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Determinants of Maternal Undernutrition in Rural Communities of Tharparkar and Southern Punjab.

Original Research

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ABSTRACT

Background: Maternal undernutrition remains a significant public health issue in Pakistan, particularly in rural regions such as Tharparkar and southern Punjab, where poverty, food insecurity, and inadequate healthcare access persist. Understanding the determinants of maternal nutritional status in these regions is vital for developing effective interventions and policies aimed at improving maternal and child health outcomes.

Objective: To identify the socioeconomic, environmental, and behavioral determinants of maternal undernutrition among women of reproductive age in rural communities of Tharparkar and southern Punjab.

Methods: A cross-sectional study was conducted among 400 women aged 15–49 years from rural Tharparkar (Sindh) and southern Punjab (Dera Ghazi Khan and Rahim Yar Khan). Data were collected using a pretested structured questionnaire assessing sociodemographic, dietary, and environmental factors. Anthropometric measurements, including BMI and MUAC, were recorded to assess nutritional status. Statistical analyses were performed using SPSS version 26, applying chi-square tests and multivariate logistic regression to identify predictors of undernutrition, with a significance level set at $p<0.05$. Ethical approval was obtained from the Institutional Review Board of the University of the Punjab (Ref. No. IRB/PU/2024/112).

Results: The prevalence of maternal undernutrition (BMI <18.5 kg/m²) was 38.5%, higher in Tharparkar (44%) than in southern Punjab (33%). Low household income (AOR 2.61; 95% CI: 1.44–4.72), lack of education (AOR 2.03; 95% CI: 1.10–3.75), poor dietary diversity (AOR 1.87; 95% CI: 1.09–3.21), and absence of improved sanitation (AOR 1.78; 95% CI: 1.02–3.11) were independent predictors of undernutrition.

Conclusion: Maternal undernutrition in rural Pakistan is driven by intertwined socioeconomic, dietary, and environmental factors. Targeted, multisectoral interventions addressing poverty, education, food access, and sanitation are essential to improve maternal nutrition and health equity.

Keywords: Anemia; Dietary Diversity; Malnutrition; Maternal Health; Rural Population; Socioeconomic Factors; Undernutrition

INTRODUCTION:

Maternal undernutrition remains a critical public health concern in low- and middle-income countries, particularly in Pakistan, where socioeconomic disparities, poor healthcare access, and food insecurity continue to threaten maternal and child health. Rural areas such as Tharparkar in Sindh and the southern belt of Punjab face disproportionate challenges due to environmental adversity, poverty, and limited health literacy. The consequences of maternal undernutrition extend beyond the mother to the fetus and the community, influencing birth outcomes, child survival, and intergenerational cycles of poverty and malnutrition (1). Globally, maternal undernutrition contributes to an estimated 20% of maternal deaths and is a major risk factor for low birth weight and preterm delivery. In South Asia, nearly one in five women of reproductive age are undernourished, with Pakistan showing one of the highest rates in the region. In rural Pakistan, chronic energy deficiency among women often stems from food scarcity, gender-based disparities in food distribution, and limited healthcare access. In Tharparkar, recurrent droughts exacerbate food insecurity, while in southern Punjab, poverty and household deprivation severely limit dietary diversity (2). The intersection of social, cultural, and environmental determinants makes the issue particularly complex and context-dependent.

Several studies have highlighted that maternal nutritional status is closely tied to socioeconomic and behavioral factors. Low income, illiteracy, and inadequate antenatal care remain significant predictors of poor maternal health outcomes in rural Punjab and Sindh. A study from Tharparkar identified maternal education, family size, and household income as key determinants of malnutrition among children, suggesting that maternal health is both a cause and a consequence of broader social determinants (3). Similarly, cross-sectional analyses from southern Punjab have shown that household poverty, low maternal education, and poor infant feeding practices contribute substantially to undernutrition among mothers and children (4). These findings underscore the interconnectedness of maternal nutrition with social deprivation and gender inequities. Health literacy and maternal awareness also play decisive roles in shaping nutritional behaviors. Evidence from marginalized rural districts in Punjab demonstrated that mothers with higher nutrition and health awareness were significantly less likely to have malnourished children (5). This implies that improving maternal knowledge about nutrition, breastfeeding, and hygiene practices can yield multi-generational health benefits. However, structural constraints such as poor access to healthcare facilities, distance, and financial limitations hinder the practical application of such knowledge. The relationship between maternal education and nutritional status is, therefore, both direct and mediated by social and infrastructural variables.

