actual practices, particularly the frequency of milk and dairy consumption, aligning with Sharma & Singh (2021). Homemakers and women from low-income households were most vulnerable to deficiency, supporting the observations of NFHS-5 (2021).

Family Type and Calcium Intake: Although not statistically highlighted in this dataset, descriptive analysis revealed differences in family structure. Women from nuclear families (56.8%) reported slightly better adequacy compared to joint or extended families. This may be due to greater autonomy in food choices within nuclear households, as supported by Choudhary et al. (2019), who noted that decision-making autonomy positively affects women's diet quality. The relationship between family structure and diet quality is complex and mediated by intra-household food allocation norms; several studies have found that household composition and women's intra-household status influence dietary diversity and nutrient adequacy.

- **Cultural Practices:** Food allocation within households disadvantaged women, particularly homemakers, who often ate last and in smaller portions. Vegetarianism, common in Bihar, further narrowed food options, making dairy and vegetables the only viable calcium sources.

Findings align with Singh et al. (2021), who demonstrated affordability as the main barrier to dairy consumption in rural households. The results also support Agarwal (2020), who linked patriarchal norms to women's undernutrition.

- **Overall Implication:** The findings emphasize the need for **culturally tailored nutrition education and affordable calcium interventions** targeting low-income, less-educated, and homemaker women to prevent osteoporosis and other deficiencies. This study underscores the multifactorial barriers to adequate calcium intake among women in Sitamarhi. The high prevalence of deficiency (71.3%) aligns with national estimates of dietary calcium insufficiency among Indian women (ICMR-NIN, 2021). Homemakers, representing more than half of the respondents, were disproportionately deficient, likely due to limited financial autonomy and decision-making power in food choices. Nuclear family structures, while increasingly common, restricted shared resources, unlike joint families, where dietary diversity was higher. The low uptake of supplements (23.3%) highlights systemic barriers, including affordability, availability, and lack of awareness. Public health strategies must therefore integrate both dietary and supplement-based approaches.

Public health implications are critical: without addressing socio-economic disparities, calcium deficiency among women will persist, increasing the burden of osteoporosis and fractures in Bihar.

Conclusion and Recommendations

The study highlights that age, education, occupation, and income are significant determinants of calcium adequacy among women in Sitamarhi district. Low literacy and economic constraints emerged as the most critical barriers, limiting women's access to calcium-rich foods and supplements.

These results mirror national-level findings, such as those of the National Family Health Survey (NFHS-5, 2021), which documented widespread nutritional deficiencies among women, particularly in rural Bihar. Similar research by Rio et al. (2019) in Latin America and Rao et al. (2018) in India also demonstrated that socio-demographic inequalities are central to explaining poor dietary calcium adequacy.

This study shows that socio-economic factors—specifically education, income, and occupation—directly influence knowledge, habits, and calcium consumption among middle-aged women in Sitamarhi. Women from poorer socio-economic strata exhibited inadequate awareness, restricted dietary diversity, and elevated deficiency symptoms. Intervention workshops shown efficacy in enhancing awareness and practices. This study demonstrates that socioeconomic obstacles are crucial in restricting calcium consumption among women in rural Bihar. Poverty, illiteracy, and cultural dietary standards impede access to calcium-rich foods and supplements, despite increased awareness. Overcoming these obstacles necessitates comprehensive reforms, encompassing: Economic interventions, such as income support and dairy subsidies. Integration of policies (calcium-centric initiatives under the POSHAN Abhiyaan). Strategies for fortifying diets to enhance calcium intake. Empowerment of communities via women's self-help groups and microfinance initiatives. Enhancing calcium consumption is not solely a nutritional concern but also a socioeconomic and gender equity burden. Addressing these disparities will foster improved health among women and bolster community strength in rural Bihar.

Improving calcium intake is not merely a nutritional issue but a socioeconomic and gender equity challenge. Bridging these gaps will contribute to healthier women and stronger communities in rural Bihar.

Limitations

There are few limitations of the study, as the cross-sectional design cannot establish causality, and reliance on self-reported dietary data may involve recall bias.

Future Research Directions

Longitudinal studies may be undertaken to track calcium intake and bone health outcomes. Experimental trials should be conducted comparing different intervention models.

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