

Socioeconomic Dimensions of Nutritional Anthropometry among Village Households within 10 km radius of IB Thermal Power Station at Banaharpali of Odisha, India

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I. Introduction

Nutritional anthropometry is the scientific measurement of the physical dimensions and composition of the human body to assess growth, nutritional status, and overall health. It is one of the simplest, most reliable, non-invasive, and cost-effective methods for evaluating the nutritional well-being of individuals and communities. Anthropometric measurements provide valuable information about body size, body composition, growth patterns, and nutritional deficiencies or excesses. Thus, it acts as an indicator of Malnutrition. International organizations such as the World Health Organization (WHO), UNICEF, and the Food and Agriculture Organization (FAO) recommend anthropometric assessment as an essential component of nutritional surveillance.

II. Literature Review

Anthropometry as a measure of nutritional status

Nutritional anthropometry involves measuring human body dimensions—principally weight, height or length, Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), head circumference, skinfold thickness and waist circumference—to assess nutritional status, growth and health at the individual, household and population levels (World Health Organization, 2006). Its central value lies in providing an integrated indication of the cumulative effects of dietary intake, disease, infection, and socioeconomic and environmental circumstances (World Health Organization, 2006; Wells & Fewtrell, 2006). Compared with biochemical measurement, anthropometry is inexpensive, non-invasive and well suited to large-scale surveys, which explains its central place in nutritional surveillance (World Health Organization & UNICEF, 2019).

For children under five, the WHO Child Growth Standards (World Health Organization, 2006) provide internationally accepted references for length/height-for-age, weight-for-age, weight-for-length/height, BMI-for-age, head circumference and arm circumference. These were derived from the WHO Multicentre Growth Reference Study, which examined 8,440 healthy children across Brazil, Ghana, India, Norway, Oman and the United States and demonstrated that children from diverse populations achieve similar growth under favourable nutritional and environmental conditions (WHO Multicentre Growth Reference Study Group, 2006a, 2006b). This marked a deliberate shift away from earlier descriptive references, such as the NCHS/WHO reference, toward standards intended to reflect physiological growth potential rather than the performance of a particular reference population (de Onis et al. 2007a). A separate WHO growth reference was subsequently developed for school-age

children and adolescents aged 5–19 years (de Onis, et al., 2007b), while adult assessment continues to rely primarily on BMI-based criteria.

Anthropometric indicators and classification of malnutrition

Three classical indicators—height-for-age, weight-for-height and weight-for-age—are used internationally to estimate stunting, wasting and underweight respectively, expressed as standard-deviation (Z) scores against the WHO reference median (World Health Organization, 2006). A height-for-age Z-score below -2 SD denotes stunting and a weight-for-height Z-score below -2 SD denotes wasting, with severe forms conventionally identified below -3 SD (World Health Organization & UNICEF, 2009). Stunting carries particular analytical significance because it captures the cumulative effect of chronic undernutrition and recurrent infection in early life, whereas wasting reflects more recent or acute nutritional stress; underweight, combining elements of both, requires more cautious interpretation (Victora et al. 2010).

MUAC has gained prominence as a rapid, low-cost indicator of acute malnutrition among children aged 6–59 months, with WHO and UNICEF recommending a threshold below 115 mm for severe acute malnutrition and 115–125 mm for moderate acute malnutrition (World Health Organization & UNICEF, 2009). Because MUAC is independent of weight and height, it is especially valuable where accurate weighing or height measurement is difficult (Briend & Zimicki, 1986). Subsequent research clarifies that MUAC and weight-for-height identify overlapping but non-identical groups of malnourished children and are therefore best used in combination rather than as substitutes (Grellety & Golden, 2016; Myatt et al. 2006). Children who are concurrently wasted and stunted also face substantially elevated mortality risk compared with children affected by either condition alone (Myatt et al. 2012; Khara et al. 2018).

A further development is the recognition of a "double burden" of malnutrition, in which undernutrition and overweight/obesity coexist within the same population, household or even individual across the life course (Wells et al., 2021). Rapid dietary and socioeconomic transition in low- and middle-income countries means BMI-for-age, weight-for-height and waist circumference are now used alongside conventional undernutrition indicators to capture overweight and obesity as well as deficits (World Health Organization & UNICEF, 2009). Global estimates confirm that undernutrition remains widespread even as overweight prevalence rises, underlining the continuing relevance of both ends of the malnutrition spectrum (Black et al., 2013).

Nutritional anthropometry and socioeconomic/environmental determinants

A substantial body of evidence links anthropometric outcomes to socioeconomic and environmental circumstances, including household income, parental education, occupation, food security, sanitation, housing conditions and access to healthcare (Black et al., 2008). Because nutritional status integrates the effects of these influences, anthropometric indicators function as an indirect marker of cumulative socioeconomic and environmental disadvantage rather than a direct measure of any single cause (Harding et al. 2018). In children, chronic undernutrition typically reflects the combined effects of inadequate dietary intake, repeated infection and poor sanitation; in adults, underweight may signal food insecurity or chronic illness, while overweight may increasingly reflect dietary transition and reduced physical activity (Wells, 2012).

This determinant structure has direct implications for community-level comparative research: where anthropometric status differs systematically between geographical groups, such differences are likely to reflect underlying variation in income, employment, education, food availability, sanitation, healthcare access and environmental exposure rather than a single isolated cause (Black et al., 2008; World Health Organization, 2006). The literature therefore recommends that anthropometric indicators be interpreted jointly with socioeconomic and environmental variables rather than in isolation (World Health Organization & UNICEF, 2019).

Nutritional status of rural/tribal communities in India

Indian studies consistently report substantial anthropometric differences between rural and urban populations and across socioeconomic groups, with rural and tribal communities frequently facing greater constraints in access to food, healthcare, sanitation, education and livelihood opportunities (Debnath et al 2024). Bagavandas (2021), in a multilevel analysis of quality of life among a tribal population in India, incorporated health, economic, human-development, infrastructural and work-participation dimensions into a composite assessment; although concerned with quality of life rather than anthropometry alone, the study illustrates the close empirical relationship between nutritional/health status and broader socioeconomic circumstances in tribal settings. Similar community-based evidence from rural Punjab (Kasaudhan et al. 2024), among older adults in rural eastern India (Antony et al., 2024) and in north-eastern India (Engheppi et al., 2024) confirms that health and nutritional well-being in rural populations are shaped jointly by demographic, economic and infrastructural factors specific to the local setting.

For populations located around large industrial establishments, these existing rural–urban and inter-village disparities are compounded by variation in local economic opportunity, occupational pattern and access to infrastructure across otherwise similar villages (Harding et al., 2018). The nutritional status of such populations is therefore best interpreted as an outcome of the interaction between household resources, local food systems, employment, healthcare, sanitation and environmental conditions, rather than any single determinant.

Nutritional anthropometry as a component of Quality of Human Life

Because adequate nutrition underpins physical growth, cognitive development, work capacity, resistance to infection and general health, nutritional status is increasingly recognised as integral to human well-being and, by extension, to Quality of Human Life (Bagavandas, 2021). In children, chronic undernutrition can affect physical and cognitive development with consequences extending into adulthood, while in adults both undernutrition and obesity may be associated with reduced health and productivity (Wells et al., 2021). Nutritional anthropometry can accordingly be incorporated into a multidimensional Quality of Life Index as a health/nutritional dimension, drawing on indicators such as BMI, height-for-age, weight-for-age and weight-for-height Z-scores, MUAC, and the prevalence of underweight, overweight/obesity, stunting and wasting (World Health Organization, 2006; World Health Organization & UNICEF, 2009).

A methodological caution from this literature is that, in a mixed-age household survey, raw anthropometric measurements should not be combined across children and adults, since reference standards and interpretation differ by age group; age-specific indicators should instead be derived first and subsequently aggregated at the household, village or zone level (de Onis et al. 2007). A study conducted by Dey et al. (2025) on assessment of Nutritional Status of pre-school children attending Anganbadi Centre revealed a 70% of the children in normal of nutritional status.

Research gap and relevance to the present study

The reviewed literature establishes nutritional anthropometry as an economical, non-invasive and scientifically robust method of nutritional assessment, and demonstrates that anthropometric outcomes are shaped by socioeconomic status, education, occupation, food availability, health services, sanitation and environmental conditions. However, relatively limited research has integrated nutritional anthropometry into a broader Quality of Human Life framework for communities living around coal-based thermal power stations, particularly with simultaneous differentiation by spatial location (Core/Buffer) and CSR intervention status. The present study of communities around Ib Thermal Power Station addresses this gap by examining anthropometric indicators among Core and Buffer zone households, further differentiated by CSR and Non-CSR status, to investigate whether nutritional well-being varies with geographical proximity and exposure to community development interventions—while recognising that any such association must be interpreted cautiously, alongside the socioeconomic, health and demographic variables with which nutritional status is jointly determined (Black et al., 2008; Harding et al., 2018).

Common Anthropometric Measurements

Several standard measurements are used depending on the age and purpose of the assessment. Height (or Length) Height is measured in standing adults and children above two years of age, while recumbent length is measured in infants. It reflects long-term nutritional status and growth. Body Weight Body weight is the most commonly used anthropometric measurement. Changes in body weight reflect alterations in nutritional status, illness, or physiological conditions. Body Mass Index (BMI) BMI is calculated as: $BMI = \text{Weight (kg)} \div \text{Height (m}^2\text{)}$ BMI is widely used to classify adults into categories such as underweight, normal weight, overweight, and obesity. Mid-Upper Arm Circumference (MUAC) MUAC is particularly useful for assessing acute malnutrition among children aged 6–59 months. It is simple, rapid, and suitable for field surveys. Head Circumference Measured primarily in infants and young children, head circumference reflects brain growth and development. Chest Circumference Chest circumference is sometimes measured in infants to assess growth and nutritional development. Waist and Hip Circumference These measurements assess body fat distribution and help estimate the risk of cardiovascular disease, diabetes, and metabolic disorders. Skinfold Thickness Skinfold measurements at sites such as the triceps, biceps, subscapular, and suprailiac regions estimate body fat reserves and body composition.

Anthropometric Indices

Individual measurements are often combined into indices that provide more meaningful information. Weight-for-Age Indicates whether a child is underweight compared with a healthy reference population. Height-for-Age Assesses stunting, indicating chronic undernutrition. Weight-for-Height Evaluates wasting, indicating acute malnutrition. BMI-for-Age Used mainly for assessing overweight and obesity among children and

adolescents. Waist-Hip Ratio Measures abdominal obesity and predicts metabolic and cardiovascular risk. Application of Nutritional anthropometry is widely used in:

- National nutrition surveys.
- Growth monitoring of children.
- Maternal and child health programmes.
- School health programmes.
- Clinical nutrition assessment.
- Disaster and emergency nutrition assessment.
- Evaluation of food supplementation programmes.
- Epidemiological research.
- Environmental and occupational health studies.

Advantages of Nutritional Anthropometry

- Simple and inexpensive.
- Non-invasive and safe.
- Requires minimal equipment.
- Suitable for large-scale field surveys.
- Standardized internationally.
- Highly reliable when performed correctly.
- Useful for repeated monitoring over time.

Limitations

Despite its usefulness, anthropometry has certain limitations:

- Does not identify specific nutrient deficiencies.
- Measurements require proper training and standardization.
- Body composition varies among different ethnic groups.
- Results may be influenced by hydration status, pregnancy, edema, or illness.
- Interpretation requires comparison with appropriate reference standards.

III. Methodology

In the present study, nutritional anthropometry-based health status of the people has been assessed pertaining to the frequency of occurrence of various diseases and level of malnourishment through anthropometrical study. Information / data has been collected dividing the total area in to following six zones.

- Villages in Core Zone
- Villages in Buffer Zone
- Villages in Core Zone receiving CSR facilities from the Project Proponent
- Villages in Core Zone receiving no CSR facilities from the Project Proponent
- Villages in Buffer Zone receiving CSR facilities from the Project Proponent
- Villages in Buffer Zone receiving No CSR facilities from the Project Proponent

The study has sought to examine the incidence of various common ailments like fever, cold and cough, body pain, diarrhea etc. as well as air-borne, water-borne diseases and parasitic diseases, data as collected during the survey.

Mid-Upper Arm Circumference (MUAC) is a rapid, inexpensive, and reliable screening tool for assessing acute malnutrition, particularly in children under five (Kulathinal et al., 2016, Asthekar et al. 2020). It measures the muscle and subcutaneous fat in the upper arm to detect under nutrition, often using simple colour-coded tapes for immediate screening.

A suitable reference is the MUAC-for-age reference for School Children and adolescents aged 5-18 years developed by Mramba et al. (2017). It provides age- and sex-specific reference curves and uses the following classifications.

MUAC-for-age z Score	Interpretation
≥ -2 SD	Not under nourished
< -2 - ≥ -3 SD	Moderate undernutrition
< -3 SD	Severe undernutrition

Using the MUAC malnutrition can be classified as,

Severe Acute Malnutrition (SAM)	<11.5 cm
Moderate Acute Malnutrition (MAM)	11.5-12.5 cm
Normal Nutrition Status (NNS)	>12.5

The anthropometrical study analyses the weight and height measurements of each member of the households and seeks to present the indices such as Body Mass Index (BMI) for persons above 18 years of age. It is computed as weight (in Kg) /height in m)². The classification used to classify the health status is as follows.

Severe Under weight	<16.00
Moderate	16.0-17.0
Mild	17.0-18.5
Normal	>18.5

For the age group of more than 5 years (60 months) , weight for Age (WFA) has been calculated as (Actual weight in Kg/Standard weight) x 100 as per IPA 2015.The Gomez classification used to classify the weight status is as follows.

Grade-III	<60.00 %
Grade-II	60.0-70.0%
Grade-I	70.0-80.0%
Normal	>80.0%

IV. Results

Nutritional status of village residents across socio-economic categories and groups based on food intake

a. Core villages

Table 4.1 a: BMI and Gomez classification in core villages

Nutritional deprivation in core villages was marked by higher BMI-based malnutrition among women in several socially disadvantaged groups. Moderate BMI malnutrition was highest among OBC women (9.2%), while severe malnutrition was particularly high among ST women (6.9%) and was also observed among OBC women (4.6%). Gomez-based severe undernutrition was concentrated among OBC boys (11.8%), SC girls (14.3%) and ST girls (12.5%), indicating that childhood undernutrition cuts across caste groups but is especially visible among socially disadvantaged communities.

Educational and income differentials broadly indicate greater vulnerability among persons with lower socioeconomic resources. Women with primary education showed 13.3% moderate and 8.9% severe BMI malnutrition, while LIG women recorded 7.5% moderate and 6.0% severe malnutrition; LIG households also accounted for the largest number of Gomez-classified undernourished children. Food-pattern results show that undernutrition persisted across all reported dietary categories: BMI malnutrition was comparatively high among those reporting non-vegetarian intake at least twice weekly, while Gomez undernutrition was notable among completely vegetarian households and those reporting curd consumption. These findings suggest that reported intake frequency of individual foods may not necessarily ensure adequate diet quality, quantity or intra-household dietary access.

Table 4.1 b: MUAC-based undernutrition in core villages

MUAC findings reinforce the presence of substantial nutritional vulnerability among children, adolescents and especially adult women in core villages. Low MUAC among young children was highest among ST boys (57.1%) and OBC/SC girls (44.4% and 50.0%, respectively), although the corresponding eligible samples are small. Adolescent moderate undernutrition was generally limited, but was more visible among ST boys (3.3%) and among those with graduation-level education (11.8% among boys), again requiring cautious interpretation because of the small denominators.

Among adults, women consistently showed higher MUAC-based undernutrition than men: 33.0% of OBC women and 31.4% of SC women were below the relevant MUAC threshold, compared with 19.8% among ST women. Adult female MUAC undernutrition was also high among persons with primary education (32.6%), high-school education (29.0%), and among middle-income households (36.2%). Food categories similarly showed high female MUAC undernutrition—28.0% among completely vegetarian women, 29.4% among those consuming curd at least twice weekly, and 27.9% among those reporting non-vegetarian intake—showing that food frequency alone did not eliminate adult female nutritional risk.

b. Buffer villages**Table 4.2 a: BMI and Gomez classification in buffer villages**

In buffer villages, moderate BMI malnutrition was generally more common among women than men. ST women recorded the highest moderate BMI malnutrition (19.5%), followed by OBC women (14.8%); severe BMI malnutrition was also relatively high among ST adults, affecting 4.8% of men and 4.9% of women. Gomez-based severe undernutrition was most pronounced among SC children—23.3% of boys and 15.4% of girls—followed by ST children, demonstrating continuing nutritional disadvantage among SC and ST households.

The education and income profiles show that women with basic education and high-school education had relatively high moderate BMI malnutrition (12.7% and 14.8%, respectively), while severe malnutrition among women was highest in the post-graduation group (7.7%), based on a very small denominator. LIG households carried the largest absolute burden, with 14.8% moderate BMI malnutrition among women and 12.5% and 12.8% Gomez undernutrition among boys and girls, respectively. Diet-wise, completely vegetarian women had 15.2% moderate BMI malnutrition, while severe BMI malnutrition among men was highest in this category (4.7%). Underweight was also evident among households reporting regular non-vegetarian foods, dairy foods and leafy vegetables, indicating that dietary diversity and adequacy require attention beyond the reported frequency of selected foods.

Table 4.2 b: MUAC-based undernutrition in buffer villages

MUAC indicators reveal notable nutritional vulnerability in buffer villages, particularly among young children and adult women. Low MUAC among young children was highest in SC households—70.0% among boys and 36.4% among girls—and was also high among ST girls (44.4%). Moderate adolescent undernutrition was comparatively low, though severe adolescent undernutrition was observed among ST girls (2.9%) and among high-school-educated groups (2.1% among girls).

Women experienced a substantially higher burden of adult MUAC-based undernutrition than men in nearly all socioeconomic groups. Female adult undernutrition was highest among ST women (30.1%) and OBC women (27.8%), while men recorded much lower levels. Women with basic education had a high prevalence of low MUAC (33.3%), and LIG households accounted for the largest number of affected adults and children. Across food-intake categories, adult female MUAC undernutrition remained high among those reporting milk consumption (32.1%), curd consumption (35.0%), and leafy-vegetable consumption (25.7%). The results indicate that nutrition interventions should address overall diet adequacy, women's dietary access and child feeding practices rather than focusing only on whether particular foods are consumed.

Core CSR and non-CSR villages**Table 4.3 a: BMI and Gomez classification in core CSR villages**

In core CSR villages, moderate BMI malnutrition was generally modest but showed important gender and social-group variation. OBC women had 9.4% moderate BMI malnutrition, while severe BMI malnutrition was most evident among OBC women (5.2%) and SC women (4.8%). Gomez-classified severe undernutrition was highest among OBC boys (12.9%) and SC girls (33.3%), though the latter percentage is based on a very small number of eligible girls. ST households showed lower BMI malnutrition than OBC households, but still had evidence of severe BMI malnutrition among women and Gomez undernutrition among girls.

Women with basic education had 11.5% moderate and 7.7% severe BMI malnutrition, while women in the MIG category had 11.4% moderate BMI malnutrition. LIG households carried the largest numerical burden of BMI and Gomez undernutrition. Across food groups, BMI malnutrition was especially high among respondents reporting curd consumption at least twice weekly, with moderate malnutrition affecting 13.6% of men and 10.0% of women, and severe malnutrition affecting 10.0% of women. The pattern across vegetarian, non-vegetarian, dairy and leafy-vegetable groups indicates that the frequency of a particular food group alone is insufficient to ensure nutritional adequacy.

Table 4.3 b: MUAC-based undernutrition in core CSR villages

MUAC-based results show that adult women remained the group with the greatest nutritional vulnerability in core CSR villages. Female adult low MUAC was highest among SC women (40.9%), OBC women (34.4%) and General-category women (30.0%), while the corresponding male prevalence was low or zero in most caste groups. Low MUAC among young children was also evident among OBC children, affecting 25.0% of boys and 50.0% of girls, although the child samples were small.

Education and income patterns again suggest disproportionate risk among women: female adult low MUAC was 37.0% among those with basic education and 28.7% among those educated to high-school level. The LIG group contained the largest number of affected individuals, while the MIG group had a relatively high prevalence of adult female low MUAC (31.4%). Food-intake patterns show high female MUAC undernutrition among those reporting curd intake at least twice weekly (42.9%), completely vegetarian diets (33.3%), and non-vegetarian diets at least twice weekly (27.3%). Thus, even in CSR villages, nutritional vulnerability persists across food categories and requires attention to balanced dietary intake, household food security and women's nutrition.

