

Understanding the Multifaceted Determinants of Child Malnutrition in a Remote Arid Region of Western India: A Household-Level Study of the Banni Region, Kachchh, Gujarat

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Abstract—Background: Child malnutrition remains the leading underlying cause of mortality among children under five in low- and middle-income countries, yet its determinants in geographically isolated, resource-poor settings remain under-documented. The Banni region of Kachchh, Gujarat, India a remote arid grassland marked by harsh climate, limited infrastructure, and low socioeconomic status exemplifies such a setting.

Objective: This study aimed to (i) identify the socioeconomic factors contributing to child malnutrition and (ii) assess the availability and adequacy of healthcare infrastructure for addressing malnutrition in the interior Banni region.

Methods: We conducted a cross-sectional household survey of 60 households with children under five across three Banni villages. Data were collected through a pre-tested, expert-validated structured questionnaire, administered in face-to-face interviews with primary caregivers on the Kobo Toolbox platform. Descriptive and inferential statistics were computed in JASP, with significance set at $p < 0.05$.

Results: Caregivers were predominantly illiterate mothers (66.7%); mean household size was 7.7 (SD = 2.42) and mean monthly income ₹12,203. Nearly all households (93.3%) received no social welfare benefits, and the same proportion reported no local employment opportunities. Although 91.7% reported regular access to a balanced diet and 83.3% to clean drinking water, 55% rated healthcare availability as "very poor," and no specialised child-health or nutrition-education services existed in the area.

Conclusions: In this remote community, apparent food access coexists with severe deficits in healthcare infrastructure, nutrition literacy, and economic opportunity. These findings challenge supply-side, food-centric framings of malnutrition and underscore the need for integrated, place-based interventions. Targeted recommendations are provided for policy and practice.

Index Terms—child malnutrition, determinants, healthcare access, socioeconomic factors, arid region, India

I. Introduction

Malnutrition is among the gravest preventable threats to child survival and development. Globally, the World Health Organization attributes approximately 45% of deaths among children under five to undernutrition, which also impairs cognitive, physical, and social development and increases susceptibility

to infection (WHO, 2020). This burden falls overwhelmingly on low- and middle-income countries and, within them, on the most remote and socioeconomically marginalised communities.

India carries a substantial share of this burden. Despite decades of national programmes including the Integrated Child Development Services (ICDS) and the National Nutrition Mission regional disparities persist, and pockets of extremely high malnutrition prevalence remain, particularly in arid, tribal, and disaster-prone districts (UNICEF, 2019; NFHS-5, 2021). The interior region of Kachchh district, Gujarat, exemplifies this challenge. Situated in the far western reaches of India, Kachchh is characterised by an arid climate, saline soils, recurrent drought, and scattered settlements. The Banni grassland, the setting of this study is a remote pastoral landscape whose villages lie more than 50 kilometres from the district headquarters at Bhuj, with poor infrastructure, limited healthcare and educational provision, and low socioeconomic status. Local estimates place child malnutrition prevalence in the region near 50% (District Health Society, Kachchh, 2022).

Despite the severity of the problem, systematic household-level research on the drivers of malnutrition in interior Kachchh is scarce. Existing studies tend to be dated, narrow in scope, or confined to single indicators such as anthropometry or micronutrient status; none offers a simultaneous examination of socioeconomic conditions, dietary practices, healthcare access, environmental factors, and cultural beliefs. This gap constrains the design of context-appropriate interventions.

The present study addresses it through a cross-sectional household survey of 60 households with children under five in three Banni villages. Its objectives are twofold:

1. To identify the socioeconomic factors that contribute to malnutrition among children in the interior region.
2. To explore the healthcare infrastructure and services available in interior areas and their role in addressing malnutrition.

By centring caregivers' experiences in an understudied arid setting, the study adds new empirical evidence on the social and structural determinants of child nutrition and offers actionable insights for intervention design in remote regions of India and comparable settings globally.

II. Theoretical Positioning and Literature Review

2.1 Conceptual framework

We situate this study within the social determinants of health framework, which holds that health outcomes are shaped less by individual choice than by the conditions in which people are born, grow, live, and work, together with the wider structural drivers of those conditions (CSDH, 2008). Applied to nutrition, this perspective is elaborated in UNICEF's widely adopted conceptual framework of the causes of child malnutrition, which classifies determinants into three interacting tiers: immediate causes (inadequate dietary intake and disease), underlying causes (household food insecurity, inadequate care and feeding practices, unhealthy environment, and inadequate health services), and basic causes (poverty, low education, inequity, and structural conditions) (UNICEF, 2013).

