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Original Research Article

A comparative study on the association of chronic energy deficiency with sociodemographic factors among rural and urban populations of the ethnic Punjabi community in Amritsar district

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Abstract

Background: Chronic energy deficiency (CED) refers to a sustained state where an individual's caloric and/or nutrient intake consistently falls short of their energy needs. This prolonged imbalance leads to a negative energy status and is commonly linked to poor nutritional intake, potentially resulting in multiple adverse health outcomes. CED continues to be a significant public health issue in India, especially in populations with socioeconomic disparities. Punjab being considered the food bowel of India, there are many studies conducted on obesity and diabetes in this area but very few studies are available on CED, so this study was planned to this aspect in ethnic Punjabi population.
Materials and Methods: A community-based cross-sectional study was conducted among adults aged 20–60 years, selected from rural and urban areas of the Amritsar district using stratified random sampling. Anthropometric data were collected to calculate Body Mass Index (BMI), with CED defined as BMI <18.5 kg/m². Sociodemographic variables such as age, gender, caste, religion, education, occupation, and income were recorded. Comparative analysis was done using Fisher's Exact test where applicable.
Results: The prevalence of CED was found to be higher in rural participants compared to their urban counterparts. Statistically significant associations were observed between CED and factors such as age, education, and income levels in both populations.
Conclusion: Sociodemographic determinants significantly influence the distribution of CED in the ethnic Punjabi population. Targeted public health strategies are needed to address rural-urban disparities in nutritional outcomes.

Keywords: Chronic energy deficiency, Body mass index, World health organization.

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1. Introduction

Nowadays, low- and middle-income countries are currently attacked by a double burden of malnutrition as well as nutritionally deficient foods. Chronic Energy Deficiency (CED) is characterized by inadequate dietary energy intake leading to undernutrition and remains a significant public health challenge in India.[1] CED is defined as a "steady state" where an individual is in energy balance, i.e. the energy intake equals the energy expenditure, despite the low body weight and low body energy stores.[2] It is most commonly identified using Body Mass Index (BMI), with a value below 18.5 kg/m² indicative of chronic undernutrition.[3]

CED disproportionately affects adults in low-resource settings, especially those involved in labor-intensive occupations with limited access to a nutritionally adequate diet.[4] CED leads to low productivity among adults and is related to heightened morbidity and mortality.[5]

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The prevalence of CED is strongly associated with sociodemographic factors such as age, gender, religion, caste, education, occupation, income, and place of residence. Rural populations face a higher burden due to constrained access to healthcare, persistent food insecurity, and socioeconomic disadvantages.[6]

Understanding the burden and determinants of CED is essential for developing targeted nutritional interventions and public health policies. This study aims to assess the prevalence of CED and its association with key sociodemographic variables among the rural and urban ethnic Punjabi populations of Amritsar district. The goal is to identify high-risk groups and provide evidence-based recommendations to guide effective and equitable policy responses.

2. Material and Methods

This study was a community-based cross-sectional study carried out in areas falling under Urban Health Training Centre and Rural Health Training Centre of SGRD Institute of Medical Sciences & Research, Amritsar, Punjab, India. Only ethnic Punjabi adults in age group of 20–60 years were considered for study residing in rural and urban localities of the district. A simple random stratified sampling technique was used. Stratification was based on rural and urban residence, and participants were randomly selected within each stratum to ensure proportional representation. According to existing literature, the prevalence of CED in India is estimated to be approximately 32.2%, according to average of NFHS II and NFHS III.[7,8] Using this prevalence and a Z-value of 5 to achieve a high level of confidence and precision, the minimum required sample size was calculated to be 336. However, to accommodate operational feasibility and potential non-response or data loss, a total of 400 individuals were included in the study comprising 200 participants each from rural and urban areas. Data was collected using pretested structured questionnaire to obtain sociodemographic information including age, gender, education, occupation, and income etc. Anthropometric Measurements were done to obtain height and weight of the participants. Body Mass Index (BMI) was calculated using the standard formula:

$$BMI = \frac{Weight(kg)}{Height(m)^2}$$

BMI was categorized based on the World Health Organization (WHO) guidelines[3].