Table 4.4 a: BMI and Gomez classification in core non-CSR villages

Core non-CSR villages show a distinct concentration of BMI and Gomez undernutrition among ST households. ST women had 10.8% moderate and 13.5% severe BMI malnutrition, while ST men had 5.1% moderate and 2.6% severe malnutrition. Gomez undernutrition was also observed only among ST girls in the caste-wise comparison (22.2%), highlighting a strong pattern of nutritional disadvantage among ST households in this sub-area.

The educational profile indicates high female vulnerability among those with basic education, where moderate and severe BMI malnutrition were 15.8% and 10.5%, respectively. Severe malnutrition among women was also high in the high-school group (8.1%). LIG women recorded 9.1% moderate and 9.1% severe BMI malnutrition, and LIG households contained the principal burden of Gomez undernutrition. By food intake, respondents reporting non-vegetarian consumption at least twice weekly showed 14.8% moderate and 7.4% severe BMI malnutrition among women; however, completely vegetarian households had a relatively high Gomez undernutrition rate among girls (25.0%). These findings suggest that food consumption frequency should be assessed alongside portion size, diet diversity, affordability and household-level food allocation.

Table 4.4 b: MUAC-based undernutrition in core non-CSR villages

MUAC-based results in core non-CSR villages show particularly acute vulnerability among ST children and women. Low MUAC affected 66.7% of ST boys and 50.0% of ST girls, while ST adolescent boys recorded 12.5% moderate undernutrition. Adult female low MUAC was also highest among ST women (35.1%), compared with 23.1% among OBC women and 15.4% among General and SC women.

At the education level, child low MUAC was high among high-school and basic-education groups, although based on small eligible child samples. Adult female MUAC undernutrition remained high among women with high-school education (29.7%) and basic education (26.3%). Income-wise, LIG households had high child low MUAC—57.1% among boys and 50.0% among girls—and adult female low MUAC of 23.6%; the 50.0% prevalence among MIG women should be treated cautiously because of the small denominator. Across dietary categories, female adult low MUAC was high among respondents reporting non-vegetarian intake (29.6%) and leafy vegetables (22.2%), while low MUAC among young children was visible even among households reporting milk, non-vegetarian foods and leafy vegetables.

Buffer CSR and non-CSR villages

Table 4.5 a: BMI and Gomez classification in buffer CSR villages

In buffer CSR villages, adult BMI malnutrition showed a pronounced female burden, particularly among ST and OBC women. Moderate BMI malnutrition was highest among ST women (20.0%) and OBC women (16.1%), while severe malnutrition was reported among ST women (4.2%), OBC women (3.2%) and SC women (2.4%). Gomez-based undernutrition was most apparent among SC children, affecting 17.4% of boys and 25.0% of girls, with ST children also showing undernutrition.

Women with basic and high-school education had relatively high moderate BMI malnutrition (14.0% and 16.6%, respectively), and women with post-graduate education also recorded 16.7%, although this figure is based on a small sample. LIG households represented the largest group and had 16.1% moderate BMI malnutrition among women, alongside Gomez undernutrition among both boys and girls. Food-category patterns show continuing malnutrition among groups reporting regular consumption of selected foods: completely vegetarian women had 15.5% moderate BMI malnutrition, while curd-consuming men had 10.0% moderate malnutrition. The persistence of undernutrition among non-vegetarian, dairy and leafy-vegetable consumers suggests that regular intake of isolated food groups may not ensure sufficiently nutritious and balanced diets.

Table 4.5 b: MUAC-based undernutrition in buffer CSR villages

MUAC-based undernutrition in buffer CSR villages was notable among SC and ST young children and among adult women. Low MUAC was especially high among SC boys (57.1%) and ST girls (40.0%). Adult female low

MUAC ranged from 24.1% among SC women to 29.0% among OBC women and 26.3% among ST women, indicating a broad burden across caste groups rather than a pattern confined to one community.

Women with basic education had 36.0% adult low MUAC, compared with 23.4% among high-school-educated women and 26.8% among graduates. LIG households bore the largest numerical burden of MUAC undernutrition, while the MIG group showed 33.3% adult female low MUAC. Food-intake results show adult female low MUAC of 34.4% among those reporting curd consumption, 29.3% among those reporting milk consumption, and 26.6% among those consuming leafy vegetables at least twice weekly. Low MUAC in children and adult women across these food groups points to the importance of overall dietary adequacy, care practices and access to nutrition services.

Table 4.6 a: BMI and Gomez classification in buffer non-CSR villages

Buffer non-CSR villages show the most marked BMI and Gomez vulnerability among ST and SC households. ST women had 17.9% moderate BMI malnutrition and 7.1% severe malnutrition, while ST men had 9.1% moderate and 9.1% severe BMI malnutrition. SC households recorded 11.5% moderate BMI malnutrition among men and 10.0% severe BMI malnutrition among women. Gomez undernutrition was particularly high among SC boys (42.9%) and ST girls (15.4%), illustrating heightened child nutritional risk in these communities.

Education and income findings indicate that high-school-educated respondents experienced notable BMI malnutrition—10.0% moderate and 6.0% severe among men, and 7.9% moderate and 10.5% severe among women. LIG households contained most of the observed undernutrition, with 8.7% moderate BMI malnutrition among men, 10.2% among women, and Gomez undernutrition among 19.0% of boys and 8.7% of girls. Food categories indicate that non-vegetarian consumers had substantial BMI malnutrition, particularly among men (12.7% moderate), while completely vegetarian households recorded both moderate and severe BMI malnutrition among women (12.5% each). High Gomez undernutrition among children reporting non-vegetarian diets or leafy vegetable consumption demonstrates that reported food frequency does not necessarily reflect nutritionally adequate intake.

Table 4.6 b: MUAC-based undernutrition in buffer non-CSR villages

MUAC data reveal serious child and adult nutritional concerns in buffer non-CSR villages, particularly among SC and ST households. Low MUAC among young children affected all SC boys and half of SC girls in the available sample; it was also high among OBC boys (66.7%) and ST girls (50.0%). ST adolescents showed moderate undernutrition and the only observed severe adolescent undernutrition in the caste-wise analysis. Adult female low MUAC was especially high among ST women (42.9%), compared with 20.0% among OBC women and 15.0% among SC women.

MUAC outcomes vary by education and income, but several rates are based on small denominators. Women with high-school education had 26.3% adult low MUAC, while LIG households showed child low MUAC of 66.7% among boys and 44.4% among girls, together with 25.4% adult female low MUAC. Dietary-category results again show undernutrition across all food groups: women consuming milk reported 41.7% adult low MUAC, while completely vegetarian and curd-consuming women each recorded 37.5%. Among groups reporting non-vegetarian foods and leafy vegetables, child low MUAC and adolescent undernutrition also remained evident. These patterns emphasise the need for household-level nutrition support that improves regular access to diverse, energy- and nutrient-adequate diets, particularly for children, adolescent girls and adult women.

TABLE 4.1(a) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification) in Core Villages																		
SOCIO-ECONOMIC FACTORS	Total Numbers		Malnutrition based on BMI (>18 yrs - 60 yrs) (No.) ≤ 18.5										Eligible Gomez Total (5-18 yrs)		Malnourished based on Gomez Classification (No.) ≤ 60			
			Moderate Malnutrition (BMI >16 to ≤18.5)						Severe Malnutrition (BMI ≤16)									
	Male	Female	Elihible Total Male	Eligible Total Female	Male	%	Female	%	Male	%	Female	%	Male	Female	Male	%	Female	%
CASTE																		
General	40	29	21	23	1	4.8%	2	8.7%	0	0.0%	0	0.0%	7	2	0	0.0%	0	0.0%
OBC	183	179	100	109	5	5.0%	10	9.2%	0	0.0%	5	4.6%	34	40	4	11.8%	2	5.0%
SC	60	55	35	34	1	2.9%	1	2.9%	0	0.0%	1	2.9%	13	7	0	0.0%	1	14.3%
ST	158	150	99	101	5	5.1%	6	5.9%	1	1.0%	7	6.9%	30	24	0	0.0%	3	12.5%
EDUCATION GROUP																		
Basic (Primary or Elementary)	84	80	41	45	0	0.0%	6	13.3%	1	2.4%	4	8.9%	15	14	0	0.0%	2	14.3%
High School	244	221	147	145	9	6.1%	10	6.9%	0	0.0%	8	5.5%	49	43	2	4.1%	3	7.0%
IGraduation	101	97	59	67	3	5.1%	3	4.5%	0	0.0%	1	1.5%	18	13	2	11.1%	1	7.7%
Post Graduation	12	15	8	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	3	0	0.0%	0	0.0%
INCOME WISE																		
HIG	24	29	15	19	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	6	0	0.0%	0	0.0%
LIG	339	321	197	201	11	5.6%	15	7.5%	1	0.5%	12	6.0%	69	62	3	4.3%	6	9.7%
MIG	78	63	43	47	1	2.3%	4	8.5%	0	0.0%	1	2.1%	11	5	1	9.1%	0	0.0%
Food Pattern and Frequency																		
Completely Veg	125	125	73	74	2	2.7%	4	5.4%	0	0.0%	1	1.4%	24	25	2	8.3%	3	12.0%
Non-Veg at least twice a week	182	157	109	104	7	6.4%	10	9.6%	1	0.9%	6	5.8%	40	31	1	2.5%	1	3.2%
Milk at least twice a week	114	106	61	66	3	4.9%	2	3.0%	0	0.0%	3	4.5%	23	23	1	4.3%	1	4.3%
Curd at least twice a week	58	57	35	33	3	8.6%	2	6.1%	0	0.0%	2	6.1%	8	16	1	12.5%	0	0.0%
Leafy Veg at least twice a week	313	307	179	200	6	3.4%	15	7.5%	0	0.0%	7	3.5%	62	55	3	4.8%	3	5.5%

Socioeconomic Dimensions of Nutritional Anthropometry among Village Households within ..

TABLE 4.1(b) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (MUAC based) in Core Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnourished based on MUAC (No.)																					
			Eligible Total		Children (6months-60months) MUAC Less than 11.5 cm				Eligible Total		Moderate Undernutrition Adolescents (6 yr - 18 yr) (Z-Score ≤ -2 and ≥ -3)				Severe Undernutrition Adolescents Age 6 yr - 18 yr (Z-Score < -3)				Adults >18 yr-60 yr) Male ≤ 22.5 Female ≤ 23					
	Male	Female	Male	Female	Male	%	Female	%	Male	Female	Male	%	Female	%	Male	%	Female	%	Eligible Male Total	Eligible Female Total	Male	%	Female	%
CASTE																								
General	40	29	5	0	0	0.0%	0	0.0%	5	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	21	23	0	0.0%	5	21.7%
OBC	183	179	12	9	3	25.0%	4	44.4%	32	36	3	9.4%	0	0.0%	0	0.0%	0	0.0%	100	109	4	4.0%	36	33.0%
SC	60	55	4	2	1	25.0%	1	50.0%	12	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	35	35	0	0.0%	11	31.4%
ST	158	150	7	10	4	57.1%	3	30.0%	30	21	1	3.3%	1	4.8%	0	0.0%	0	0.0%	99	101	1	1.0%	20	19.8%
EDUCATION GROUP																								
Basic (Primary or Elementary)	84	80	6	4	2	33.3%	2	50.0%	14	11	1	7.1%	1	9.1%	0	0.0%	0	0.0%	41	46	0	0.0%	15	32.6%
High School	244	221	15	12	4	26.7%	5	41.7%	46	40	1	2.2%	0	0.0%	0	0.0%	0	0.0%	147	145	1	0.7%	42	29.0%
IGraduation	101	97	7	4	2	28.6%	1	25.0%	17	13	2	11.8%	0	0.0%	0	0.0%	0	0.0%	59	67	4	6.8%	14	20.9%
Post Graduation	12	15	0	1	0	0.0%	0	0.0%	2	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	8	10	0	0.0%	1	10.0%
INCOME WISE																								
HIG	24	29	1	1	0	0.0%	1	100.0%	4	6	0	0.0%	0	0.0%	0	0.0%	0	0.0%	15	19	1	6.7%	4	21.1%
LIG	339	321	21	17	8	38.1%	6	35.3%	65	55	3	4.6%	1	1.8%	0	0.0%	0	0.0%	197	202	3	1.5%	51	25.2%
MIG	78	63	6	3	0	0.0%	1	33.3%	10	5	1	10.0%	0	0.0%	0	0.0%	0	0.0%	43	47	1	2.3%	17	36.2%
Food Pattern and Frequency																								
Completely Veg	125	125	4	9	1	25.0%	2	22.2%	24	22	3	12.5%	1	4.5%	0	0.0%	0	0.0%	73	75	1	1.4%	21	28.0%
Non-Veg at least twice a week	182	157	15	8	3	20.0%	5	62.5%	36	27	1	2.8%	0	0.0%	0	0.0%	0	0.0%	109	104	2	1.8%	29	27.9%
Milk at least twice a week	114	106	10	7	2	20.0%	3	42.9%	21	20	1	4.8%	0	0.0%	0	0.0%	0	0.0%	61	66	0	0.0%	15	22.7%
Curd at least twice a week	58	57	5	5	0	0.0%	2	40.0%	7	12	1	14.3%	0	0.0%	0	0.0%	0	0.0%	35	34	1	2.9%	10	29.4%
Leafy Veg at least twice a week	313	307	20	15	5	25.0%	4	26.7%	58	49	2	3.4%	0	0.0%	0	0.0%	0	0.0%	179	201	2	1.1%	53	26.4%

TABLE 4.2(a) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification) in Buffer Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnutrition based on BMI (>18 yrs - 60 yrs) (No.) ≤ 18.5										Eligible Gomez Total (5-18 yrs)		Malnourished based on Gomez Classification (No.) ≤ 60			
			Moderate Malnutrition (BMI >16 to ≤18.5)						Severe Malnutrition (BMI ≤16)									
	Male	Female	Elihible Total Male	Eligible Total Female	Male	%	Female	%	Male	%	Female	%	Male	Female	Male	%	Female	%
CASTE																		
General	21	20	13	14	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	3	0	0.0%	0	0.0%
OBC	194	180	106	108	7	6.6%	16	14.8%	1	0.9%	3	2.8%	33	22	1	3.0%	1	4.5%
SC	166	154	96	103	8	8.3%	7	6.8%	1	1.0%	4	3.9%	30	26	7	23.3%	4	15.4%
ST	201	186	125	123	5	4.0%	24	19.5%	6	4.8%	6	4.9%	40	38	4	10.0%	5	13.2%
EDUCATION GROUP																		
Basic (Primary or Elementary)	112	115	54	63	4	7.4%	8	12.7%	1	1.9%	2	3.2%	21	26	3	14.3%	4	15.4%
High School	330	291	202	183	14	6.9%	27	14.8%	7	3.5%	9	4.9%	66	53	9	13.6%	6	11.3%
IGraduation	116	112	71	89	2	2.8%	10	11.2%	0	0.0%	1	1.1%	17	7	0	0.0%	0	0.0%
Post Graduation	24	22	13	13	0	0.0%	2	15.4%	0	0.0%	1	7.7%	2	3	0	0.0%	0	0.0%
INCOME WISE																		
HIG	27	22	17	15	1	5.9%	1	6.7%	0	0.0%	1	6.7%	3	3	0	0.0%	0	0.0%
LIG	461	437	259	277	14	5.4%	41	14.8%	8	3.1%	10	3.6%	96	78	12	12.5%	10	12.8%
MIG	94	81	64	56	5	7.8%	5	8.9%	0	0.0%	2	3.6%	7	8	0	0.0%	0	0.0%
Food Pattern and Frequency																		
Completely Veg	117	107	64	66	4	6.3%	10	15.2%	3	4.7%	1	1.5%	21	13	1	4.8%	0	0.0%
Non-Veg at least twice a week	304	268	182	170	10	5.5%	20	11.8%	3	1.6%	5	2.9%	47	44	5	10.6%	4	9.1%
Milk at least twice a week	97	86	52	53	3	5.8%	6	11.3%	0	0.0%	0	0.0%	17	9	0	0.0%	0	0.0%
Curd at least twice a week	71	65	39	40	3	7.7%	5	12.5%	0	0.0%	0	0.0%	10	8	0	0.0%	0	0.0%
Leafy Veg at least twice a week	406	375	231	241	15	6.5%	30	12.4%	6	2.6%	9	3.7%	81	57	10	12.3%	7	12.3%

Socioeconomic Dimensions of Nutritional Anthropometry among Village Households within ..

TABLE 4.2(b) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (MUAC based) in Buffer Villages																						
SOCIO-ECONOMIC FACTORS	Malnourishment based on MUAC (No.)																					
	Eligible Total		Children (6months-60months) MUAC Less than 11.5 cm				Eligible Total		Moderate Undernutrition Adolescents (6 yr - 18 yr) (Z-Score ≤ -2 and ≥ -3)				Severe Undernutrition Adolescents Age 6 yr - 18 yr (Z-Score < -3)				Adults (>18 yr-60 yr) Male ≤ 22.5 Female ≤ 23					
	Male	Female	Male	%	Female	%	Male	Female	Male	%	Female	%	Male	%	Female	%	Eligible Male Total	Eligible Female Total	Male	%	Female	%
CASTE																						
General	0	1	0	0.0%	0	0.0%	3	3	0	0.0%	1	33.3%	0	0.0%	0	0.0%	13	14	0	0.0%	2	14.3%
OBC	13	12	3	23.1%	1	8.3%	29	20	1	3.4%	0	0.0%	0	0.0%	0	0.0%	106	108	4	3.8%	30	27.8%
SC	10	11	7	70.0%	4	36.4%	29	23	1	3.4%	0	0.0%	0	0.0%	0	0.0%	98	103	4	4.1%	23	22.3%
ST	15	9	3	20.0%	4	44.4%	36	34	1	2.8%	0	0.0%	0	0.0%	1	2.9%	125	123	5	4.0%	37	30.1%
EDUCATION GROUP																						
Basic (Primary or Elementary)	5	7	3	60.0%	2	28.6%	21	23	1	4.8%	1	4.3%	0	0.0%	0	0.0%	54	63	1	1.9%	21	33.3%
High School	24	21	8	33.3%	5	23.8%	58	47	2	3.4%	0	0.0%	0	0.0%	1	2.1%	203	183	10	4.9%	44	24.0%
IGraduation	7	4	2	28.6%	2	50.0%	16	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	72	89	2	2.8%	23	25.8%
Post Graduation	2	1	0	0.0%	0	0.0%	2	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	13	13	0	0.0%	4	30.8%
INCOME WISE																						
HIG	0	0	0	0.0%	0	0.0%	3	3	0	0.0%	1	33.3%	0	0.0%	0	0.0%	17	15	1	5.9%	3	20.0%
LIG	32	29	12	37.5%	8	27.6%	87	69	3	3.4%	0	0.0%	0	0.0%	1	1.4%	261	277	11	4.2%	71	25.6%
MIG	6	4	1	16.7%	1	25.0%	7	8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	64	56	1	1.6%	18	32.1%
Food Pattern and Frequency																						
Completely Veg	8	6	2	25.0%	0	0.0%	20	11	0	0.0%	0	0.0%	0	0.0%	0	0.0%	64	66	3	4.7%	17	25.8%
Non-Veg at least twice a week	22	18	9	40.9%	6	33.3%	43	40	2	4.7%	1	2.5%	0	0.0%	1	2.5%	184	170	6	3.3%	40	23.5%
Milk at least twice a week	8	6	4	50.0%	1	16.7%	15	9	1	6.7%	0	0.0%	0	0.0%	0	0.0%	53	53	1	1.9%	17	32.1%
Curd at least twice a week	7	3	4	57.1%	0	0.0%	8	7	1	12.5%	0	0.0%	0	0.0%	0	0.0%	40	40	2	5.0%	14	35.0%
Leafy Veg at least twice a week	26	21	10	38.5%	7	33.3%	76	54	2	2.6%	1	1.9%	0	0.0%	1	1.9%	233	241	9	3.9%	62	25.7%

TABLE 4.3 (a) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification) in Core CSR Villages																			
SOCIO-ECONOMIC FACTORS	Total Numbers		Malnutrition based on BMI (>18 yrs - 60 yrs) (No.) ≤ 18.5										Eligible Gomez Total (5-18 yrs)		Malnourished based on Gomez Classification (No.) ≤ 60				
			Moderate Malnutrition (BMI >16 to ≤18.5)						Severe Malnutrition (BMI ≤16)										
	Male	Female	Eligible Total Male	Eligible Total Female	Male	%	Female	%	Male	%	Female	%	Male	Female	Male	%	Female	%	
CASTE																			
General	15	13	8	10	0	0.0%	2	20.0%	0	0.0%	0	0.0%	5	0	0	0.0%	0	0.0%	
OBC	162	157	84	96	5	6.0%	9	9.4%	0	0.0%	5	5.2%	31	35	4	12.9%	2	5.7%	
SC	43	34	23	21	1	4.3%	1	4.8%	0	0.0%	1	4.8%	11	3	0	0.0%	1	33.3%	
ST	94	96	60	64	3	5.0%	2	3.1%	0	0.0%	2	3.1%	22	15	0	0.0%	1	6.7%	
EDUCATION GROUP																			
Basic (Primary or Elementary)	47	51	20	26	0	0.0%	3	11.5%	0	0.0%	2	7.7%	9	9	0	0.0%	1	11.1%	
High School	184	169	104	108	6	5.8%	8	7.4%	0	0.0%	5	4.6%	43	36	2	4.7%	3	8.3%	
IGraduation	77	71	47	51	3	6.4%	3	5.9%	0	0.0%	1	2.0%	16	7	2	12.5%	0	0.0%	
Post Graduation	6	9	4	6	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1	0	0.0%	0	0.0%	
INCOME WISE																			
HIG	13	16	10	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	3	0	0.0%	0	0.0%	
LIG	246	237	136	146	8	5.9%	10	6.8%	0	0.0%	7	4.8%	57	46	3	5.3%	4	8.7%	
MIG	55	47	29	35	1	3.4%	4	11.4%	0	0.0%	1	2.9%	10	4	1	10.0%	0	0.0%	
Food Pattern and Frequency																			
Completely Veg	87	91	46	53	1	2.2%	4	7.5%	0	0.0%	1	1.9%	21	17	2	9.5%	1	5.9%	
Non-Veg at least twice a week	135	117	82	77	6	7.3%	6	7.8%	0	0.0%	4	5.2%	30	24	1	3.3%	1	4.2%	
Milk at least twice a week	76	70	40	42	3	7.5%	2	4.8%	0	0.0%	3	7.1%	18	15	1	5.6%	0	0.0%	
Curd at least twice a week	37	38	22	20	3	13.6%	2	10.0%	0	0.0%	2	10.0%	6	12	1	16.7%	0	0.0%	
Leafy Veg at least twice a week	222	228	124	146	4	3.2%	11	7.5%	0	0.0%	6	4.1%	50	41	3	6.0%	2	4.9%	

Socioeconomic Dimensions of Nutritional Anthropometry among Village Households within ..