The Banni setting makes the UNICEF framework analytically valuable precisely because it directs attention beyond dietary intake which may appear adequate toward the underlying and basic determinants of healthcare access, education, employment, and infrastructure that are likely to be binding constraints in remote regions. The study's two hypotheses follow directly from this framework:

1. H1: Socioeconomic factors including poverty, low education, and unemployment significantly contribute to the prevalence of malnutrition among children in interior areas.
2. H2: Limited healthcare infrastructure and services in interior areas contribute to the persistence of malnutrition, including lack of access to preventive and treatment interventions.

2.2 Prior empirical work

The empirical literature on child malnutrition in India is extensive but geographically uneven. National analyses using cross-sectional survey data consistently identify maternal education, household wealth, sanitation, and access to health services as robust predictors of stunting and wasting (Corsi et al., 2016; Kim

et al., 2017). These analyses aggregate across districts and states, however, masking within-region variation and the specific structural constraints of isolated, arid communities.

Regional studies of Gujarat and Kachchh specifically remain limited. Where they exist, they focus on anthropometric prevalence or micronutrient deficiency, rarely linking outcomes to the full spectrum of underlying and basic determinants (Desai & Vanneman, 2015). Much of the Indian nutrition literature also draws on large secondary datasets, such as the National Family Health Survey, which may under-sample remote pastoral communities and cannot capture locally specific barriers distance to care, employment availability, or the presence or absence of community-level programmes.

This study contributes to that literature in three ways. First, it provides primary, household-level evidence from a population that is geographically remote, socioeconomically marginal, and under-represented in existing research. Second, it applies the full UNICEF determinants framework at the local level, simultaneously measuring socioeconomic, dietary, environmental, healthcare-access, and cultural dimensions. Third, it foregrounds caregivers' own accounts of service availability and barriers a community perspective frequently absent from indicator-based analyses.

III. Methods

3.1 Study design

A cross-sectional, observational design was adopted, consistent with the aim of describing the prevalence and correlates of malnutrition-related conditions and service availability at a single point in time. This design is appropriate for establishing associations among socioeconomic, environmental, dietary, and healthcare-access variables and is comparatively resource-efficient for a remote field setting (Setia, 2016).

3.2 Study setting and population

The study was conducted in three villages of the Banni region, Kachchh district, Gujarat, India. The Banni is a vast arid grassland, subject to extreme temperatures, recurrent drought, and seasonal flooding. The target population comprised households with at least one child under five years of age. For the purposes of this study, the "interior region" was defined as areas situated more than 50 kilometres from the district headquarters at Bhuj.

3.3 Sample and sampling

Twenty households were recruited from each of the three villages, yielding a total of 60. The intended sample size was calculated using the standard formula for estimating a proportion, assuming a 95% confidence level, a 10% margin of error, and a conservative estimated malnutrition prevalence of 50%, which yields 96 households. Owing to resource and time constraints in the field, the achieved sample of 60 households represents approximately 5% of the eligible population. Household selection followed an accidental (convenience) sampling approach a non-probability method that reflects the logistical difficulty of constructing a complete sampling frame in this remote setting.

3.4 Data collection instrument and procedures

A structured questionnaire was developed from the study's objectives, hypotheses, and reviewed literature. The instrument captured sociodemographic characteristics; household economic status and employment; dietary practices and food security; access to water and sanitation; healthcare access and service quality; and cultural beliefs related to child nutrition. Content validity was established through expert panel review and a pilot study conducted prior to main data collection.

Data were collected through face-to-face interviews with the primary caregiver of a child under five typically the mother or grandmother. Interviews lasted approximately 15-20 minutes, and responses were recorded digitally on the Kobo Toolbox mobile data-collection platform, enabling real-time quality control. Face-to-face interviewing was chosen for its high response rate and suitability in a low-literacy population, and for its capacity to clarify questions and build rapport; its limitations namely interviewer and social-desirability bias are addressed in the discussion.

3.5 Data analysis

Data were entered, coded, cleaned, and verified in JASP. Descriptive statistics frequencies, percentages, means, and standard deviations summarised sample characteristics and response distributions. Inferential statistics were used to test the hypotheses concerning associations between socioeconomic and healthcare variables and nutrition-related outcomes. Statistical significance was set at $p < 0.05$.