Severe CED (Grade III):	BMI < 16.0 kg/m²
Moderate CED (Grade II):	BMI 16.0–16.9 kg/m²
Mild CED (Grade I):	BMI 17.0–18.4 kg/m²
Normal:	BMI 18.5–24.9 kg/m²
Overweight/Obese:	BMI ≥ 25.0 kg/m²

Preliminary data was recorded using Microsoft Excel and statistical analysis was conducted using SPSS version 26. Descriptive and inferential statistics were applied, using Fisher's Exact test. A p-value of <0.05 was considered statistically significant.[10]

3. Results

Table 1 shows a comparative analysis of 400 study participants (200 rural and 200 urban) which was conducted to evaluate key sociodemographic parameters. The urban population had a higher representation in the 50–60 age group, while the rural population was more evenly distributed among the younger age brackets. Female participants were slightly more predominant in rural areas, whereas males were more prevalent in urban areas. Upper caste individuals were more concentrated in urban areas, while Scheduled Castes had a higher representation in rural areas. A notable disparity was observed in literacy levels. Illiteracy was much higher in rural areas, while urban areas showed higher proportions of graduates and postgraduates. Urban residents reported higher incomes. A significant portion of the rural population (27%) fell into the lowest income bracket, while nearly two-thirds of the urban population earned above ₹6,750. Sikh and Hindu communities dominated both rural and urban populations, with a higher proportion of Sikhs in rural areas. This sociodemographic breakdown reveals significant differences between rural and urban populations in terms of education, income, and caste structure. These variations can have important implications when analyzing health indicators such as CED or access to healthcare services.

Table 2 shows analysis of a total of 400 individuals (200 rural and 200 urban) who were assessed for Body Mass Index (BMI) and categorized as per WHO classification to identify the prevalence of CED and other nutritional statuses. The combined prevalence of CED (CED I, II, III) was, 44 individuals (22.0%) in rural settings and 32 individuals (16.0%) from urban settings. This indicates a higher burden of CED in the rural population, with CED III (severe) being more prominent in rural areas (4.5% vs 2.0%). Normal BMI was found to be 49% in rural settings and 52.5% in urban settings. A slightly higher proportion of overweight individuals was observed in the urban population, which is often associated with changing dietary patterns and sedentary lifestyles. This shows that CED is more prevalent in rural areas, reflecting possible nutritional deprivation or chronic undernutrition. Urban populations show a dual burden with both overweight and undernutrition coexisting.

Table 3 shows that on comparing age with CED, significant association was found in both rural (0.0003) and urban (0.0458) areas. So, age is strongly associated with positivity rates in both settings. Young adults (20–29) show higher +ve rates. On comparing sex with CED, significant association was found in urban areas only (0.0354). This may possibly reflect exposure, access, or behavioral differences. On comparing religion with CED, significant association was

found in both rural (0.0319) and urban (0.0025) settings. Highly significant results were found on comparing caste with CED, (0.0001) in rural areas and (0.0006) in urban areas. CED in Punjab was found to be more in Hindu population in both rural 27 and 20 individuals. According to religion and caste, significance in both may reflect socio-cultural factors affecting exposure or health-seeking behavior. On comparing education with CED, the results were found to be statistically highly significant, (0.0000) in rural areas and (0.0000) in urban areas. Similarly, comparing income with CED, the results were also found to be highly significant (0.0000) in rural areas while (0.0004) in urban areas. Education & Income shows very strong significance, suggesting a powerful influence of socio-economic status on health outcomes.

Table 1: Showing frequencies according to the socio-demographic characteristics

Factor	Parameter	Rural		Urban		Total
		Frequency (n=200)	Percentage (%)	Frequency (n=200)	Percentage (%)	
Age (in years)	20-29	56	28.0	50	25.0	106
	30-39	49	24.5	32	16.0	81
	40-49	36	18.0	40	20.0	76
	50-60	59	29.5	78	39.0	137
Total		200	100	200	100	400
Sex	Male	86	43.0	97	48.5	183
	Female	114	57.0	103	51.5	217
Total		200	100	200	100	400
Caste	Upper Caste	95	47.5	126	63.0	221
	Scheduled Caste	86	43.0	56	28.0	142
	Scheduled Tribe	02	1.0	00	0.0	02
	Backward Class	17	8.5	18	9.0	35
Total		200	100	200	100	400
Education Status	Illiterate	78	39.0	30	15.0	108
	Primary School	18	9.0	25	12.5	43
	Middle School	28	14.0	41	12.5	69
	High School	44	22.0	41	20.5	85
	Graduate	26	13.0	46	23.0	72
	Postgraduate	06	3.0	17	8.5	23
Total		200	100	200	100	400
Income	>13500	29	14.5	58	29.0	87
	6750-13499	45	22.5	77	38.5	122
	5050-6749	32	16.0	32	16.0	64
	3375-5049	40	20.0	27	13.5	67
	2025-3374	54	27.0	06	3.0	60
Total		200	100	200	100	400
Religion	Sikh	104	52.0	61	30.5	165
	Hindu	87	43.5	61	30.5	148
	Muslim	06	3.0	08	4.0	14
	Christian	03	1.5	03	1.5	06
Total		200	100	200	100	400