TABLE 4.3(b) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification, MUAC based) in Core CSR Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnourished based on MUAC (No.)																					
			Eligible Total		Children (6months-60months) MUAC Less than 11.5 cm				Eligible Total		Moderate Undernutrition Adolescents (6 yr - 18 yr) (Z-Score ≤ -2 and ≥ -3)				Severe Undernutrition Adolescents Age 6 yr - 18 yr (Z-Score < -3)				Adults (>18 yr-60 yr) Male ≤ 22.5 Female ≤ 23					
	Male	Female	Male	Female	Male	%	Female	%	Male	Female	Male	%	Female	%	Male	%	Female	%	Eligible Male Total	Eligible Female Total	Male	%	Female	%
CASTE																								
General	15	13	0	0	0	0.0%	0	0.0%	5	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	8	10	0	0.0%	3	30.0%
OBC	162	157	12	8	3	25.0%	4	50.0%	29	32	3	10.3%	0	0.0%	0	0.0%	0	0.0%	84	96	4	4.8%	33	34.4%
SC	43	34	4	1	1	25.0%	0	0.0%	10	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	23	22	0	0.0%	9	40.9%
ST	94	96	1	6	0	0.0%	1	16.7%	22	13	0	0.0%	1	7.7%	0	0.0%	0	0.0%	60	64	0	0.0%	7	10.9%
EDUCATION GROUP																								
Basic (Primary or Elementary)	47	51	2	2	1	50.0%	1	50.0%	9	7	0	0.0%	1	14.3%	0	0.0%	0	0.0%	20	27	0	0.0%	10	37.0%
High School	184	169	11	10	1	9.1%	3	30.0%	41	33	1	2.4%	0	0.0%	0	0.0%	0	0.0%	104	108	1	1.0%	31	28.7%
IGraduation	77	71	4	3	2	50.0%	1	33.3%	15	7	2	13.3%	0	0.0%	0	0.0%	0	0.0%	47	51	3	6.4%	11	21.6%
Post Graduation	6	9	0	0	0	0.0%	0	0.0%	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	6	0	0.0%	0	0.0%
INCOME WISE																								
HIG	13	16	0	1	0	0.0%	1	100.0%	2	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	10	10	1	10.0%	3	30.0%
LIG	246	237	14	11	4	28.6%	3	27.3%	54	41	2	3.7%	1	2.4%	0	0.0%	0	0.0%	136	147	2	1.5%	38	25.9%
MIG	55	47	3	3	0	0.0%	1	33.3%	10	4	1	10.0%	0	0.0%	0	0.0%	0	0.0%	29	35	1	3.4%	11	31.4%
Food Pattern and Frequency																								
Completely Veg	87	91	4	6	1	25.0%	1	16.7%	21	15	2	9.5%	1	6.7%	0	0.0%	0	0.0%	46	54	1	2.2%	18	33.3%
Non-Veg at least twice a week	135	117	9	6	2	22.2%	4	66.7%	28	21	1	3.6%	0	0.0%	0	0.0%	0	0.0%	82	77	2	2.4%	21	27.3%
Milk at least twice a week	76	70	6	5	1	16.7%	3	60.0%	17	13	1	5.9%	0	0.0%	0	0.0%	0	0.0%	40	42	0	0.0%	11	26.2%
Curd at least twice a week	37	38	3	4	0	0.0%	2	50.0%	6	9	1	16.7%	0	0.0%	0	0.0%	0	0.0%	22	21	1	4.5%	9	42.9%
Leafy Veg at least twice a week	222	228	12	12	3	25.0%	3	25.0%	48	36	2	4.2%	0	0.0%	0	0.0%	0	0.0%	124	147	1	0.8%	41	27.9%

TABLE 4.4(a) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification) in Core Non-CSR Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnutrition based on BMI (>18 yrs - 60 yrs) (No.) ≤ 18.5										Eligible Gomez Total (5-18 yrs)		Malnourished based on Gomez Classification (No.) ≤ 60			
			Moderate Malnutrition (BMI >16 to ≤18.5)						Severe Malnutrition (BMI ≤16)									
	Male	Female	Elhibile Total Male	Eligible Total Female	Male	%	Female	%	Male	%	Female	%	Male	Female	Male	%	Female	%
CASTE																		
General	25	16	13	13	1	7.7%	0	0.0%	0	0.0%	0	0.0%	2	2	0	0.0%	0	0.0%
OBC	21	22	16	13	0	0.0%	1	7.7%	0	0.0%	0	0.0%	3	5	0	0.0%	0	0.0%
SC	17	21	12	13	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	4	0	0.0%	0	0.0%
ST	64	54	39	37	2	5.1%	4	10.8%	1	2.6%	5	13.5%	8	9	0	0.0%	2	22.2%
EDUCATION GROUP																		
Basic (Primary or Elementary)	37	29	21	19	0	0.0%	3	15.8%	1	4.8%	2	10.5%	6	5	0	0.0%	1	20.0%
High School	60	52	43	37	3	7.0%	2	5.4%	0	0.0%	3	8.1%	6	7	0	0.0%	0	0.0%
IGraduation	24	26	12	16	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	6	0	0.0%	1	16.7%
Post Graduation	6	6	4	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	2	0	0.0%	0	0.0%
INCOME WISE																		
HIG	11	13	5	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	3	0	0.0%	0	0.0%
LIG	93	84	61	55	3	4.9%	5	9.1%	1	1.6%	5	9.1%	12	16	0	0.0%	2	12.5%
MIG	23	16	14	12	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1	0	0.0%	0	0.0%
Food Pattern and Frequency																		
Completely Veg	38	34	27	21	1	3.7%	0	0.0%	0	0.0%	0	0.0%	3	8	0	0.0%	2	25.0%
Non-Veg at least twice a week	47	40	27	27	1	3.7%	4	14.8%	1	3.7%	2	7.4%	10	7	0	0.0%	0	0.0%
Milk at least twice a week	38	36	21	24	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	8	0	0.0%	1	12.5%
Curd at least twice a week	21	19	13	13	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	4	0	0.0%	0	0.0%
Leafy Veg at least twice a week	91	79	55	54	2	3.6%	4	7.4%	0	0.0%	1	1.9%	12	14	0	0.0%	1	7.1%

Socioeconomic Dimensions of Nutritional Anthropometry among Village Households within ..

TABLE 4.4(b) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (MUAC based) in Core Non-CSR Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnourished based on MUAC (No.)																					
			Eligible Total		Children (6months-60months) MUAC Less than 11.5 cm				Eligible Total		Moderate Undernutrition Adolescents (6 yr - 18 yr) (Z-Score ≤ -2 and ≥ -3)				Severe Undernutrition Adolescents Age 6 yr - 18 yr (Z-Score < -3)				Adults (>18 yr-60 yr) Male ≤ 22.5 Female ≤ 23					
	Male	Female	Male	Female	Male	%	Female	%	Male	Female	Male	%	Female	%	Male	%	Female	%	Eligible Male Total	Eligible Female Total	Male	%	Female	%
CASTE																								
General	25	16	5	0	0	0.0%	0	0.0%	0	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	13	13	0	0.0%	2	15.4%
OBC	21	22	0	1	0	0.0%	0	0.0%	3	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	16	13	0	0.0%	3	23.1%
SC	17	21	0	1	0	0.0%	1	100.0%	2	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	12	13	0	0.0%	2	15.4%
ST	64	54	6	4	4	66.7%	2	50.0%	8	8	1	12.5%	0	0.0%	0	0.0%	0	0.0%	39	37	1	2.6%	13	35.1%
EDUCATION GROUP																								
Basic (Primary or Elementary)	37	29	4	2	1	25.0%	1	50.0%	5	4	1	20.0%	0	0.0%	0	0.0%	0	0.0%	21	19	0	0.0%	5	26.3%
High School	60	52	4	2	3	75.0%	2	100.0%	5	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	43	37	0	0.0%	11	29.7%
IGraduation	24	26	3	1	0	0.0%	0	0.0%	2	6	0	0.0%	0	0.0%	0	0.0%	0	0.0%	12	16	1	8.3%	3	18.8%
Post Graduation	6	6	0	1	0	0.0%	0	0.0%	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	4	0	0.0%	1	25.0%
INCOME WISE																								
HIG	11	13	1	0	0	0.0%	0	0.0%	2	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	9	0	0.0%	1	11.1%
LIG	93	84	7	6	4	57.1%	3	50.0%	11	14	1	9.1%	0	0.0%	0	0.0%	0	0.0%	61	55	1	1.6%	13	23.6%
MIG	23	16	3	0	0	0.0%	0	0.0%	0	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	14	12	0	0.0%	6	50.0%
Food Pattern and Frequency																								
Completely Veg	38	34	0	3	0	0.0%	1	33.3%	3	7	1	33.3%	0	0.0%	0	0.0%	0	0.0%	27	21	0	0.0%	3	14.3%
Non-Veg at least twice a week	47	40	6	2	1	16.7%	1	50.0%	8	6	0	0.0%	0	0.0%	0	0.0%	0	0.0%	27	27	0	0.0%	8	29.6%
Milk at least twice a week	38	36	4	2	1	25.0%	0	0.0%	4	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	21	24	0	0.0%	4	16.7%
Curd at least twice a week	21	19	2	1	0	0.0%	0	0.0%	1	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	13	13	0	0.0%	1	7.7%
Leafy Veg at least twice a week	91	79	8	3	2	25.0%	1	33.3%	10	13	0	0.0%	0	0.0%	0	0.0%	0	0.0%	55	54	1	1.8%	12	22.2%

TABLE 4.5(a) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification) in Buffer CSR Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnutrition based on BMI (>18 yrs - 60 yrs) (No.) ≤ 18.5										Eligible Gomez Total (5-18 yrs)		Malnourished based on Gomez Classification (No.) ≤ 60			
			Moderate Malnutrition (BMI >16 to ≤18.5)						Severe Malnutrition (BMI ≤16)									
	Male	Female	Elilible Total Male	Eligible Total Female	Male	%	Female	%	Male	%	Female	%	Male	Female	Male	%	Female	%
CASTE																		
General	12	9	6	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	2	0	0.0%	0	0.0%
OBC	162	155	90	93	6	6.7%	15	16.1%	1	1.1%	3	3.2%	27	20	1	3.7%	1	5.0%
SC	125	117	70	83	5	7.1%	7	8.4%	1	1.4%	2	2.4%	23	16	4	17.4%	4	25.0%
ST	146	138	92	95	2	2.2%	19	20.0%	3	3.3%	4	4.2%	30	25	3	10.0%	3	12.0%
EDUCATION GROUP																		
Basic (Primary or Elementary)	91	89	41	50	3	7.3%	7	14.0%	1	2.4%	2	4.0%	20	17	2	10.0%	3	17.6%
High School	246	223	152	145	9	5.9%	24	16.6%	4	2.6%	5	3.4%	48	38	6	12.5%	5	13.2%
IGraduation	86	89	53	71	1	1.9%	8	11.3%	0	0.0%	1	1.4%	13	7	0	0.0%	0	0.0%
Post Graduation	22	18	12	12	0	0.0%	2	16.7%	0	0.0%	1	8.3%	2	1	0	0.0%	0	0.0%
INCOME WISE																		
HIG	20	13	14	12	1	7.1%	1	8.3%	0	0.0%	1	8.3%	1	0	0	0.0%	0	0.0%
LIG	346	336	190	218	8	4.2%	35	16.1%	5	2.6%	6	2.8%	75	55	8	10.7%	8	14.5%
MIG	79	70	54	48	4	7.4%	5	10.4%	0	0.0%	2	4.2%	7	8	0	0.0%	0	0.0%
Food Pattern and Frequency																		
Completely Veg	98	90	53	58	4	7.5%	9	15.5%	2	3.8%	0	0.0%	19	9	1	5.3%	0	0.0%
Non-Veg at least twice a week	212	185	127	121	3	2.4%	16	13.2%	2	1.6%	4	3.3%	33	26	1	3.0%	2	7.7%
Milk at least twice a week	78	67	42	41	3	7.1%	5	12.2%	0	0.0%	0	0.0%	13	7	0	0.0%	0	0.0%
Curd at least twice a week	52	51	30	32	3	10.0%	4	12.5%	0	0.0%	0	0.0%	6	6	0	0.0%	0	0.0%
Leafy Veg at least twice a week	306	284	171	192	9	5.3%	27	14.1%	3	1.8%	6	3.1%	66	38	6	9.1%	6	15.8%

TABLE 4.5(b) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (MUAC based) in Buffer CSRVillages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnourished based on MUAC (No.)																						
			Eligible Total		Children (6months-60months) MUAC Less than 11.5 cm			Eligible Total		Moderate Undernutrition Adolescents (6 yr - 18 yr) (Z-Score ≤ -2 and ≥ -3)				Severe Undernutrition Adolescents Age 6 yr - 18 yr (Z-Score < -3)				Adults (>18 yr-60 yr) Male ≤ 22.5 Female ≤ 23							
	Male	Female	Male	Female	Male	%	Female	%	Male	Female	Male	%	Female	%	Male	%	Female	%	Eligible Male	Eligible Female	Male	%	Female	%	
CASTE																									
General	12	9	0	0	0	0.0%	0	0.0%	3	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	7	0	0.0%	2	28.6%	
OBC	162	155	10	11	1	10.0%	1	9.1%	24	18	1	4.2%	0	0.0%	0	0.0%	0	0.0%	90	93	3	3.3%	27	29.0%	
SC	125	117	7	7	4	57.1%	2	28.6%	23	14	0	0.0%	0	0.0%	0	0.0%	0	0.0%	71	83	3	4.2%	20	24.1%	
ST	146	138	11	5	2	18.2%	2	40.0%	28	23	0	0.0%	0	0.0%	0	0.0%	0	0.0%	92	95	3	3.3%	25	26.3%	
EDUCATION GROUP																									
Basic (Primary or Elementary)	91	89	4	4	2	50.0%	0	0.0%	20	16	0	0.0%	0	0.0%	0	0.0%	0	0.0%	41	50	1	2.4%	18	36.0%	
High School	246	223	17	15	4	23.5%	3	20.0%	43	33	1	2.3%	0	0.0%	0	0.0%	0	0.0%	152	145	7	4.6%	34	23.4%	
IGraduation	86	89	5	3	1	20.0%	2	66.7%	13	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	54	71	1	1.9%	19	26.8%	
Post Graduation	22	18	2	1	0	0.0%	0	0.0%	2	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	12	12	0	0.0%	3	25.0%	
INCOME WISE																									
HIG	20	13	0	0	0	0.0%	0	0.0%	1	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	14	12	1	7.1%	2	16.7%	
LIG	346	336	23	20	6	26.1%	4	20.0%	70	49	1	1.4%	0	0.0%	0	0.0%	0	0.0%	191	218	8	4.2%	56	25.7%	
MIG	79	70	5	3	1	20.0%	1	33.3%	7	8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	54	48	0	0.0%	16	33.3%	
Food Pattern and Frequency																									
Completely Veg	98	90	7	6	2	28.6%	0	0.0%	18	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	53	58	2	3.8%	14	24.1%	
Non-Veg at least twice a week	212	185	16	11	4	25.0%	3	27.3%	31	24	0	0.0%	0	0.0%	0	0.0%	0	0.0%	128	121	4	3.1%	30	24.8%	
Milk at least twice a week	78	67	7	5	3	42.9%	1	20.0%	12	7	1	8.3%	0	0.0%	0	0.0%	0	0.0%	43	41	1	2.3%	12	29.3%	
Curd at least twice a week	52	51	5	3	3	60.0%	0	0.0%	5	5	1	20.0%	0	0.0%	0	0.0%	0	0.0%	31	32	2	6.5%	11	34.4%	
Leafy Veg at least twice a week	306	284	19	13	4	21.1%	4	30.8%	63	37	0	0.0%	0	0.0%	0	0.0%	0	0.0%	172	192	5	2.9%	51	26.6%	

TABLE 4.6(a) Socioeconomic Variables, Food Intake and Nutritional Anthropometry based Malnourishment (BMI, Gomez Classification) in Buffer Non-CSR Villages

SOCIO-ECONOMIC FACTORS	Total Numbers		Malnutrition based on BMI (>18 yrs - 60 yrs) (No.) ≤18.5										Eligible Gomez Total (5-18 yrs)		Malnourished based on Gomez Classification (No.) ≤60			
			Moderate Malnutrition (BMI >16 to ≤18.5)						Severe Malnutrition (BMI ≤16)									
	Male	Female	Elilible Total Male	Eligible Total Female	Male	%	Female	%	Male	%	Female	%	Male	Female	Male	%	Female	%
CASTE																		
General	9	11	7	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	1	0	0.0%	0	0.0%
OBC	32	25	16	15	1	6.3%	1	6.7%	0	0.0%	0	0.0%	6	2	0	0.0%	0	0.0%
SC	41	37	26	20	3	11.5%	0	0.0%	0	0.0%	2	10.0%	7	10	3	42.9%	0	0.0%
ST	55	48	33	28	3	9.1%	5	17.9%	3	9.1%	2	7.1%	10	13	1	10.0%	2	15.4%
EDUCATION GROUP																		
Basic (Primary or Elementary)	21	26	13	13	1	7.7%	1	7.7%	0	0.0%	0	0.0%	1	9	1	100.0%	1	11.1%
High School	84	68	50	38	5	10.0%	3	7.9%	3	6.0%	4	10.5%	18	15	3	16.7%	1	6.7%
IGraduation	30	23	18	18	1	5.6%	2	11.1%	0	0.0%	0	0.0%	4	0	0	0.0%	0	0.0%
Post Graduation	2	4	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	2	0	0.0%	0	0.0%
INCOME WISE																		
HIG	7	9	3	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	3	0	0.0%	0	0.0%
LIG	115	101	69	59	6	8.7%	6	10.2%	3	4.3%	4	6.8%	21	23	4	19.0%	2	8.7%
MIG	15	11	10	8	1	10.0%	0	0.0%	0	0.0%	0	0.0%	0	0	0	0.0%	0	0.0%
Food Pattern and Frequency																		
Completely Veg	19	17	11	8	0	0.0%	1	12.5%	1	9.1%	1	12.5%	2	4	0	0.0%	0	0.0%
Non-Veg at least twice a week	92	83	55	49	7	12.7%	4	8.2%	1	1.8%	1	2.0%	14	18	4	28.6%	2	11.1%
Milk at least twice a week	19	19	10	12	0	0.0%	1	8.3%	0	0.0%	0	0.0%	4	2	0	0.0%	0	0.0%
Curd at least twice a week	19	14	9	8	0	0.0%	1	12.5%	0	0.0%	0	0.0%	4	2	0	0.0%	0	0.0%
Leafy Veg at least twice a week	100	91	60	49	6	10.0%	3	6.1%	3	5.0%	3	6.1%	15	19	4	26.7%	1	5.3%

Association of socio-economic factors and food intake variables with nutritional anthropometry parameters

The test of association was conducted for 3 pooled samples by (1) combining core and buffer as one pooled sample; (2) core CSR (corporate social responsibility) and buffer CSR as pooled CSR sample; (3) core NCSR and buffer NCSR as pooled NCSR sample. Male and female as well as mild to moderate and severe malnutrition cases were combined for each of the pooled samples and the chi-square test was performed for BMI's association with socioeconomic and food intake categories. For each of the pooled sample the data has been presented in one consolidated table with an explanation of the results as well as implications arising therefrom especially for CSR interventions.