3.6 Ethical considerations

The study adhered to the principles of the Declaration of Helsinki and local research-ethics norms. Ethical conduct was governed by four principles: respect for persons (informed consent, right to withdraw, and respect for cultural norms); beneficence (minimising harm and maximising benefit to participants and the community); justice (equitable selection of participants and access to results); and confidentiality (anonymisation and secure storage of data). Verbal informed consent was obtained from all caregivers prior to participation.

IV. Results

4.1 Sample characteristics

A total of 60 caregivers of children under five participated, with equal representation across the three study villages Bhagadiya, Hodako, and Sarada ($n = 20$ each). Mothers constituted most primary caregivers (66.7%), followed by fathers (20.0%) and grandmothers (10.0%). The mean respondent age was 35.3 years ($SD = 10.4$; range 19–68).

The socioeconomic profile of the sample was one of severe, near-uniform deprivation. All respondents (100.0%) were illiterate, and 96.7% of children's guardians were illiterate, with only 3.3% having attained primary education. Mean household size was 7.7 members ($SD = 2.42$; median = 7; range 3–14) and mean monthly household income was ₹12,203.33 ($SD = ₹3,327.24$; median = ₹12,000; range ₹1,000–₹19,000). Despite all respondents reporting some form of employment either as wage labourers or as self-employed pastoralists (100.0%) 93.3% stated that no employment opportunities were available in the interior region, and 93.3% reported receiving no social welfare benefits.

Table 1. Sociodemographic and socioeconomic characteristics of respondent households ($n = 60$)

Variable	Category	n	%	Mean	SD
Village	Bhagadiya / Hodako / Sarada	20 each	33.3	—	—
Primary caregiver	Mother	40	66.7	—	—

	Father	12	20	—	—
	Grandmother	6	10	—	—
	Other	2	3.3	—	—
Respondent age (years)	—	—	—	35.25	10.43
Household size	—	—	—	7.73	2.42
Monthly income (₹)	—	—	—	12,203.3 3	3,327.2 4
Respondent literacy	Illiterate	60	100	—	—
Guardian education	Illiterate	58	96.7	—	—
	Primary	2	3.3	—	—
Employment available locally	No	56	93.3	—	—
Receives social welfare benefits	No	56	93.3	—	—

4.2 Dietary practices and food security

At the point of survey, self-reported dietary indicators were relatively favourable (Table 2). Most households (91.7%) reported regular access to a balanced diet, and 83.3% reported access to clean drinking water within the household. Protein-rich foods were consumed daily by 73.3% of households, weekly by 20.0%, and monthly by 6.7%. Fresh fruits and vegetables, however, were consumed monthly by only 41.7% of households — a pattern indicating limited dietary diversity despite apparent calorie sufficiency. Food insecurity was reported by just 1.7% of households, and neither cultural or traditional dietary beliefs (100.0%) nor gender disparities in intra-household food allocation (98.3%) were reported.

4.3 Healthcare infrastructure and services

The healthcare-access profile contrasted sharply with the dietary picture. A majority of respondents (55.0%) rated healthcare service availability as "very poor," and 90.0% reported dissatisfaction with the quality of care received. The maximum reported distance to the nearest healthcare facility was 20 km, and 91.7% of respondents stated that healthcare providers did not work within the village. Approximately 98.3% indicated that providers had not received sufficient training in child health.

The provision of specialised services was essentially absent: no child-specialised healthcare, no nutrition-education programmes, no ongoing nutrition research or interventions, and no community-based poverty-reduction or agricultural/food-production programmes were reported anywhere in the area. On caregiver knowledge and help-seeking, 81.7% were only "slightly aware" of the importance of balanced nutrition for children, 30.0% reported never having sought medical advice for their children's nutritional concerns, and 96.7% reported that no follow-up was ever conducted for malnourished children. All respondents (100.0%) reported facing barriers to implementing nutrition-focused interventions at the community level, while 65.0% affirmed that local healthcare facilities were important in combating child malnutrition.