Table 2: Showing prevalence of CED in rural and urban areas

Category	BMI	Area			
		Rural		Urban	
		Number	Frequency	Number	Frequency
CED III	<16.0	9	4.5	4	2.0
CED II	16-16.9	7	3.5	6	3.0
CED I	17-18.4	28	14.0	22	11.0
Normal	18.5-24.9	98	49.0	105	52.5
Overweight	>25	58	29.0	63	31.5

Table 3: Cross table showing association of sociodemographic factors with CED in both rural and urban areas

Parameter	Factor	CED Present (+ve) or Absent (-ve)							
		Rural				Urban			
		+ ve	- ve	Total		+ ve	- ve	Total	
Age	20-29	21(37.5%)	35(62.5%)	56	Fisher Exact = 0.0003	13(26.0%)	37(74.0%)	50	Fisher Exact = 0.003
	30-39	15(30.6%)	34(69.4%)	49		10(31.3%)	22(68.7%)	32	
	40-49	02(5.6%)	34(94.4%)	36		08(20.0%)	32(80.0%)	40	
	50-60	06(10.2%)	53(89.8%)	59		01(1.3%)	77(98.7%)	78	
	Total	44(22.0%)	156(78.0%)	200		32(16.0%)	168(84.0%)	200	
Sex	Male	18(20.9%)	68(79.1%)	86	Fisher Exact =0.4676	06(6.2%)	91(93.8%)	97	Fisher Exact =0.0354
	Female	26(22.8%)	88(77.2%)	114		26(25.2%)	77(74.8%)	103	
	Total	44(22.0%)	156(78.0%)	200		32(16.0%)	168(84.0%)	200	
Religion	Sikh	15(14.4%)	89(85.6%)	104	Fisher Exact =0.0319	07(11.5%)	54(88.5%)	61	Fisher Exact =0.0025
	Hindu	27(31.0%)	60(69.0%)	87		20(15.6%)	108(84.4%)	128	
	Muslim	01(16.7%)	05(83.3%)	06		05(62.5%)	03(37.5%)	08	
	Christian	01(33.3%)	02(66.7%)	03		00(0.0%)	03(37.5%)	03	
	Total	44(22.0%)	156(78.0%)	200		32(16.0%)	168(84.0%)	200	
Caste	Upper Caste	04(4.2%)	91(95.8%)	95	Fisher Exact =0.0001	05(4.0%)	121(96.0%)	126	Fisher Exact =0.0006
	Scheduled Caste	36(41.9%)	52(58.1%)	86		23(41.1%)	33(58.9%)	56	
	Backward Caste	04(23.5%)	13(76.5%)	17		04(22.2%)	14(77.8%)	18	
	Total	44	156	200		32	168	200	
Education	Illiterate	28(35.9%)	50(64.1%)	78	Fisher Exact =0.0000	09(30.0%)	21(70. 0%)	30	Fisher Exact =0.0000
	Primary School	15(83.3%)	03(16.7%)	18		17(68.0%)	08(32.0%)	25	
	Middle School	01(3.6%)	27(96.4%)	28		06(14.6%)	35(85.4%)	41	
	High School	00(0.0%)	44(100.0%)	44		00(0.0%)	41(100.0%)	41	
	Graduate	00(0.0%)	26(100.0%)	26		00(0.0%)	46(100.0%)	46	
	Postgraduate	00(0.0%)	06(100.0%)	06		00(0.0%)	17(100.0%)	17	
	Total	44(22.0%)	156(78.0%)	200		32(16.0%)	168(84.0%)	200	
Income	>13500	00(0.0%)	29(100.0%)	29	Fisher Exact =0.0000	02(2.6%)	56(96.6%)	58	Fisher Exact =0.0004
	6750-13499	00(0.0%)	45(100.0%)	45		02(2.6%)	75(97.4%)	77	
	5050-6749	00(0.0%)	32(100.0%)	32		05(15.6%)	27(84.4%)	32	
	3375-5049	13(32.5%)	27(67.5%)	40		20(74.1%)	07(25.9%)	27	
	2025-3374	31(57.4%)	23(42.6%)	54		03(50.0%)	03(50.0%)	06	
	Total	44(22.0%)	156(78.0%)	200		32(16.0%)	168(84.0%)	200	