Pooled BMI association results

Across the three pooled samples, significant BMI-malnutrition associations differ by area type. In the **overall Core + Buffer pooled sample**, education and income are significant; in the **pooled CSR sample**, no tested factor is significant; and in the **pooled non-CSR sample**, caste is strongly associated with BMI malnutrition.

For all analyses, adult males and females aged 18–60 years were combined, and BMI malnutrition includes both moderate ($BMI > 16$ to ≤ 18.5) and severe ($BMI \leq 16$) cases.

Table 4.7 a Chi-square test for pooled Core + Buffer sample

Factor	Categories	Test	χ^2	df	p-value	Result
Caste	General, OBC, SC, ST	Pearson chi-square	0.54	3	0.911	Not significant
Education	Basic, High school, Graduation, Post-graduation	Pearson chi-square	11.63	3	0.009	Significant
Income group	High, Low, Middle income	Pearson chi-square	15.04	2	<0.001	Significant
Diet type	Completely vegetarian vs non-vegetarian at least twice weekly	Pearson chi-square	0.76	1	0.383	Not significant

Table 4.7 b Prevalence of BMI-malnourished in pooled Core + Buffer sample across socio-economic and diet-type categories

Factor	Category	Eligible adults	BMI-malnourished	Prevalence
Caste	General	71	3	4.2%
Caste	OBC	423	21	5.0%
Caste	SC	268	15	5.6%
Caste	ST	448	20	4.5%
Education	Basic	203	12	5.9%
Education	High school	677	84	12.4%
Education	Graduation	286	20	7.0%
Education	Post-graduation	44	3	6.8%
Income	High	66	2	3.0%
Income	Low	934	112	12.0%
Income	Middle	210	9	4.3%
Diet type	Completely vegetarian	277	25	9.0%
Diet type	Non-vegetarian ≥ 2 times/week	565	62	11.0%

Across the combined Core and Buffer sample, BMI malnutrition is strongly patterned by **income**: prevalence is 12.0% in low-income adults, compared with 4.3% in middle-income and 3.0% in high-income adults. The significant education association is driven by a 12.4% prevalence among the high-school group, relative to 5.9% among those with basic education and 7.0% among graduates. This does not mean high-school education causes malnutrition; it is more likely that education is capturing differences in employment, income insecurity, age structure or other unmeasured socioeconomic conditions.

Diet type is not significantly associated with BMI malnutrition in the overall sample. The observed prevalence is 9.0% among completely vegetarian adults and 11.0% among those reporting non-vegetarian consumption at least twice weekly. This indicates that this broad dietary marker alone does not adequately distinguish nutritional risk.

Pooled CSR sample (combines **Core CSR** and **Buffer CSR** areas)

Table 4.8 a Chi-square test for pooled Core CSR and Buffer CSR sample

Factor	Categories	Test	χ^2	df	p-value	Result
Caste	General, OBC, SC, ST	Pearson chi-square	2.04	3	0.565	Not significant
Education	Basic, High school, Graduation, Post-graduation	Pearson chi-square	2.59	3	0.459	Not significant
Income group	High, Low, Middle income	Pearson chi-square	1.76	2	0.415	Not significant
Diet type	Completely vegetarian vs non-vegetarian at least twice weekly	Pearson chi-square	1.09	1	0.296	Not significant

Table 4.8 b Prevalence of BMI-malnourished in pooled Core CSR + Buffer CSR sample across socio-economic and diet-type categories

Factor	Category	Eligible adults	BMI-malnourished	Prevalence
Caste	General	31	2	6.5%
Caste	OBC	363	39	10.7%
Caste	SC	197	15	7.6%
Caste	ST	311	33	10.6%
Education	Basic	137	12	8.8%
Education	High school	509	48	9.4%
Education	Graduation	222	13	5.9%
Education	Post-graduation	34	3	8.8%
Income	High	46	3	6.5%
Income	Low	690	66	9.6%
Income	Middle	166	11	6.6%
Diet type	Completely vegetarian	210	20	9.5%
Diet type	Non-vegetarian ≥ 2 times/week	407	29	7.1%

In CSR areas, no socioeconomic or dietary factor shows a statistically significant bivariate association with BMI malnutrition. Although prevalence is somewhat higher among OBC adults (10.7%), ST adults (10.6%) and low-income adults (9.6%), the differences are not sufficiently large relative to sampling variation to establish statistically reliable associations.

This pattern may indicate a relatively more even distribution of BMI malnutrition across social categories within CSR villages, but it should **not** be interpreted as evidence that CSR interventions have eliminated nutritional inequity. The CSR sample still has substantial BMI malnutrition—particularly among OBC, ST and low-income groups—and the cross-sectional, bivariate analysis cannot determine whether CSR exposure changed nutrition outcomes.

Pooled non-CSR sample (combines **Core Non-CSR** and **Buffer Non-CSR** areas)

Table 4.9 a Chi-square test for pooled Core Non-CSR and Buffer Non-CSR sample

Factor	Categories	Test	χ^2	df	p-value	Result
Caste	General, OBC, SC, ST	Pearson chi-square	15.37	3	0.002	Significant
Education	Basic, High school, Graduation, Post-graduation	Pearson chi-square*	2.04	3	0.564	Not significant
Income group	High, Low, Middle income	Pearson chi-square*	4.75	2	0.093	Not significant
Diet type	Completely vegetarian vs non-vegetarian at least twice weekly	Pearson chi-square	1.94	1	0.163	Not significant

Table 4.8 b Prevalence of BMI-malnourished in pooled Core Non-CSR + Buffer Non-CSR sample across socio-economic and diet-type categories

Factor	Category	Eligible adults	BMI-malnourished	Prevalence
Caste	General	40	1	2.5%
Caste	OBC	60	2	3.3%
Caste	SC	71	5	7.0%
Caste	ST	137	25	18.2%
Education	Basic	66	5	7.6%
Education	High school	168	15	8.9%
Education	Graduation	64	3	4.7%
Education	Post-graduation	10	0	0.0%
Income	High	20	0	0.0%
Income	Low	244	24	9.8%
Income	Middle	44	1	2.3%

Diet type	Completely vegetarian	67	3	4.5%
Diet type	Non-vegetarian ≥ 2 times/week	158	16	10.1%

* Some cells have expected frequencies below five. These results should be treated as indicative; collapsing sparse categories or using an exact multi-category procedure would strengthen confirmatory inference.

In non-CSR areas, caste is strongly associated with BMI malnutrition. ST adults have an 18.2% prevalence, much higher than SC adults (7.0%), OBC adults (3.3%) and General-caste adults (2.5%). This finding indicates a concentrated nutritional disadvantage among ST households in villages without CSR coverage.

Low-income adults in non-CSR areas also show a high prevalence of 9.8%, compared with 2.3% among middle-income adults and no recorded cases among the small high-income category. However, the income association does not reach the 5% threshold ($p = 0.093$), partly because of small category sizes.

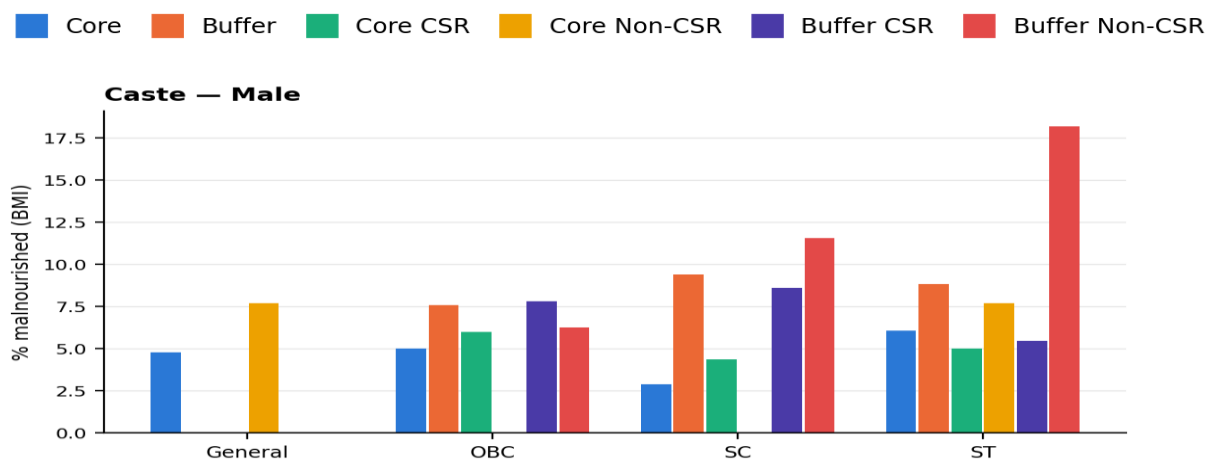
CSR implications

- CSR nutrition programming should retain a **universal component** in CSR villages because BMI malnutrition is not confined to one statistically distinct subgroup. Adult screening, referral and nutrition counselling should therefore remain available across caste, education and income groups.
- At the same time, programme monitoring should stratify outcomes by caste and income. The elevated prevalence among OBC and ST adults in CSR areas—about 10.6–10.7%—suggests that equity-sensitive targeting remains necessary even where the overall association is not statistically significant.
- The sharp caste gradient in non-CSR areas, especially the 18.2% prevalence among ST adults, supports prioritising ST communities for intensive nutrition and food-security measures where CSR coverage is absent or limited. Potential actions include active BMI screening, household food-security support, women's nutrition interventions, livelihood linkage and referral for severe cases.
- The absence of a significant association with vegetarian/non-vegetarian status in all three pooled samples indicates that CSR nutrition strategies should not rely on diet type as a targeting proxy. They should instead assess diet quality, meal frequency, dietary diversity, protein adequacy, intra-household food allocation, morbidity and food affordability.
- These findings are suitable for identifying **priority groups and monitoring equity**, but not for claiming CSR programme impact. A stronger impact assessment would compare CSR and non-CSR areas while controlling for baseline differences in caste composition, income, education, age, sex and village-level conditions.

V. Discussion

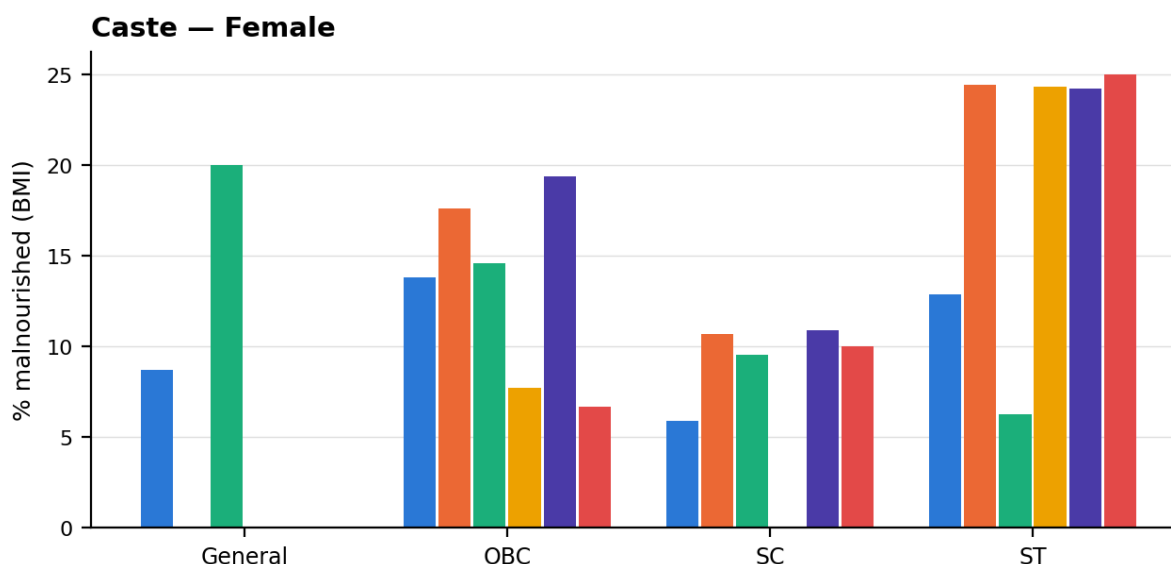
Comparison of nutritional anthropometry parameters between survey sites and distributed across socioeconomic factors and food intake variables

BMI-based Malnutrition and Socioeconomic Factors - Comparative panel charts across all six survey sites (Based on Tables 4.1(a)–4.6(a): Core, Buffer, Core CSR, Core Non-CSR, Buffer CSR, and Buffer Non-CSR villages.) Each chart shows the percentage of individuals classified as malnourished by BMI (moderate + severe combined), grouped by socioeconomic category and split by sex. Bars are color-coded by site so the six locations can be compared directly within each category.

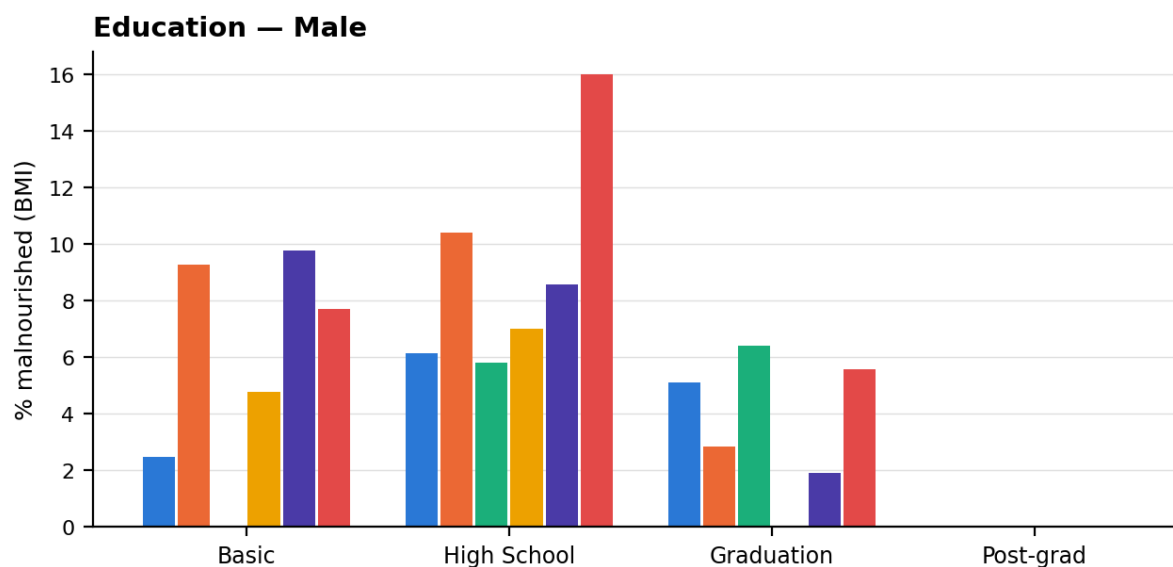


- **Core vs Buffer:** Buffer men show higher BMI malnutrition than Core men in every caste except General (avg 6.4% vs 4.7%). The gap is widest in SC (9.4% vs 2.9%) and ST (8.8% vs 6.1%).

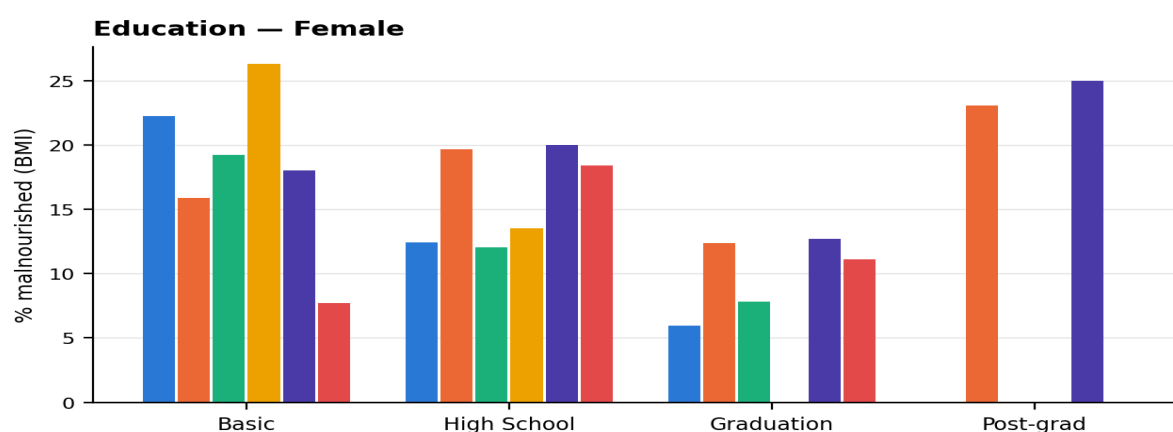
- **Core CSR vs Buffer CSR:** The same pattern holds among CSR villages (avg 5.5% vs 3.8%), with SC again the largest gap (8.6% vs 4.4%).
- **Core Non-CSR vs Buffer Non-CSR:** The Buffer disadvantage is sharpest outside CSR coverage (avg 9.0% vs 3.9%) — SC and ST men in Buffer Non-CSR villages show the highest rates in the whole panel (11.5% and 18.2%).
- **Core CSR vs Core Non-CSR:** Within Core, CSR status makes almost no difference for men (avg 3.8% vs 3.9%) — caste, not CSR coverage, drives the variation.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages fare notably better than Non-CSR (avg 5.5% vs 9.0%), especially for ST men (5.4% vs 18.2%).