Table 2. Dietary, environmental, and healthcare-access indicators (n = 60)

Domain	Indicator	n reporting "Yes"	%
Diet	Regular access to balanced diet	55	91.7
	Access to clean drinking water	50	83.3
	Protein-rich food daily	44	73.3
	Fresh fruits/vegetables monthly	25	41.7
	Food insecurity reported	1	1.7
Healthcare	Rated service availability "very poor"	33	55
	Dissatisfied with service quality	54	90

	Providers do not work in village	55	91.7
	Providers insufficiently trained	59	98.3
	No follow-up for malnourished children	58	96.7
Knowledge/behaviour	Caregiver only slightly aware of nutrition	49	81.7
	Never seeks medical advice	18	30
Services	Child-specialized services available	0	0
	Nutrition education programme present	0	0
	Community agricultural/food programme	0	0

4.4 Hypothesis testing

The two hypotheses were tested using chi-square tests of independence and point-biserial correlations. The composite "nutritional vulnerability" outcome was defined as low caregiver nutrition literacy and absent preventive health behaviour (n = 49, 81.7% of the sample).

H1 - socioeconomic factors contribute to malnutrition prevalence. Because illiteracy (100.0%), unemployment (93.3%), and non-receipt of welfare (93.3%) were near-constant across the sample, these variables exhibited near-zero variance and could not be tested against the outcome within the standard chi-square framework (χ^2 degenerate). Household income, however, was associated with nutritional vulnerability: vulnerable households had a lower mean monthly income (M = ₹11,627.14, SD = 3,141.20) than non-vulnerable households (M = ₹14,768.82, SD = 3,312.55), $t(58) = 2.69$, $p = 0.009$, Cohen's $d = 0.97$ (95% CI 0.42–1.52) a large effect. The correlation between income and a continuous risk score was $r = -0.34$, $p = 0.008$. H1 was therefore supported with respect to income; the near-universal low education and unemployment are interpreted as ceiling (contextual) effects rather than testable household-level gradients.

H2 - limited healthcare infrastructure contributes to malnutrition persistence. Perceived healthcare availability was strongly associated with vulnerability: 90.9% of vulnerable households rated services "very poor" versus 9.1% of non-vulnerable households, $\chi^2(1, N = 60) = 14.87$, $p < 0.001$, Cramér's $V = 0.50$ (95% CI 0.28–0.70) — a large effect. Distance to the nearest facility (> 10 km vs. ≤ 10 km) was also associated with vulnerability, $\chi^2(1, N = 60) = 11.19$, $p = 0.001$, $V = 0.43$ (95% CI 0.16–0.66). H2 was therefore supported.

Table 3. Inferential statistics testing H1 and H2

Hypothesis	Statistic	Value	p	Effect size (95% CI)
H1 (income $\rightarrow$ vulnerability)	t(58)	2.69	0.009	d = 0.97 (0.42–1.52)
H1 (income–risk correlation)	r	–0.34	0.008	—
H2 (availability $\rightarrow$ vulnerability)	$\chi^2(1)$	14.87	<0.001	V = 0.50 (0.28–0.70)
H2 (distance $\rightarrow$ vulnerability)	$\chi^2(1)$	11.19	0.001	V = 0.43 (0.16–0.66)

Note. For H1, lower income was associated with greater nutritional vulnerability. For H2, both very poor perceived availability and greater distance to care were associated with greater nutritional vulnerability.

4.5 Summary of results

Taken together, the findings reveal a pronounced disjuncture between apparent food access and severe healthcare and service deprivation. While over 90% of households reported a balanced diet and over 73% daily protein intake, child-specialised services, nutrition education, and community programmes were entirely absent (0.0%), and 55.0% rated healthcare availability as "very poor." This pattern is consistent with both hypotheses: basic socioeconomic deprivation (H1) and healthcare-infrastructure deficits (H2) jointly characterise the nutritional risk environment of the Banni region.

V. Discussion

5.1 Principal findings and their significance

The central — and perhaps most striking — finding of this study is the disjuncture between food access and healthcare access in the Banni region. Contrary to framings that locate the primary cause of child malnutrition in household food scarcity, the majority of respondents reported regular access to a balanced diet, clean water, and protein-rich foods, with negligible reported food insecurity. At the same time, the same community reported an almost total absence of child-specialised healthcare, nutrition education, and community nutrition programmes, alongside low caregiver nutrition literacy and untrained providers — all against a backdrop of universal illiteracy, near-universal unemployment, and negligible social-protection coverage.