4. Discussion

This study highlights a substantial burden of CED among the ethnic Punjabi population in the Amritsar district, with notable disparities between rural and urban areas which is in concordance with all NFHS studies. The overall prevalence of CED was higher in rural participants 44(22.0%) compared to urban participants 32(16.0%), which is consistent with national and regional findings indicating that undernutrition is more common in rural settings.[8]

The highest prevalence of CED was observed in the youngest age group (20–29 years), with 21 individuals (37.5%) affected in rural settings and 13 individuals (26.0%) in urban settings. The high prevalence of CED in this age group is concerning, as this stage is critical for productivity and reproduction. Undernutrition in early adulthood can impair work capacity, immunity, and maternal health. This disparity is likely driven by limited access to healthcare and nutrition services, lower income levels, and a greater prevalence of physically demanding occupations among rural residents.[11] This also may indicate nutritional neglect among young working adults, who may prioritize productivity over proper dietary intake, or lack awareness of their nutritional needs.[12] Similar age-related patterns have been observed in other Indian studies, underscoring the need for early, targeted preventive interventions.[13] The findings highlight the need for targeted nutritional support for young adults, especially in rural areas.

Sex was significantly associated with CED in urban areas, where females were more affected than males 26(22.8%) in rural and 26(25.2%) in urban settings. However, in our study, higher CED was seen in females residing in urban areas. This may be due to more closed net communities in rural areas, where the community shares resources among the downtrodden. This gender-based disparity may stem from unequal distribution of food within households, increased workload, or lower healthcare access for women. These findings also align with data from the National Family Health Survey (NFHS-5), which reported a higher prevalence of undernutrition among women than men.[14]

Caste and religion were also found to be significantly associated with CED in both settings. Individuals belonging to scheduled castes experienced higher levels of chronic undernutrition, 36(41.9%) in rural areas and 23(41.1%) in urban areas.[1,15,16] This reflects the impact of systemic social disadvantages on health outcomes.

The strongest associations in the study were observed with educational status and income level. Illiteracy and low income emerged as major predictors of CED, supporting the well-established correlation between socioeconomic disadvantages and poor nutritional outcomes.[17] These results suggest that interventions aimed at improving educational attainment and income generation could be powerful tools in addressing chronic undernutrition.

Interestingly, while urban participants exhibited a higher prevalence of overweight/obesity, rural populations continued to experience the dual burden of undernutrition. This reflects India's ongoing nutrition transition, where urbanization leads to greater access to energy-dense foods and sedentary lifestyles, contributing to the coexistence of both under- and overnutrition within the same communities.

5. Conclusion

This comparative study reveals a significant burden of Chronic Energy Deficiency (CED) among the ethnic Punjabi population in Amritsar district, with a higher prevalence in rural (22.0%) than in urban areas (16.0%). The results underscore that CED is not merely a nutritional issue but a complex interplay of sociodemographic determinants. Key factors significantly associated with CED include age, gender (in urban areas), education, income, caste, and religion.

Younger adults, individuals from disadvantaged caste groups, the illiterate, and those with low income emerged as the most vulnerable subgroups. The presence of CED alongside overweight individuals, particularly in urban settings, reflects the dual burden of malnutrition that is increasingly characteristic of transitioning populations like those in India.

Overall, this study emphasizes that addressing CED requires a multifactorial approach that tackles both immediate nutritional deficits and the broader social determinants of health.

6. Recommendations

Develop community-based nutrition programs tailored to high-risk groups such as young adults, women, Scheduled Caste populations, and individuals with low education or income. Promote awareness about balanced diets, the importance of nutrition across age groups, and locally available, nutrient-rich foods through culturally appropriate health education campaigns. Integrate poverty alleviation and skill-development programs with nutritional improvement strategies to address the root causes of CED.

7. Source of Funding

Self.

8. Conflict of Interest

Nil.

9. Ethical Clearance

Taken from Ethical Committee of Institution.

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