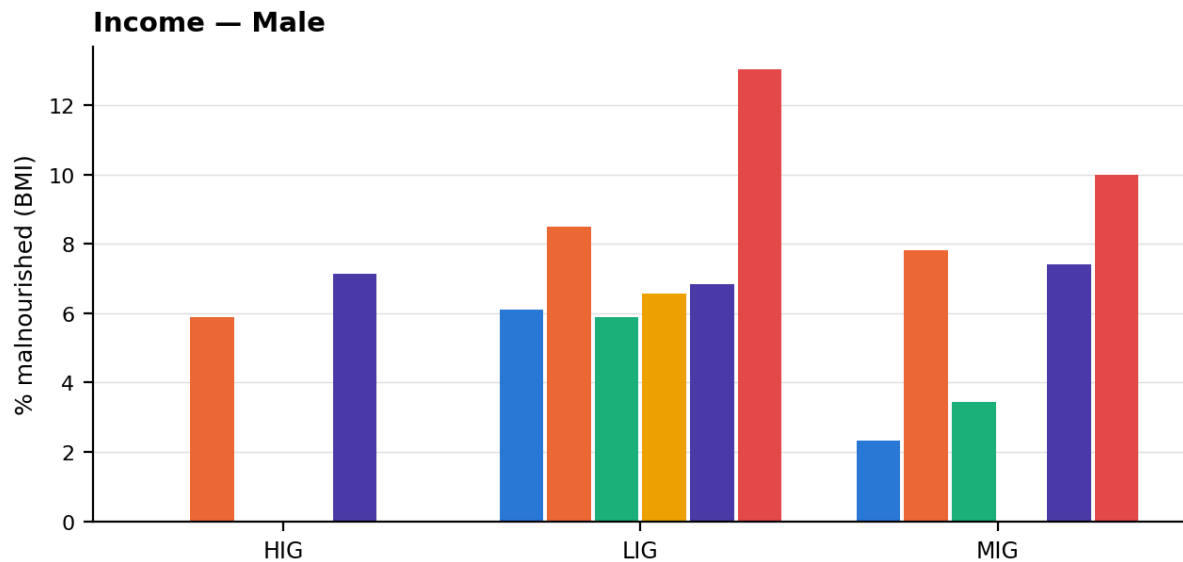
- **Core vs Buffer:** Buffer women show consistently higher malnutrition than Core women (avg 13.2% vs 10.3%), with the ST caste gap the largest in the dataset (24.4% vs 12.9%).
- **Core CSR vs Buffer CSR:** The ST gap widens further among CSR villages alone (24.2% vs 6.3%), even though overall averages are closer (13.6% vs 12.6%).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the zone gap narrows (10.4% vs 8.0%) but SC caste still shows a marked Buffer disadvantage (10.0% vs 0%).
- **Core CSR vs Core Non-CSR:** Unlike for men, Core CSR women show higher average malnutrition than Core Non-CSR women (12.6% vs 8.0%), driven by General and OBC caste; ST is the exception, running lower under CSR.
- **Buffer CSR vs Buffer Non-CSR:** Buffer CSR women also run higher than Buffer Non-CSR on average (13.6% vs 10.4%), mainly through OBC caste (19.4% vs 6.7%).



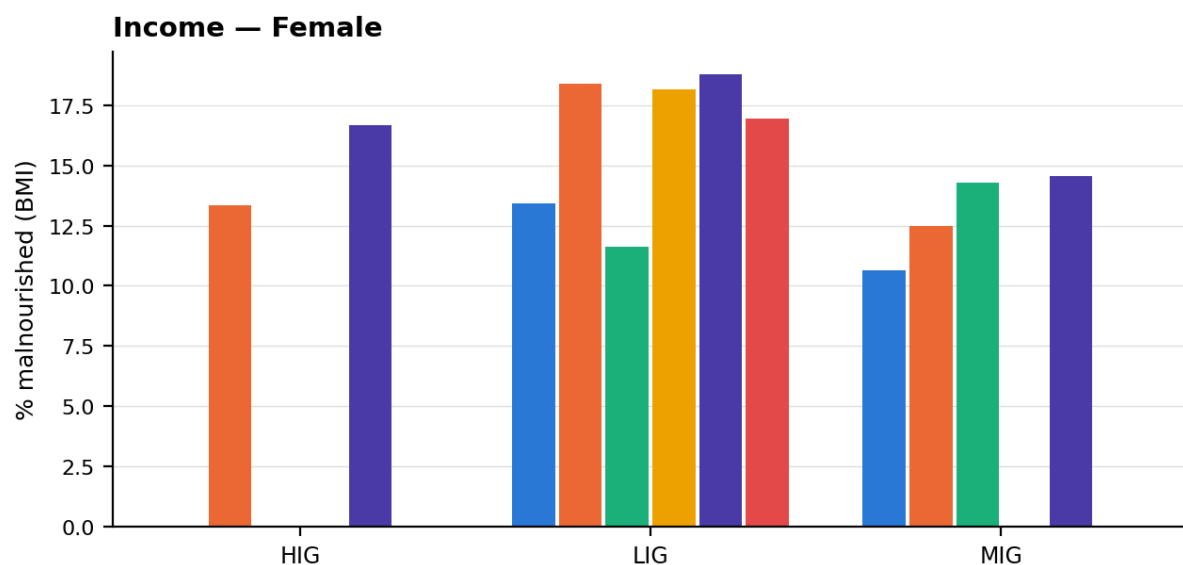
- **Core vs Buffer:** Buffer men show higher malnutrition at every education level except graduates (avg 5.6% vs 3.4%); the largest gap is among those with only basic schooling (9.3% vs 2.4%).
- **Core CSR vs Buffer CSR:** The basic-education gap is largest of all within CSR villages (9.8% vs 0%), though graduates reverse the pattern (Core CSR higher).
- **Core Non-CSR vs Buffer Non-CSR:** The zone gap is widest outside CSR coverage (avg 7.3% vs 2.9%), especially at high-school level (16.0% vs 7.0%).
- **Core CSR vs Core Non-CSR:** CSR status makes little difference on average within Core (3.0% vs 2.9%), though it shifts which education level shows the higher rate.
- **Buffer CSR vs Buffer Non-CSR:** Buffer CSR men fare better than Buffer Non-CSR overall (5.1% vs 7.3%), particularly at high-school level (8.6% vs 16.0%).



- **Core vs Buffer:** Buffer women show markedly higher malnutrition overall (avg 17.8% vs 10.2%), with post-graduate women in Buffer at 23.1% versus 0% in Core (small sample).
- **Core CSR vs Buffer CSR:** This education-linked Buffer disadvantage is even larger within CSR villages alone (18.9% vs 9.8%), again driven by the small post-graduate group.
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the zone gap nearly disappears on average (9.3% vs 10.0%), though results swing widely by education level on small samples.
- **Core CSR vs Core Non-CSR:** CSR status makes little difference within Core on average (9.8% vs 10.0%), with basic-education women showing the biggest (favourable) swing under CSR.
- **Buffer CSR vs Buffer Non-CSR:** Buffer CSR women show clearly higher average malnutrition than Buffer Non-CSR (18.9% vs 9.3%) across every education level, most sharply for post-graduates (small sample).

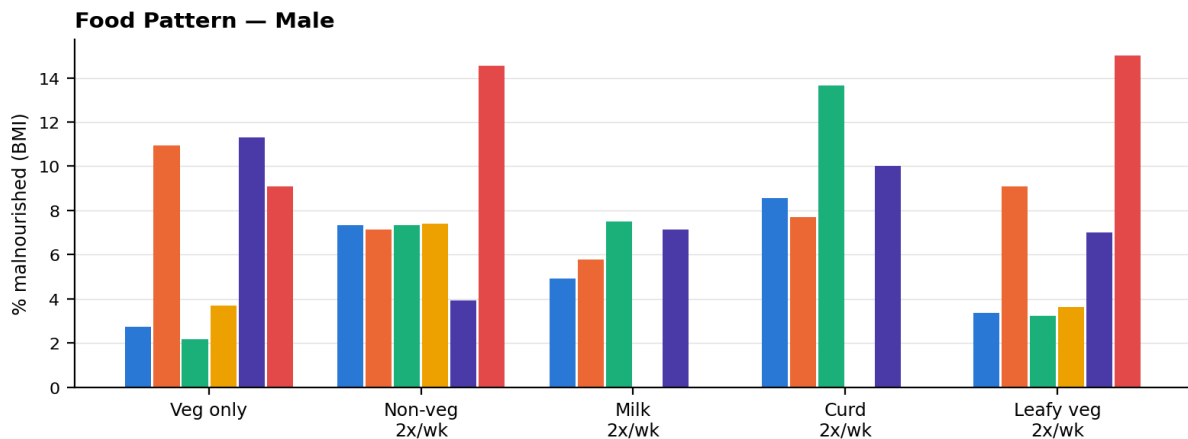


- **Core vs Buffer:** Buffer men show higher malnutrition across all income groups (avg 7.4% vs 2.8%), including a 5.9% rate among high-income Buffer men versus 0% in Core.
- **Core CSR vs Buffer CSR:** The same direction holds within CSR villages (avg 7.1% vs 3.1%), fairly evenly across income groups.
- **Core Non-CSR vs Buffer Non-CSR:** The zone gap is largest outside CSR coverage for middle-income men (10.0% vs 0%; small samples).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages show slightly higher average malnutrition than Non-CSR (3.1% vs 2.2%), reversing the direction seen for women in this domain.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR and Non-CSR average out similarly (7.1% vs 7.7%), though low-income men fare notably worse outside CSR (13.0% vs 6.8%).

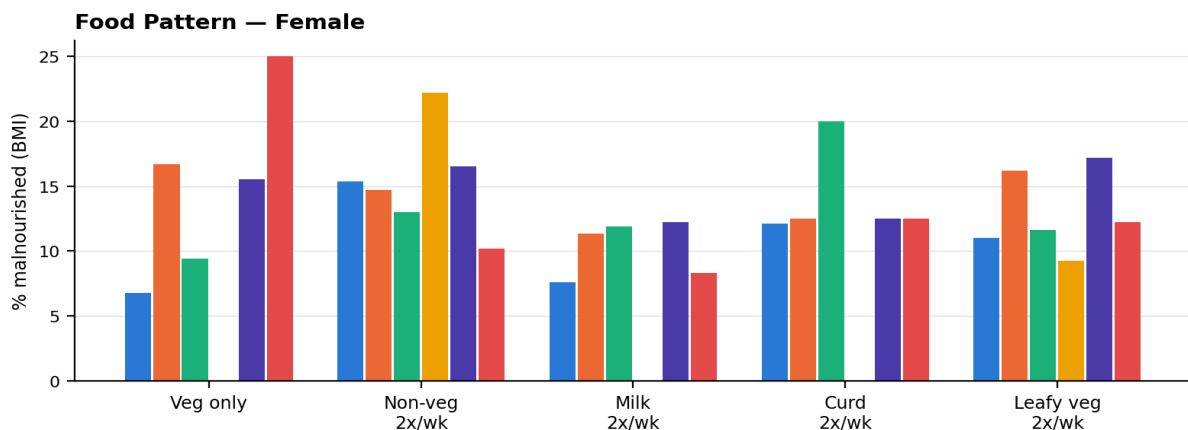


- **Core vs Buffer:** Buffer women show substantially higher malnutrition across every income group (avg 14.8% vs 8.0%), including a 13.3% rate among high-income Buffer women versus 0% in Core.
- **Core CSR vs Buffer CSR:** This gap is largest within CSR villages alone (16.7% vs 8.6%), consistent across all three income groups.
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the zone gap essentially disappears for low-income women and both zones show 0% for the (very small) high- and middle-income groups.
- **Core CSR vs Core Non-CSR:** Core CSR women show higher average malnutrition than Core Non-CSR (8.6% vs 6.1%), driven entirely by middle-income women (14.3% vs 0%, small sample).

- **Buffer CSR vs Buffer Non-CSR:** Buffer CSR women show much higher average malnutrition than Buffer Non-CSR (16.7% vs 5.7%) across every income band, the largest CSR-vs-Non-CSR gap of any domain.



- **Core vs Buffer:** Buffer men show higher malnutrition overall (avg 8.1% vs 5.4%), led by the completely-vegetarian group (10.9% vs 2.7%) and frequent leafy-vegetable eaters (9.1% vs 3.4%).
- **Core CSR vs Buffer CSR:** The vegetarian gap persists within CSR villages (11.3% vs 2.2%), while non-veg and curd-eating men trend the other way (Core CSR higher).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage, Buffer men run higher across nearly every food-pattern group (avg 7.7% vs 3.0%), especially frequent leafy-vegetable eaters (15.0% vs 3.6%).
- **Core CSR vs Core Non-CSR:** Core CSR men show higher average malnutrition than Core Non-CSR (6.8% vs 3.0%), concentrated among milk and curd consumers — likely reflecting small underlying samples rather than a food effect.
- **Buffer CSR vs Buffer Non-CSR:** Buffer CSR and Non-CSR average out similarly for men (7.9% vs 7.7%), but Non-CSR runs much higher among frequent non-veg and leafy-vegetable eaters.



- **Core vs Buffer:** Buffer women show higher malnutrition across most food-pattern groups (avg 14.3% vs 10.6%), led by the completely-vegetarian group (16.7% vs 6.8%).
- **Core CSR vs Buffer CSR:** The vegetarian-group gap is similar within CSR villages (15.5% vs 9.4%), with curd-eating women the one exception (Core CSR higher).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage, Buffer women run far higher among vegetarians (25.0% vs 0%, small sample) but lower among frequent non-veg eaters (10.2% vs 22.2%).
- **Core CSR vs Core Non-CSR:** Core CSR women show clearly higher average malnutrition than Core Non-CSR (13.2% vs 6.3%), across nearly every food-pattern group.
- **Buffer CSR vs Buffer Non-CSR:** Buffer CSR and Non-CSR women average out similarly (14.8% vs 13.7%), with direction varying by specific food group rather than showing one consistent pattern.

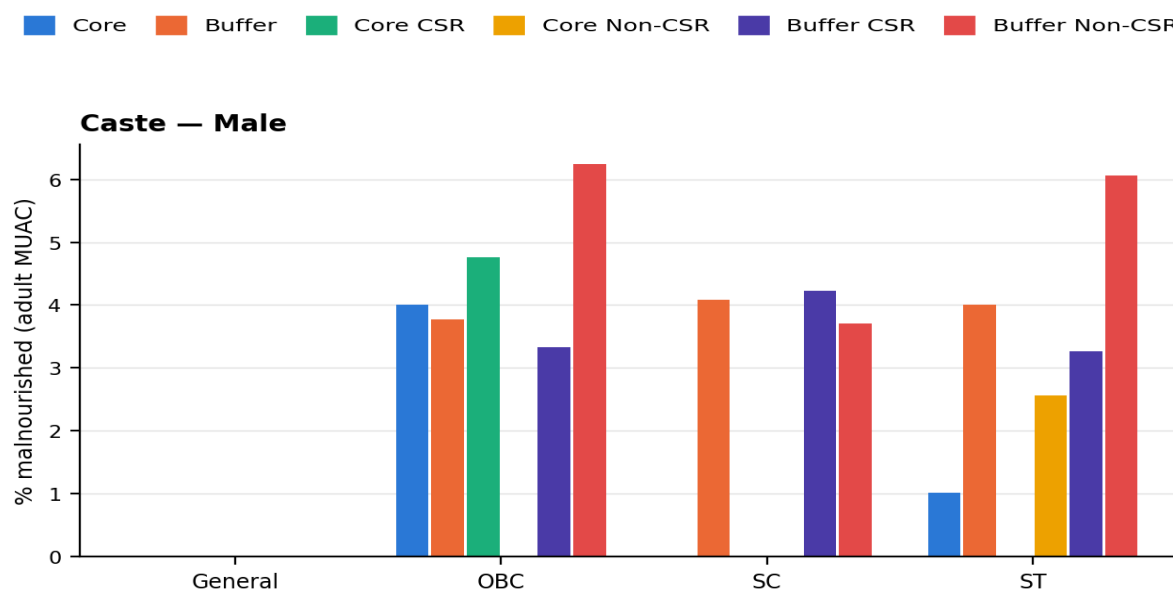
Major inferences from site-to-site differences

- Zone (Core vs Buffer) is the most consistent driver of difference. Buffer villages show higher BMI malnutrition than Core villages in almost every caste, education, income and food-pattern subgroup, for both

sexes. The gap is generally larger for women than for men and is widest among ST caste and lower-education groups.

- CSR coverage does not consistently reduce malnutrition, and its effect differs by zone and sex. In Buffer villages, CSR sites show lower male malnutrition than Non-CSR sites in most domains — consistent with a protective CSR effect for men. In Core villages, this pattern is weak or absent, and for women CSR villages often show malnutrition levels equal to or higher than Non-CSR villages in both zones.
- The CSR effect is more favourable for men than for women. Across Caste, Education and Income domains, Buffer CSR consistently outperforms Buffer Non-CSR for men, while for women the same comparison frequently reverses (Buffer CSR higher than Buffer Non-CSR), most sharply in the Income domain (16.7% vs 5.7%).
- Caste and education compound the zone effect rather than replacing it. SC and ST caste groups, and those with only basic or high-school education, show the largest Core-vs-Buffer gaps in the dataset — suggesting that geography and socioeconomic disadvantage act together, with the combination of Buffer location plus lower caste or education carrying the highest risk.
- Food-pattern differences are less clear-cut than caste, education or income. Site rankings on vegetarian status, non-veg frequency, or dairy consumption vary by domain and do not show a single consistent direction the way zone and caste do, suggesting food pattern is a weaker independent predictor here, or is confounded with caste/income.
- Several comparisons rest on very small eligible samples — General caste, Post Graduation, and HIGH income groups often include fewer than 15–20 people per site — producing 0% or extreme percentages. These specific cells should be treated as indicative only, not as stable estimates, and are best interpreted after pooling across sites or survey rounds.

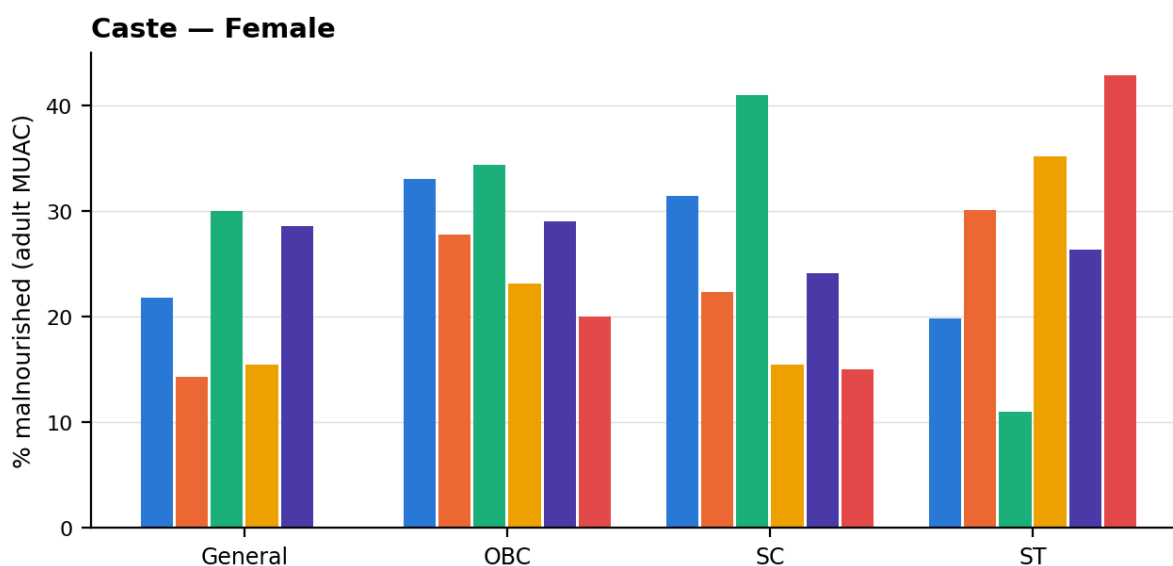
MUAC-based Malnutrition and Socioeconomic Factors - Comparative panel charts across all six survey sites (Based on Tables 4.1(b)–4.6(b): Core, Buffer, Core CSR, Core Non-CSR, Buffer CSR, and Buffer Non-CSR villages.) Each chart shows the percentage of adults (18–60 years) classified as malnourished by MUAC (male ≤ 22.5 cm, female ≤ 23 cm), grouped by socioeconomic category and split by sex. Bars are color-coded by site so the six locations can be compared directly within each category.