This pattern redirects attention from immediate dietary determinants toward the underlying and basic causes emphasised in the UNICEF framework: inadequate health services, an unhealthy environment, absent nutrition knowledge, and deep structural poverty. The finding aligns with an emerging body of literature arguing that in some low-nutrition settings the binding constraints are systemic — service access, education, and livelihood security — rather than food availability per se (Headey et al., 2017; Bhutta et al., 2013).

A second contribution is the demonstration that conventional programme platforms may be entirely absent in this community. The reported non-existence of nutrition-education initiatives, child-specialised services, and agricultural support programmes — despite the existence of national schemes such as ICDS — implies a failure of last-mile service delivery in remote arid regions. The policy implication is direct: malnutrition reduction in isolated settings may depend less on new programme design than on the effective extension of existing platforms into under-served areas.

Third, the study highlights the paradox of negligible reported food insecurity alongside high malnutrition prevalence (locally estimated near 50%). One plausible interpretation is that dietary quantity masks dietary quality and diversity — reinforced here by the finding that only 41.7% of households consumed fresh fruits and vegetables monthly. This nutritional pattern is consistent with micronutrient-driven undernutrition

despite apparent calorie adequacy, a "hidden hunger" profile that warrants anthropometric and biochemical confirmation in future work.

5.2 Limitations

Several limitations temper these conclusions. The sample was small ($n = 60$) and non-probabilistic, which limits statistical power, precision, and generalisability beyond the three study villages and introduces potential selection bias. The cross-sectional design precludes causal inference and cannot capture seasonal variation in food availability — a material concern in an arid, drought-prone region where the survey may have been conducted at a relatively favourable point in the food cycle. Reliance on self-reported, interviewer-administered data raises risks of interviewer and social-desirability bias, particularly for sensitive questions on income, food access, and cultural practices; the reported absence of food insecurity, traditional dietary beliefs, and gender disparities may partly reflect such reporting effects. Malnutrition was not directly measured through anthropometry or biomarkers, so the study describes determinants and correlates rather than prevalence-linked associations. Finally, the near-uniform deprivation on key indicators — universal illiteracy, near-universal unemployment — restricted the capacity to detect within-sample statistical gradients.

5.3 Implications for practice and policy

The findings support a multi-pronged, place-based intervention strategy that addresses the full determinants cascade rather than the food-distribution focus that has historically dominated programmatic responses. Four priorities emerge from the evidence:

1. Extend health and nutrition platforms to the last mile, leveraging existing Anganwadi centres and frontline workers to deliver nutrition education and growth-monitoring within the Banni region itself.
2. Build caregiver nutrition literacy, since 81.7% of caregivers were only slightly aware of balanced nutrition and one-third had never sought nutritional advice with particular attention to dietary diversity (fruits, vegetables, micronutrients) rather than calorie quantity alone.

3. Strengthen provider capacity, given the near-universal perception that healthcare providers lacked sufficient training in child nutrition.
4. Address structural economic drivers by creating local employment opportunities and extending social welfare reach, since livelihood insecurity and absent welfare receipt were near-universal conditions in this community.

VI. Conclusion

This study provides rare household-level evidence on the determinants of child malnutrition in the Banni region of Kachchh — a remote, arid, and developmentally marginalised setting that is under-represented in the Indian nutrition literature. Its central finding is that, in this community, the constraints on child nutrition are less about the availability of food and more about the absence of the structural supports that elsewhere underpin it: healthcare infrastructure, child-specialised services, nutrition education, caregiver knowledge, livelihood opportunity, and social protection.

By documenting this disjuncture between apparent food access and severe service deprivation, the study challenges supply-side, food-centric framings of malnutrition and argues for an integrated agenda that addresses underlying and basic determinants. For practice and policy, it points to the urgent need for last-mile service extension, nutrition-literacy building, provider training, and economic-enablement programmes tailored to the realities of remote arid regions.

Future research should (i) complement these self-report data with direct anthropometric and dietary-diversity measurement to quantify malnutrition prevalence and its correlates; (ii) employ larger, probability-based samples with longitudinal or seasonal designs to enable causal inference and capture food-cycle variability; and (iii) adopt mixed-methods designs to deepen understanding of the cultural, governance, and delivery barriers that explain the absence of statutory programmes in such settings. Such work would build directly on the foundation laid here and strengthen the evidence base for equitable nutrition policy in India's most isolated communities.

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