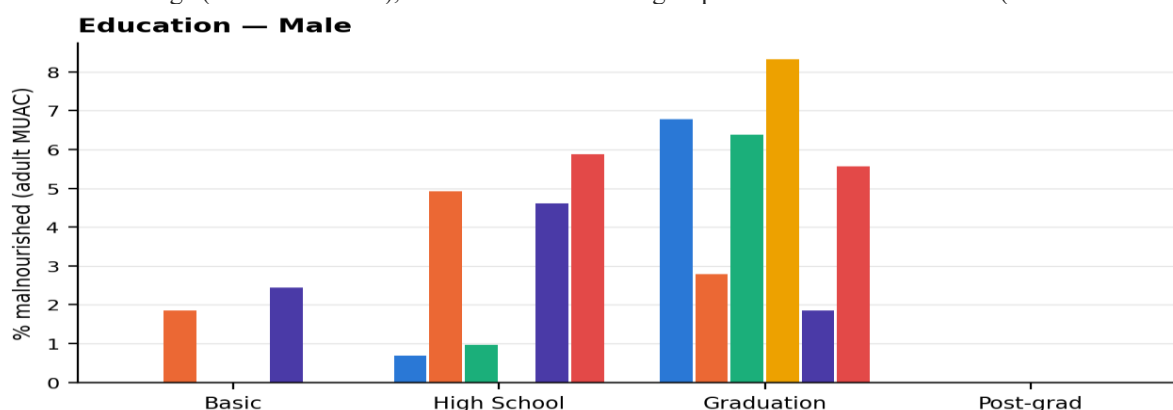
Note: adult MUAC malnutrition is reported here as a single threshold (unlike BMI's moderate/severe split), and the fixed female cut off (≤ 23 cm) flags a much larger share of women than the male cut off flags men across every site — see the inferences section for what this means for interpretation.

- **Core vs Buffer:** Buffer men show higher adult MUAC malnutrition than Core men on average (2.96% vs 1.25%), with the gap widest in SC (4.1% vs 0%) and ST (4.0% vs 1.0%) caste.
- **Core CSR vs Buffer CSR:** The same direction holds within CSR villages (2.71% vs 1.19%), again driven mainly by SC and ST caste.
- **Core Non-CSR vs Buffer Non-CSR:** The Buffer disadvantage is largest outside CSR coverage (4.0% vs 0.6%), with OBC men in Buffer Non-CSR villages at 6.3% versus 0% in Core.

- **Core CSR vs Core Non-CSR:** Within Core, CSR villages show slightly higher male MUAC malnutrition on average than Non-CSR (1.2% vs 0.6%), led by OBC caste; ST reverses this pattern.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages fare somewhat better than Non-CSR for men (2.7% vs 4.0%), consistently across OBC and ST caste.

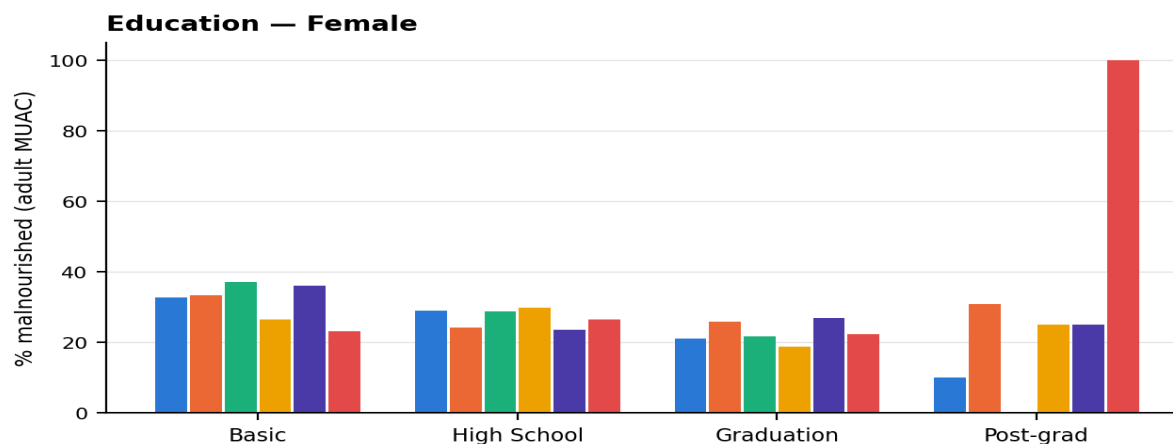


- **Core vs Buffer:** Unlike the male pattern, Core women show slightly higher average MUAC malnutrition than Buffer women (26.5% vs 23.6%), led by SC caste (31.4% vs 22.3%); ST caste is the exception, running higher in Buffer (30.1% vs 19.8%).
- **Core CSR vs Buffer CSR:** Core CSR women average higher than Buffer CSR (29.1% vs 27.0%), with SC caste showing the largest Core-side gap (40.9% vs 24.1%) while ST again reverses (10.9% vs 26.3%).
- **Core Non-CSR vs Buffer Non-CSR:** Core Non-CSR women also average higher than Buffer Non-CSR (22.3% vs 19.5%), though ST caste is sharply worse in Buffer Non-CSR (42.9% vs 35.1%).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages show notably higher female MUAC malnutrition than Non-CSR (29.1% vs 22.3%), especially SC caste (40.9% vs 15.4%); ST caste again reverses (10.9% vs 35.1%).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages also run higher than Non-CSR for women on average (27.0% vs 19.5%), but ST caste is the one group where Non-CSR is worse (42.9% vs 26.3%).

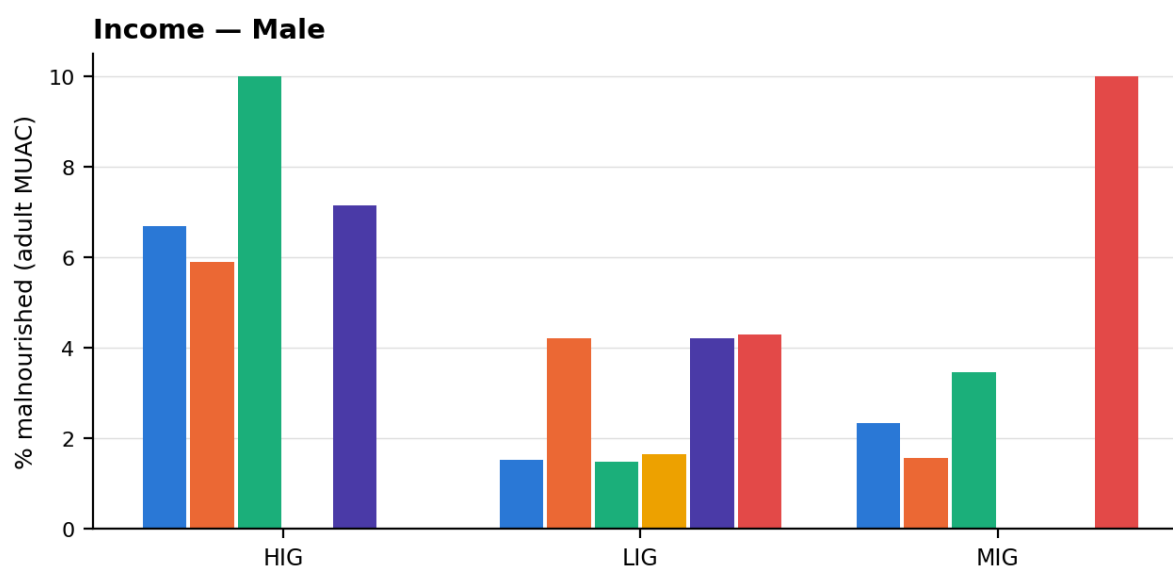


- **Core vs Buffer:** Buffer men show modestly higher average MUAC malnutrition than Core (2.4% vs 1.9%); high-school men show the largest gap (4.9% vs 0.7%), while graduates reverse it (Core higher, 6.8% vs 2.8%).
- **Core CSR vs Buffer CSR:** The same high-school gap appears within CSR villages (4.6% vs 1.0%), with graduates again reversing (6.4% vs 1.9%).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage, Buffer high-school men are the standout group (5.9% vs 0%), though overall averages are close (2.9% vs 2.1%).
- **Core CSR vs Core Non-CSR:** CSR status makes little difference within Core on average (1.8% vs 2.1%) — direction varies by education level rather than showing one pattern.

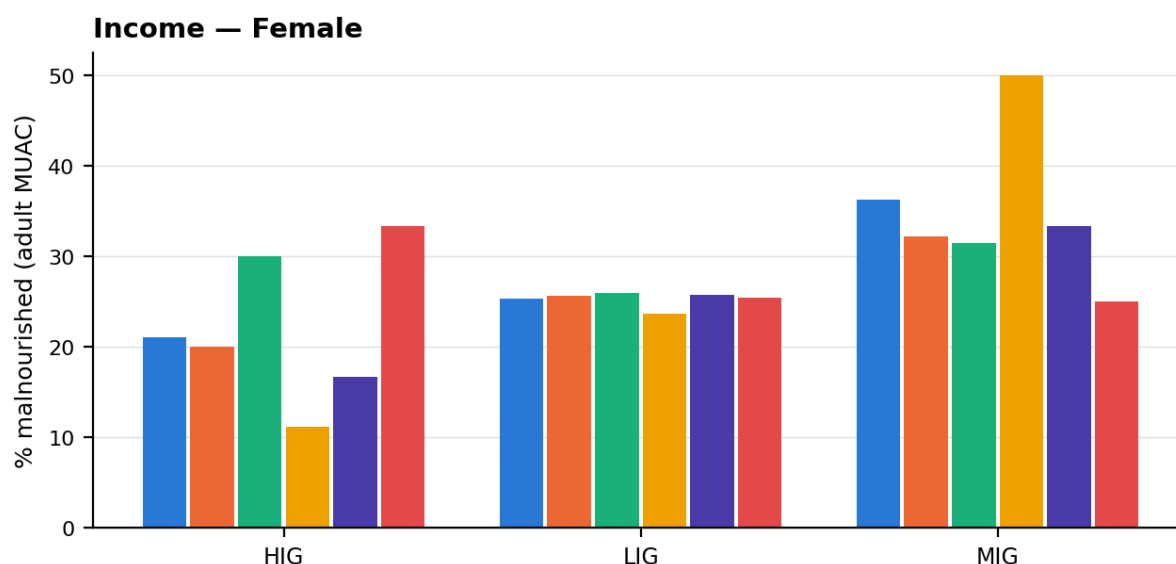
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages run somewhat lower than Non-CSR on average (2.2% vs 2.9%), most clearly among graduates (1.9% vs 5.6%).



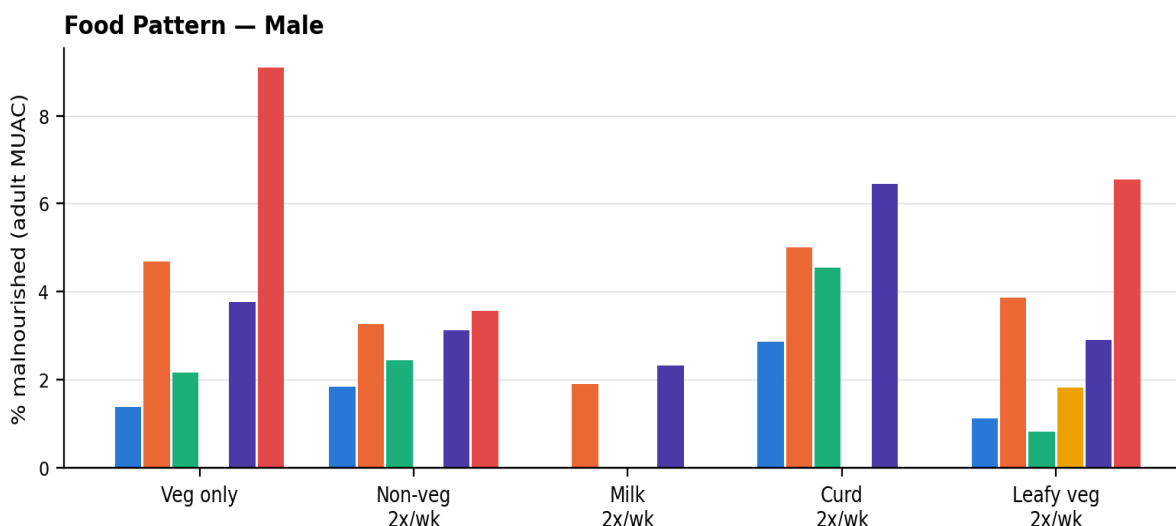
- **Core vs Buffer:** Buffer women show higher average MUAC malnutrition than Core across education levels (28.5% vs 23.1%), with post-graduate women showing the largest gap (30.8% vs 10.0%, small sample).
- **Core CSR vs Buffer CSR:** The gap is similar within CSR villages (27.8% vs 21.8%), again concentrated in the small post-graduate group (25.0% vs 0%).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the Buffer disadvantage is largest of the whole report — driven by a single post-graduate Buffer Non-CSR woman recorded as malnourished (100%, n=1) alongside a broadly higher Buffer average (42.9% vs 24.9%).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages average slightly lower female malnutrition than Non-CSR (21.8% vs 24.9%), with basic-education women the exception (37.0% vs 26.3%).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages average markedly lower than Non-CSR (27.8% vs 42.9%), though this is heavily influenced by the single extreme post-graduate case noted above.



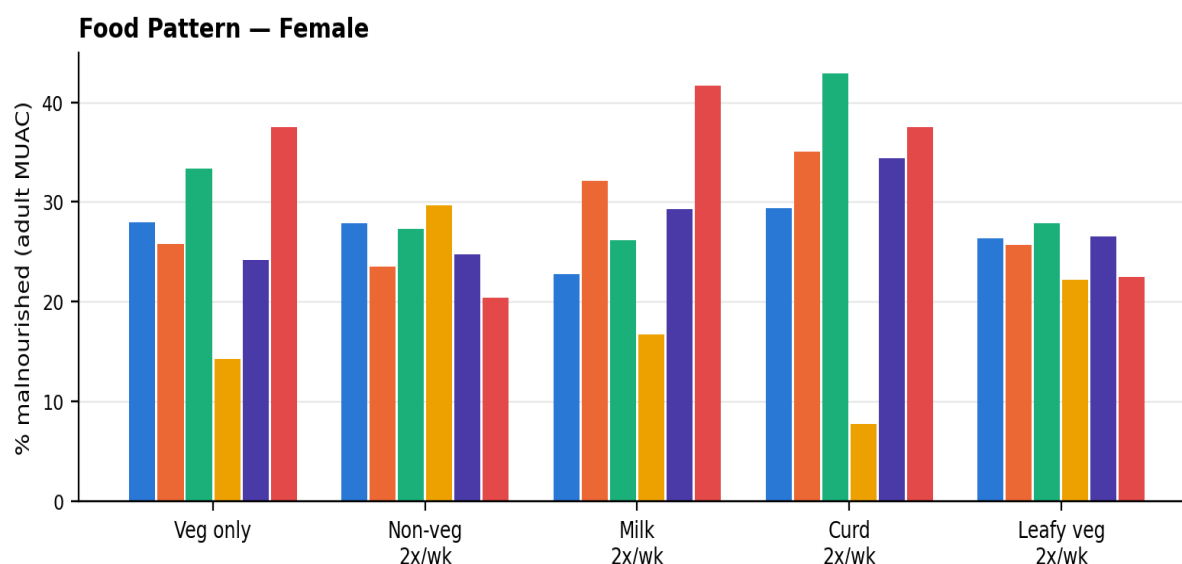
- **Core vs Buffer:** Core and Buffer men show similar overall MUAC malnutrition (3.5% vs 3.9%), with low-income (LIG) men somewhat higher in Buffer (4.2% vs 1.5%).
- **Core CSR vs Buffer CSR:** Core CSR men run slightly higher than Buffer CSR on average (5.0% vs 3.8%), driven by high-income (HIG) men (10.0% vs 7.1%, small sample).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage, Buffer Non-CSR men are clearly worse off on average (4.8% vs 0.6%), especially middle-income (MIG) men (10.0% vs 0%, small sample).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages show much higher average male malnutrition than Non-CSR (5.0% vs 0.6%), led by the small HIG group (10.0% vs 0%).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR and Non-CSR average out similarly for men (3.8% vs 4.8%), with MIG men notably worse outside CSR (10.0% vs 0%, small sample).



- **Core vs Buffer:** Core and Buffer women show broadly similar average MUAC malnutrition (27.5% vs 25.9%), with middle-income (MIG) women slightly higher in Core (36.2% vs 32.1%).
- **Core CSR vs Buffer CSR:** Core CSR women average higher than Buffer CSR (29.1% vs 25.2%), mainly through high-income (HIG) women (30.0% vs 16.7%, small sample).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the two zones average out closely (28.3% vs 27.9%), though HIG and MIG groups swing in opposite directions on small samples.
- **Core CSR vs Core Non-CSR:** CSR status makes little average difference within Core for women (29.1% vs 28.3%), with HIG women notably higher under CSR (30.0% vs 11.1%, small sample).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR women average slightly lower than Non-CSR (25.2% vs 27.9%), driven by the small HIG group (16.7% vs 33.3%).



- **Core vs Buffer:** Buffer men show higher average MUAC malnutrition than Core across every food-pattern group (3.7% vs 1.4%), most clearly among curd consumers (5.0% vs 2.9%) and vegetarians (4.7% vs 1.4%).
- **Core CSR vs Buffer CSR:** The same pattern holds within CSR villages (3.7% vs 2.0%), again led by curd consumers (6.5% vs 4.6%).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the Buffer disadvantage is starkest among vegetarians (9.1% vs 0%) and frequent leafy-vegetable eaters (6.6% vs 1.8%).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages show higher average male malnutrition than Non-CSR (2.0% vs 0.4%), across most food groups.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR and Non-CSR average out closely for men (3.7% vs 3.8%), though vegetarians fare worse outside CSR (9.1% vs 3.8%).



- **Core vs Buffer:** Core and Buffer women show broadly similar overall MUAC malnutrition (26.9% vs 28.4%), with milk consumers notably higher in Buffer (32.1% vs 22.7%).
- **Core CSR vs Buffer CSR:** Core CSR women average higher than Buffer CSR (31.5% vs 27.8%), led by vegetarians (33.3% vs 24.1%) and curd consumers (42.9% vs 34.4%).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage, Buffer Non-CSR women are markedly worse off across most groups (31.9% vs 18.1%), especially curd (37.5% vs 7.7%) and milk consumers (41.7% vs 16.7%).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages show much higher average female malnutrition than Non-CSR (31.5% vs 18.1%), most sharply among curd consumers (42.9% vs 7.7%).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages average somewhat lower than Non-CSR for women (27.8% vs 31.9%), led by lower rates among vegetarians and milk consumers.

Major inferences from site-to-site differences

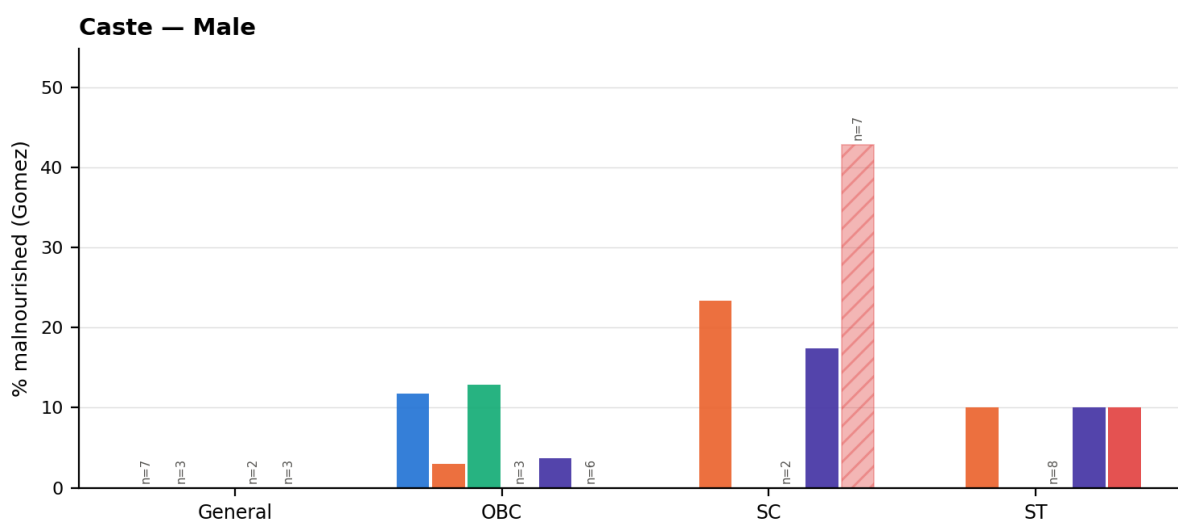
- MUAC flags a far larger share of women than men as malnourished at every site — typically 20-40% of women versus under 5% of men. This is not necessarily a true sex gap in nutritional status; it largely reflects the fixed adult MUAC cutoffs used here (male ≤ 22.5 cm, female ≤ 23 cm), which appear to classify a much broader band of women as at-risk than the equivalent male threshold. MUAC and BMI results should be read together rather than either alone, especially for women.
- For men, the Core-vs-Buffer pattern mirrors the BMI report: Buffer villages show consistently higher MUAC malnutrition than Core villages across caste, education, income and food-pattern domains, and the gap is largest outside CSR coverage.
- For women, the zone pattern does not mirror BMI and is far less consistent. In several domains (Caste, Income) Core women show slightly higher average MUAC malnutrition than Buffer women — the opposite of the BMI finding — while Education and parts of Food Pattern still show Buffer higher. This suggests MUAC and BMI are not simply capturing the same underlying pattern for women at these sites.
- CSR coverage does not show a clear, consistent nutritional benefit for either sex on this indicator. Within Core villages, CSR sites often show equal or higher MUAC malnutrition than Non-CSR sites for both men and women — the reverse of what a protective CSR effect would predict. Within Buffer villages, CSR sites tend to look somewhat better than Non-CSR, but the size of that advantage varies widely by domain.
- ST caste is the one group that repeatedly reverses the overall pattern for women: in Caste comparisons, ST women show higher MUAC malnutrition in Buffer and in Non-CSR villages than their Core/CSR counterparts, even where every other caste in the same comparison runs the opposite way. This recurring reversal is worth investigating on its own rather than averaging it away.
- Several of the largest reported differences rest on very small or extreme cells — a single post-graduate woman in Buffer Non-CSR villages accounts for a 100% malnutrition rate, and HIG income and General caste groups often include fewer than 15 people per site. These cells should be treated as indicative only and are best interpreted after pooling across sites or survey rounds, not as stable site-level estimates.

Gomez Classification Malnutrition and Socioeconomic Factors - Comparative panel charts across all six survey sites (Based on Tables 4.1(a)–4.6(a): Core, Buffer, Core CSR, Core Non-CSR, Buffer CSR, and Buffer Non-CSR villages.)

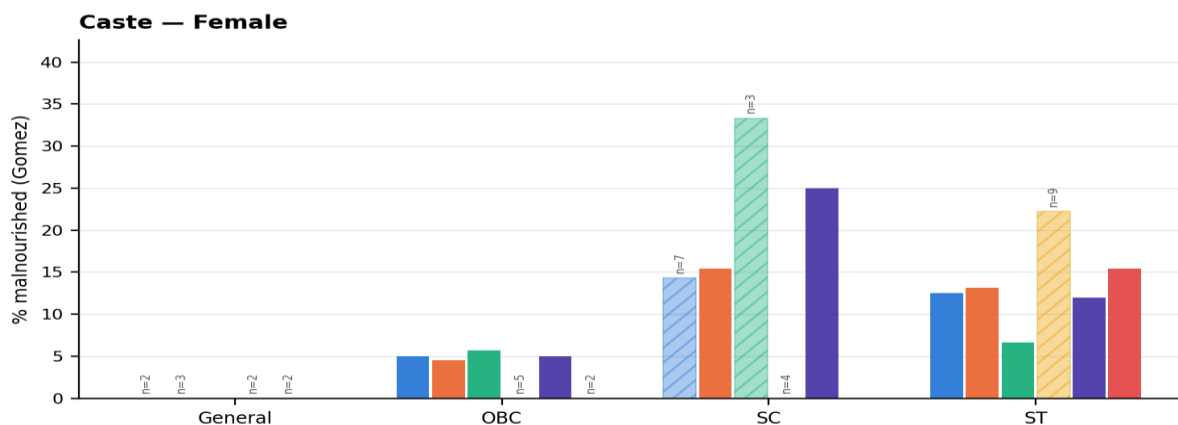
Each chart shows the percentage of children aged 5–18 classified as malnourished under the Gomez classification (weight-for-age below 60% of standard), grouped by household socioeconomic category and split by sex. Bars are color-coded by site so the six locations can be compared directly within each category.

Note: Gomez eligibility is limited to school-age children in each household subgroup, so many site-by-category cells are built on far fewer children than the adult BMI or MUAC tables. Any bar drawn from fewer than 10 eligible children is shown hatched and faded, with its exact count printed above it — these should be read as indicative only, not as stable site-level rates.

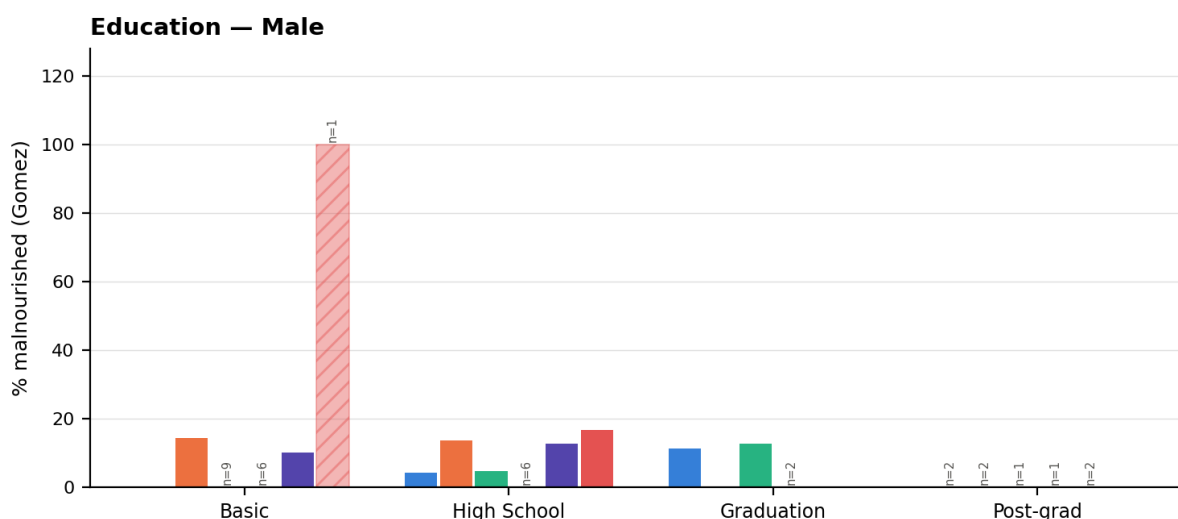
■ Core ■ Core CSR ■ Buffer CSR Eligible n < 10 (low confidence)
■ Buffer ■ Core Non-CSR ■ Buffer Non-CSR



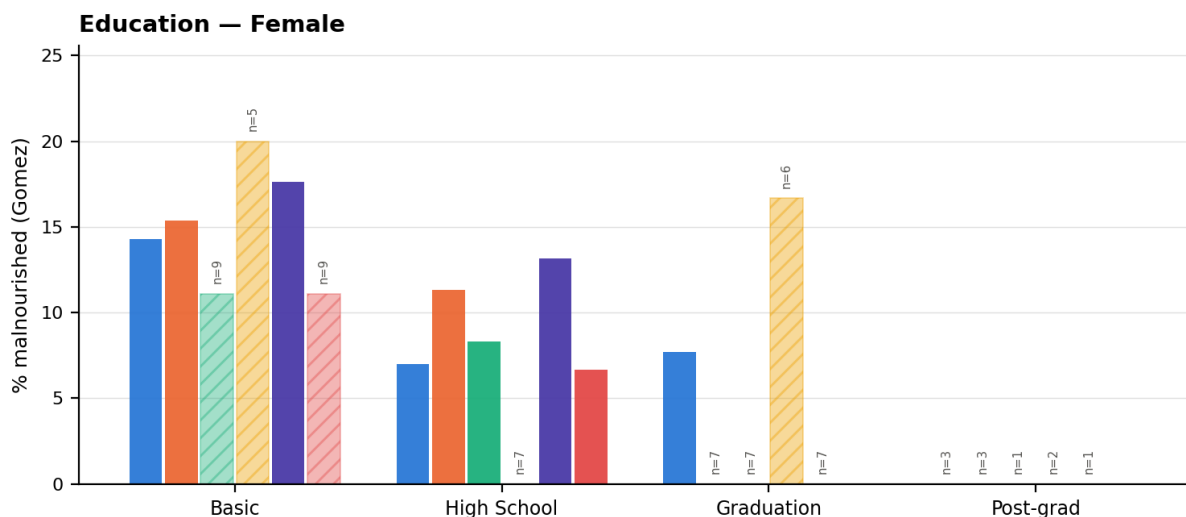
- **Core vs Buffer:** Buffer boys show much higher Gomez malnutrition than Core boys on average (9.1% vs 2.9%), driven by SC caste (23.3% vs 0%, small Core sample of 13) and ST caste (10.0% vs 0%).
- **Core CSR vs Buffer CSR:** The same direction holds within CSR villages (10.4% vs 4.3%), with SC caste again the largest gap (17.4% vs 0%, n=11 in Core CSR).
- **Core Non-CSR vs Buffer Non-CSR:** Outside CSR coverage the gap widens further (17.6% vs 0%), but every Core Non-CSR caste cell here has fewer than 10 boys, so this comparison is low-confidence.
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages average higher than Non-CSR (4.3% vs 0%), led by OBC boys (12.9% vs 0%); all Core Non-CSR caste cells are small samples ($n \leq 8$).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, Non-CSR villages run higher on average (17.6% vs 10.4%), mainly through SC caste (42.9% vs 17.4%, Non-CSR sample only 7 boys).



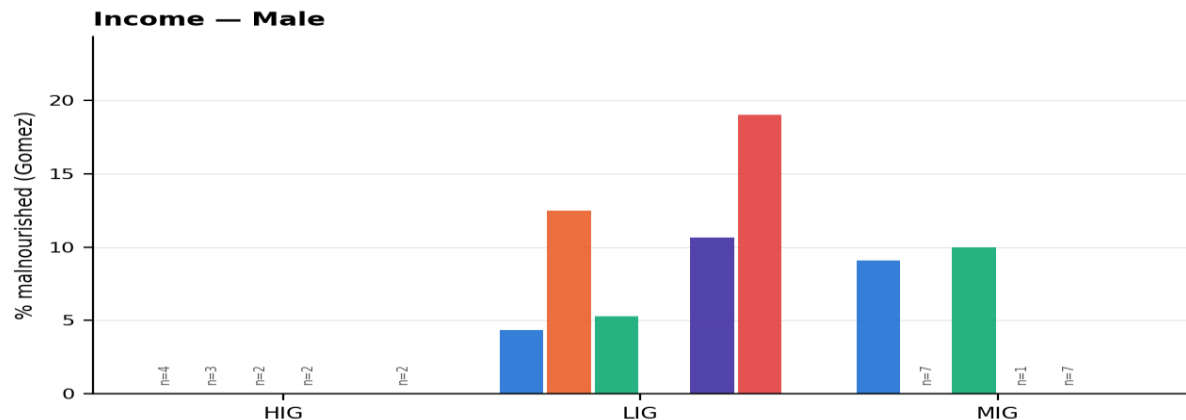
- **Core vs Buffer:** Core and Buffer girls show almost identical overall Gomez malnutrition (7.9% vs 8.3%), with caste-level direction varying — SC and ST slightly higher in Buffer, OBC slightly higher in Core.
- **Core CSR vs Buffer CSR:** Core CSR girls average somewhat higher than Buffer CSR (15.2% vs 14.0%), led by SC caste (33.3% vs 25.0%, both on samples under 20).
- **Core Non-CSR vs Buffer Non-CSR:** Core Non-CSR girls average higher than Buffer Non-CSR (7.4% vs 5.1%), entirely on very small samples (4-13 girls per cell).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages average markedly higher than Non-CSR (15.2% vs 7.4%), led by SC caste (33.3% vs 0%, Core CSR SC sample only 3 girls).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages also average higher than Non-CSR (14.0% vs 5.1%), driven by OBC (5.0% vs 0%) and SC caste (25.0% vs 0%).



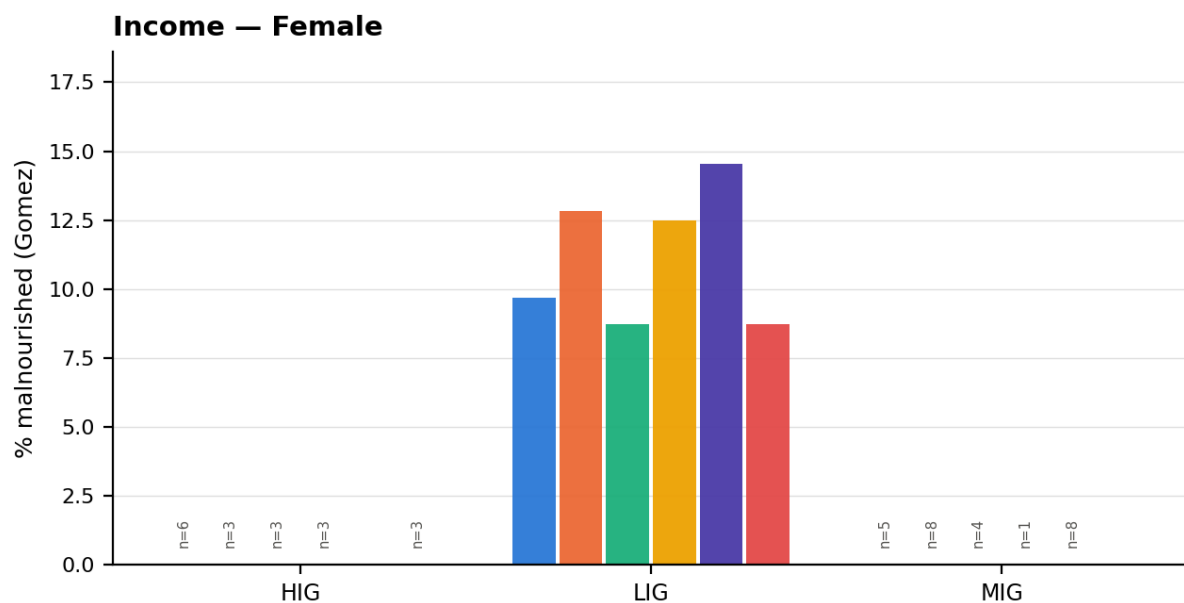
- **Core vs Buffer:** Buffer boys average higher Gomez malnutrition than Core (7.0% vs 3.8%), led by basic education (14.3% vs 0%) and high school (13.6% vs 4.1%); graduates reverse this (Core higher, on small samples).
- **Core CSR vs Buffer CSR:** The same direction holds within CSR villages (5.6% vs 4.3%), again led by basic education and high school.
- **Core Non-CSR vs Buffer Non-CSR:** This is the least reliable comparison in the report: Core Non-CSR shows 0% across both available categories (n=6 each), while Buffer Non-CSR includes a single basic-education boy recorded as 100% malnourished (n=1) alongside a more moderate high-school rate (16.7%, n=18).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages average higher than Non-CSR (4.3% vs 0%), though every Core Non-CSR education cell here has 9 or fewer boys.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, the large apparent Non-CSR disadvantage (58.3% vs 11.3% average) is almost entirely the single n=1 basic-education case; the high-school comparison alone (12.5% vs 16.7%) is far more modest and better supported.



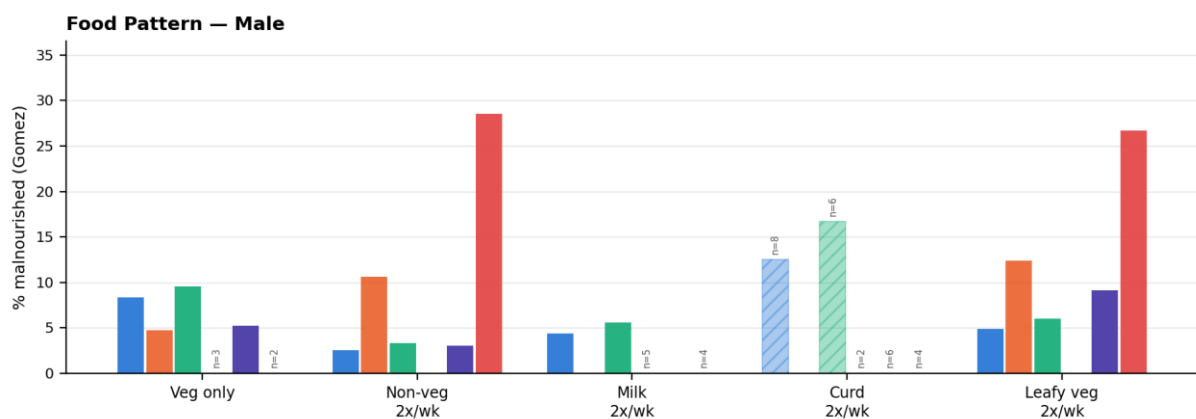
- **Core vs Buffer:** Core and Buffer girls average out closely overall (7.2% vs 6.7%), with basic-education and high-school girls slightly higher in Buffer and graduates slightly higher in Core (small samples throughout).
- **Core CSR vs Buffer CSR:** Buffer CSR girls average somewhat higher than Core CSR (7.7% vs 4.9%), consistently across basic education and high school.
- **Core Non-CSR vs Buffer Non-CSR:** Core Non-CSR girls average slightly higher than Buffer Non-CSR (10.0% vs 8.9%), on samples of 5-15 girls per cell.
- **Core CSR vs Core Non-CSR:** Within Core, Non-CSR villages average higher than CSR (9.2% vs 4.9%), but every Core Non-CSR cell here has fewer than 10 girls.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages average higher than Non-CSR (15.4% vs 8.9%), led by high-school girls (13.2% vs 6.7%).



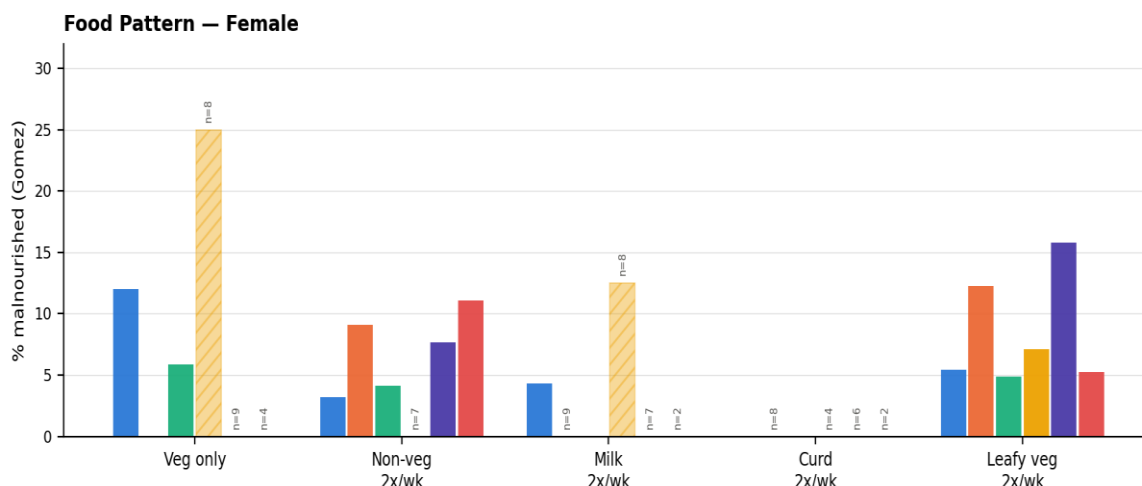
- **Core vs Buffer:** Core and Buffer boys average out closely overall (4.5% vs 4.2%), with low-income (LIG) boys higher in Buffer (12.5% vs 4.4%) and middle-income (MIG) higher in Core (9.1% vs 0%, small samples).
- **Core CSR vs Buffer CSR:** Core CSR boys average higher than Buffer CSR (7.6% vs 5.3%), mainly through the small MIG group (10.0% vs 0%, n=10 vs 7).
- **Core Non-CSR vs Buffer Non-CSR:** Buffer Non-CSR boys average higher than Core Non-CSR (9.5% vs 0%), on the LIG group alone (19.1% vs 0%, both samples under 25).
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages average higher than Non-CSR (5.1% vs 0%), though Core Non-CSR income cells here are very small (n≤12).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, Non-CSR runs higher than CSR on the one comparable group, LIG boys (19.1% vs 10.7%).



- **Core vs Buffer:** Buffer girls average slightly higher Gomez malnutrition than Core (4.3% vs 3.2%), driven by the LIG group (12.8% vs 9.7%).
- **Core CSR vs Buffer CSR:** The same direction holds within CSR villages (7.3% vs 4.3%, LIG group), with Buffer CSR notably higher.
- **Core Non-CSR vs Buffer Non-CSR:** Core Non-CSR girls average higher than Buffer Non-CSR (6.3% vs 4.3%), on the LIG group alone (12.5% vs 8.7%).
- **Core CSR vs Core Non-CSR:** Within Core, Non-CSR villages average slightly higher than CSR (4.2% vs 2.9%), on small LIG samples (16 vs 46 girls).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages average higher than Non-CSR (14.6% vs 8.7%) on the LIG group, the largest income-domain gap for girls in the report.



- **Core vs Buffer:** Core and Buffer boys average out closely overall (6.5% vs 5.6%), with direction varying by food group — non-veg and leafy-vegetable eaters higher in Buffer, vegetarians and curd consumers higher in Core.
- **Core CSR vs Buffer CSR:** Core CSR boys average higher than Buffer CSR (8.2% vs 3.5%), led by curd consumers (16.7% vs 0%, samples of 6 each).
- **Core Non-CSR vs Buffer Non-CSR:** Buffer Non-CSR boys average higher than Core Non-CSR (11.1% vs 0%), mainly through non-veg (28.6% vs 0%) and leafy-vegetable eaters (26.7% vs 0%) — all on samples under 15.
- **Core CSR vs Core Non-CSR:** Within Core, CSR villages average higher than Non-CSR across every food group (8.2% vs 0%), though Core Non-CSR samples here are consistently small ($n \leq 12$).
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, Non-CSR runs higher than CSR on average (11.1% vs 3.5%), driven by non-veg (28.6% vs 3.0%) and leafy-vegetable eaters (26.7% vs 9.1%).



- **Core vs Buffer:** Core and Buffer girls average out closely overall (5.0% vs 4.3%), with vegetarians notably higher in Core (12.0% vs 0%) and leafy-vegetable eaters higher in Buffer (12.3% vs 5.5%).
- **Core CSR vs Buffer CSR:** Buffer CSR girls average somewhat higher than Core CSR (4.7% vs 3.0%), led by leafy-vegetable eaters (15.8% vs 4.9%).
- **Core Non-CSR vs Buffer Non-CSR:** Core Non-CSR girls average higher than Buffer Non-CSR (8.9% vs 3.3%), driven by vegetarians (25.0% vs 0%, sample of 8 vs 4) and milk consumers (12.5% vs 0%).
- **Core CSR vs Core Non-CSR:** Within Core, Non-CSR villages average higher than CSR (8.9% vs 3.0%), again led by vegetarians (25.0% vs 5.9%) on small samples.
- **Buffer CSR vs Buffer Non-CSR:** Within Buffer, CSR villages average higher than Non-CSR (4.7% vs 3.3%), mainly through leafy-vegetable eaters (15.8% vs 5.3%).

Major inferences from site-to-site differences

- Sample size, not just malnutrition rate, is the dominant issue for this indicator. Because Gomez eligibility is limited to school-age children within each household subgroup, roughly half of the 90 site-by-category cells rest on fewer than 10 children per sex, and a handful (e.g. Buffer Non-CSR basic-education boys, n=1) produce 0% or 100% purely from a single case. Any single-cell comparison in this report should be read alongside its eligible N, not taken as a stable site-level rate.
- For boys, the Core-vs-Buffer pattern broadly mirrors the BMI and MUAC reports: Buffer villages average higher Gomez malnutrition than Core across caste, education, and food-pattern domains, and the gap widens further outside CSR coverage. Income is the exception, where Core and Buffer boys average out closely.
- For girls, the zone pattern is much weaker and often flat. Core and Buffer girls average within 1-2 points of each other in Caste, Education, Income and Food Pattern alike — a sharp contrast to the clear Buffer disadvantage seen for girls' BMI in the earlier report. Gomez, BMI and MUAC do not appear to be telling the same story for girls at these sites.
- CSR villages consistently show higher, not lower, average Gomez malnutrition than Non-CSR villages within the same zone, for both sexes and in nearly every domain. This is the opposite of a protective CSR effect and is the most consistent CSR-related pattern across all three malnutrition indicators covered so far — though given how thin the Non-CSR samples are in several domains, it may partly reflect which children were eligible for assessment rather than a true CSR effect.
- Caste remains the most consistent socioeconomic fault line: SC caste children show some of the largest and most repeated site gaps in the report (e.g. Buffer boys 23.3% vs Core 0%; Buffer CSR girls 25.0% vs Buffer Non-CSR 0%), appearing across multiple site-pair comparisons rather than in just one.
- Given the small-sample issues throughout, the most defensible use of this Gomez data is to look for patterns that repeat across several site-pair comparisons at once (as with caste above) rather than to treat any single comparison as conclusive. Pooling categories, extending the survey round, or reporting confidence intervals alongside percentages would substantially strengthen future versions of this table.

Test of statistical significance

The pooled adult-level data is tested for comparisons of CSR vs non-CSR villages within each caste, education, income, and diet category. The appropriate analysis is a two-sided Pearson chi-square test where expected cell counts were adequate, and Fisher's exact test for sparse 2×2 tables. The estimates are based on *moderate-to-severe malnutrition* counts and adult denominators, not household counts.

Main findings

There is evidence of lower malnutrition prevalence in CSR villages for several groups:

- **ST adults combined:** 5.1% in CSR villages versus 16.1% in non-CSR villages; difference = -10.9 percentage points; $p < 0.001$.
- **Low-income adults combined:** 6.4% versus 11.9%; difference = -5.5 percentage points; $p = 0.006$.
- **Non-vegetarian adults combined:** 6.1% versus 12.7%; difference = -6.5 percentage points; $p = 0.010$.
- Among females specifically, the CSR–non-CSR difference is statistically significant for **ST women** and **low-income women**.

The other comparisons do not meet the conventional 5% significance threshold, though absence of statistical significance is not proof that the groups have identical prevalence—several strata have very small samples and few malnutrition cases.

Consolidated results

“Difference” is CSR prevalence minus non-CSR prevalence; therefore, a negative value indicates lower malnutrition prevalence in CSR villages. “Fisher” was used when expected cell counts were sparse.

Category	Sex	CSR prevalence, n/N	Non-CSR prevalence, n/N	Difference (pp)	Test	p-value	Interpretation
General caste	Male	0.0%, 0/14	5.0%, 1/20	-5.0	Fisher	1.000	Not significant
General caste	Female	11.8%, 2/17	0.0%, 0/20	+11.8	Fisher	0.204	Not significant
General caste	Combined	6.5%, 2/31	2.5%, 1/40	+4.0	Fisher	0.577	Not significant
OBC	Male	6.9%, 12/174	3.1%, 1/32	+3.8	Fisher	0.697	Not significant
OBC	Female	9.0%, 17/189	14.3%, 4/28	-5.3	Fisher	0.489	Not significant
OBC	Combined	8.0%, 29/363	8.3%, 5/60	-0.3	Fisher	1.000	Not significant
SC	Male	7.5%, 7/93	7.9%, 3/38	-0.4	Fisher	1.000	Not significant
SC	Female	3.8%, 4/104	6.1%, 2/33	-2.2	Fisher	0.631	Not significant
SC	Combined	5.6%, 11/197	7.0%, 5/71	-1.5	Fisher	0.770	Not significant
ST	Male	5.3%, 8/152	12.5%, 9/72	-7.2	Chi-square	0.056	Borderline; not significant at 5%
ST	Female	5.0%, 8/159	20.0%, 13/65	-15.0	Chi-square	<0.001	Significant
ST	Combined	5.1%, 16/311	16.1%, 22/137	-10.9	Chi-square	<0.001	Significant
Basic education	Male	6.6%, 4/61	5.9%, 2/34	+0.7	Fisher	1.000	Not significant
Basic education	Female	9.2%, 7/76	21.9%, 7/32	-12.7	Fisher	0.113	Not significant
Basic education	Combined	8.0%, 11/137	13.6%, 9/66	-5.6	Chi-square	0.209	Not significant
High school	Male	7.4%, 19/256	11.8%, 11/93	-4.4	Chi-square	0.194	Not significant
High school	Female	7.1%, 18/253	13.3%, 10/75	-6.2	Chi-square	0.091	Not significant
High school	Combined	7.3%, 37/509	12.5%, 21/168	-5.2	Chi-square	0.036	Significant
Graduation	Male	4.0%, 4/100	3.3%, 1/30	+0.7	Fisher	1.000	Not significant
Graduation	Female	4.1%, 5/122	2.9%, 1/34	+1.2	Fisher	1.000	Not significant
Graduation	Combined	4.1%, 9/222	3.1%, 2/64	+0.9	Fisher	1.000	Not significant
Post-graduation	Male	0.0%, 0/16	0.0%, 0/5	0.0	Fisher	1.000	No cases; no evidence of difference
Post-graduation	Female	5.6%, 1/18	20.0%, 1/5	-14.4	Fisher	0.395	Not significant
Post-graduation	Combined	2.9%, 1/34	10.0%, 1/10	-7.1	Fisher	0.407	Not significant
High income	Male	4.2%, 1/24	0.0%, 0/8	+4.2	Fisher	1.000	Not significant
High income	Female	4.5%, 1/22	8.3%, 1/12	-3.8	Fisher	1.000	Not significant
High income	Combined	4.3%, 2/46	5.0%, 1/20	-0.7	Fisher	1.000	Not significant

Low income	Male	6.4%, 21/326	10.0%, 13/130	-3.6	Chi-square	0.192	Not significant
Low income	Female	6.3%, 23/364	14.0%, 16/114	-7.7	Chi-square	0.009	Significant
Low income	Combined	6.4%, 44/690	11.9%, 29/244	-5.5	Chi-square	0.006	Significant
Middle income	Male	6.0%, 5/83	4.2%, 1/24	+1.9	Fisher	1.000	Not significant
Middle income	Female	8.4%, 7/83	10.0%, 2/20	-1.6	Fisher	1.000	Not significant
Middle income	Combined	7.2%, 12/166	6.8%, 3/44	+0.4	Fisher	1.000	Not significant
Completely vegetarian	Male	7.1%, 7/99	5.3%, 2/38	+1.8	Fisher	1.000	Not significant
Completely vegetarian	Female	4.5%, 5/111	0.0%, 0/29	+4.5	Fisher	0.584	Not significant
Completely vegetarian	Combined	5.7%, 12/210	3.0%, 2/67	+2.7	Fisher	0.529	Not significant
Non-vegetarian	Male	5.3%, 11/209	12.2%, 10/82	-6.9	Chi-square	0.040	Significant
Non-vegetarian	Female	7.1%, 14/198	13.2%, 10/76	-6.1	Chi-square	0.111	Not significant
Non-vegetarian	Combined	6.1%, 25/407	12.7%, 20/158	-6.5	Chi-square	0.010	Significant

The prevalence of moderate-to-severe malnutrition was compared between adults residing in CSR-beneficiary and non-CSR villages within caste, education, income, and dietary subgroups. Pearson's chi-square test was used where expected frequencies were adequate; Fisher's exact test was applied to sparse tables. Statistically lower prevalence in CSR villages was observed among Scheduled Tribe adults (5.1% vs 16.1%, $p < 0.001$), adults with high-school education (7.3% vs 12.5%, $p = 0.036$), low-income adults (6.4% vs 11.9%, $p = 0.006$), and non-vegetarian adults (6.1% vs 12.7%, $p = 0.010$). The difference among ST women was especially pronounced (5.0% vs 20.0%, $p < 0.001$).

A synthesis of main findings/inferences

The results indicate a persistent and uneven burden of undernutrition across the ITPS influence area, with particular vulnerability among women, children, Scheduled Tribe (ST) and Scheduled Caste (SC) households, low-income households, and many buffer-zone communities. CSR-associated villages show some favourable patterns for selected adult subgroups, but the cross-sectional results do not establish programme impact and point to the need for more gender-responsive, geographically differentiated, and nutrition-sensitive CSR programming.

Main findings and inferences

- **Malnutrition remains a substantive concern in both core and buffer villages.** BMI-, MUAC-, and Gomez-based measures each identify undernutrition among adults and children, although the magnitude and pattern vary by indicator. The results therefore support use of a combined nutrition-monitoring approach rather than reliance on any one measure.
- **Adult women constitute the most consistently vulnerable group.** Across most social, educational, income and food-intake categories, women had higher BMI-based and especially MUAC-based undernutrition than men. Female MUAC undernutrition was commonly in the 20–40 percent range in several sites and social groups.
- **Women's nutrition risks persist even where households report consumption of milk, curd, leafy vegetables or non-vegetarian foods.** This indicates that reported frequency of selected foods is not a sufficient measure of dietary adequacy; quantity, dietary diversity, affordability, meal frequency, intra-household food allocation, disease burden and care practices also matter.
- **ST and SC communities face particularly high nutritional risk, although the leading vulnerable group differs by location and indicator.** Severe BMI malnutrition and low MUAC were prominent among ST women and children in several non-CSR and buffer sites, while severe Gomez undernutrition was especially high among SC children in several buffer-village comparisons.
- **Low-income households carry the largest burden of undernutrition in absolute terms.** In the pooled core–buffer sample, BMI malnutrition was 12.0 percent among low-income adults, compared with 4.3 percent among middle-income and 3.0 percent among high-income adults; income association with BMI malnutrition was statistically significant.

- **Education is associated with nutritional disadvantage, but not in a simple linear manner.** In the pooled sample, education was significantly associated with adult BMI malnutrition; however, the highest observed prevalence occurred among persons with high-school education rather than those with the least education. This is likely to reflect linked factors such as livelihood insecurity, employment conditions, age, household composition or income rather than education itself.
- **Buffer villages generally experience greater nutritional disadvantage than core villages, especially in BMI outcomes.** Buffer-zone men showed higher BMI malnutrition than core-zone men in most caste, education, income and food-pattern comparisons. For women, buffer BMI malnutrition was also generally higher, with particularly large gaps among ST and lower-education groups.
- **The combination of buffer location and social disadvantage intensifies risk.** SC/ST status, lower educational attainment and low income tend to compound the geographical disadvantage of buffer residence, suggesting that CSR interventions should not treat all villages or households as equally vulnerable.
- **Non-CSR areas show a pronounced caste gradient in adult BMI malnutrition.** In pooled non-CSR villages, caste was significantly associated with BMI malnutrition: ST adults had 18.2 percent prevalence, compared with 7.0 percent among SC adults, 3.3 percent among OBC adults and 2.5 percent among General-category adults.
- **CSR villages do not show a uniform nutritional advantage across all indicators or population groups.** In pooled CSR areas, no tested socioeconomic or dietary variable had a statistically significant bivariate association with BMI malnutrition, suggesting that malnutrition is distributed across groups rather than confined to a single subgroup. However, this should not be interpreted as evidence that CSR has eliminated inequity.
- **There is suggestive evidence of lower adult BMI malnutrition in CSR villages for selected vulnerable groups.** Compared with non-CSR villages, CSR villages had significantly lower prevalence among ST adults (5.1 percent versus 16.1 percent), low-income adults (6.4 percent versus 11.9 percent), high-school-educated adults (7.3 percent versus 12.5 percent), and adults reporting non-vegetarian intake (6.1 percent versus 12.7 percent). The reduction was especially marked among ST women (5.0 percent versus 20.0 percent).
- **The observed CSR–non-CSR differences should be treated as associations, not causal effects.** CSR and non-CSR villages were not randomly assigned; the analysis is cross-sectional and largely bivariate, and village populations may differ in caste composition, income, age, sex, access to services and other baseline conditions.
- **Child undernutrition requires focused attention, but child-level estimates are less stable.** Gomez and child MUAC findings identify important risk among SC/ST boys and girls, especially in buffer and non-CSR locations. However, many child subgroups have small eligible samples, so extreme percentages should be interpreted cautiously and verified through repeat monitoring.
- **BMI, MUAC and Gomez indicators do not always tell the same story, particularly for women and girls.** This may partly reflect what each measure captures and the use of fixed MUAC cut-offs. Programme decisions should therefore triangulate indicators with clinical assessment, dietary information, morbidity data and household food-security conditions.

Recommendations

- **Adopt a differentiated CSR nutrition strategy for core and buffer zones.** Core-zone programmes should focus on closing persistent gender and household-level nutrition gaps, while buffer-zone programming should receive enhanced intensity because BMI-based malnutrition is generally higher there, particularly among socially disadvantaged groups.
- **Prioritise women and adolescent girls as the central target group.** CSR interventions should include regular screening, nutrition counselling, anaemia prevention and referral, diversified supplementary nutrition where required, reproductive and maternal nutrition support, and counselling on equitable household food allocation. Adult women should not be addressed only as caregivers; they should be treated as direct nutrition beneficiaries.
- **Develop an ST- and SC-responsive outreach model.** High-risk ST and SC hamlets should receive proactive household visits, community nutrition sessions in locally appropriate formats, targeted screening camps, referral support and linkage with ICDS, health facilities, PDS, social protection and livelihood schemes.
- **Use risk-based household targeting, not only village-level targeting.** A simple vulnerability register should identify households with low income, pregnant or lactating women, adolescent girls, under-five children, school-age children with low weight, persons with severe undernutrition, recurrent illness, disability, food insecurity or difficult access to services.
- **Give additional priority to buffer non-CSR villages.** The elevated prevalence among ST adults and several SC/ST child groups in non-CSR buffer locations supports expansion of CSR coverage or establishment of a dedicated nutrition-and-livelihood outreach package for these settlements.
- **Move beyond food-frequency messaging to diet-quality interventions.** Rather than advising households merely to consume milk, curd, leafy vegetables or non-vegetarian foods more often, CSR should promote

affordable, locally available, diverse diets that combine cereals/millet, pulses, eggs or other protein sources, vegetables, fruits where feasible, fats and micronutrient-rich foods.

□ **Strengthen household food security and livelihoods alongside nutrition education.** Since low-income adults show substantially higher BMI malnutrition, nutrition interventions should be integrated with livelihood strengthening, kitchen gardens, small livestock or poultry, women's producer groups, skills development, financial inclusion, wage-employment linkages and timely access to public entitlements.

□ **Improve women's control over food and health resources.** CSR programmes should engage men, mothers-in-law and household decision-makers on women's dietary needs, meal priority during pregnancy and lactation, adolescent nutrition, health-care seeking and equitable allocation of nutritious foods within the household.

□ **Institute regular integrated nutrition screening.** Conduct six-monthly or annual screening using BMI for adults, MUAC for children/adolescents and adults, and age-appropriate child growth indicators. Screening should include immediate counselling, referral pathways, follow-up visits and a confidential tracking system for moderate and severe cases.

□ **Use child-focused measures with stronger age-group targeting.** For young children, link CSR activities closely with ICDS, Anganwadi Centres, Village Health Sanitation and Nutrition Days and routine immunisation. For school-age children and adolescents, support periodic school health and nutrition screening, deworming linkage, menstrual hygiene support, nutrition education and referral for growth faltering.

□ **Strengthen convergence rather than duplicate public systems.** CSR should complement ICDS, NHM, PDS, mid-day meals/PM POSHAN, Poshan Abhiyaan, school health programmes, tribal welfare schemes and social-security programmes. The company's comparative role is to close delivery gaps, support last-mile access, improve awareness, finance local facilitation and monitor vulnerable households.

□ **Design women-centred community platforms.** Self-help groups, mothers' groups, adolescent-girl groups and village-level nutrition committees can be used for counselling, cooking demonstrations, kitchen gardens, nutrition planning, entitlements support and follow-up of high-risk women and children.

□ **Establish a stronger monitoring, evaluation and learning system.** All CSR nutrition projects should maintain baseline, annual and endline data disaggregated by sex, age, caste, income group, core/buffer location and CSR exposure. Indicators should include BMI, MUAC, child growth, dietary diversity, meal frequency, food insecurity, anaemia/referral status, morbidity and uptake of public services. Future evaluations should use a quasi-experimental design with baseline and endline data, comparable intervention and comparison villages, adequate sample sizes, person-level data, and multivariable analysis controlling for sex, age, caste, income, education and village-level differences.

□ **Address small-sample limitations in future surveys.** Increase the sample of children, ST/SC households, women in high-risk age groups and smaller socioeconomic categories.

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