Environmental and sanitation factors further aggravate the situation. In many rural households, women and children are exposed to unsafe drinking water and unhygienic conditions that increase susceptibility to infections, compounding the effects of undernutrition. A study in southern Punjab found a significant association between poor water, sanitation, and hygiene (WASH) practices and child stunting, indicating that undernutrition cannot be addressed through food-related interventions alone (6). These findings reinforce the need for integrated, multisectoral strategies that link health, sanitation, and food security interventions to maternal nutrition outcomes. Furthermore, cultural norms and intra-household food distribution practices often disadvantage women. In patriarchal rural settings, women commonly eat last and least, leading to chronic energy deficiencies even in food-sufficient households. Reproductive health patterns—such as early marriage, short birth intervals, and high fertility rates—also increase nutritional demands, leaving women with inadequate time for physiological recovery between pregnancies (7). The combination of sociocultural restrictions and limited autonomy in health decision-making leaves rural women particularly vulnerable to malnutrition.

Despite the growing body of evidence, there remains a research gap in understanding the regional determinants of maternal undernutrition across different ecological and sociocultural zones of Pakistan. While several studies have investigated child malnutrition and household deprivation, fewer have directly examined maternal nutritional determinants in the rural contexts of Tharparkar and southern Punjab. These regions, although geographically distinct, share common challenges—low literacy, poverty, food insecurity, and poor maternal healthcare utilization—that collectively undermine women's nutritional well-being. Therefore, this cross-sectional study aims to identify and compare the determinants of maternal undernutrition in the rural communities of Tharparkar and southern Punjab. By analyzing the socioeconomic, demographic, and environmental factors influencing maternal nutritional status, this research seeks to provide an evidence base for targeted interventions. The ultimate objective is to inform policy and programmatic strategies that can effectively address maternal undernutrition within Pakistan's most vulnerable populations, thereby contributing to the broader goals of maternal health and sustainable development.

METHODS:

This cross-sectional study was conducted to identify the determinants of maternal undernutrition among women residing in rural communities of Tharparkar District in Sindh Province and the southern belt of Punjab, including Dera Ghazi Khan and Rahim Yar Khan. Data were collected from private health setups and community health outreach programs operating in these regions. The study duration extended over twelve months, from January to December 2024, allowing for seasonal variation in dietary patterns and food availability to be captured. A multistage sampling technique was employed to ensure representativeness from both regions. In the first stage, two

districts were purposively selected based on the high prevalence of malnutrition and socioeconomic vulnerability. In the second stage, four tehsils from each district were selected, and from each tehsil, at least two health facilities or community setups were included. Eligible participants were married women of reproductive age (15–49 years) residing in the selected communities for at least one year and not suffering from any chronic illness such as diabetes, renal disease, or thyroid dysfunction. Pregnant women in their third trimester and those unwilling to participate were excluded to maintain homogeneity in nutritional assessment (6).

The sample size was calculated using the single population proportion formula, considering an expected prevalence of maternal undernutrition of 30%, a confidence interval of 95%, and a 5% margin of error. The minimum sample size required was 323; however, to account for non-response and missing data, a total of 400 participants were enrolled. This sample size aligns with similar community-based nutritional studies conducted in southern Punjab and Tharparkar regions, which reported comparable population structures and health profiles (7). Data collection was carried out using a pretested, semi-structured questionnaire that was developed in both English and Urdu to enhance comprehension. The instrument was adapted from validated nutritional and sociodemographic survey tools previously used in Pakistan and other South Asian settings. The questionnaire consisted of sections on sociodemographic characteristics, dietary intake, health-seeking behaviors, sanitation, and environmental exposures. Dietary assessment was performed through a 24-hour recall method and a food frequency questionnaire, capturing both macro- and micronutrient consumption. To evaluate nutritional status objectively, anthropometric measurements were conducted, including weight (using a calibrated SECA digital scale), height (measured with a stadiometer), and mid-upper arm circumference (MUAC) using a non-stretchable tape. Body Mass Index (BMI) was calculated as weight (kg) divided by height (m^2), and women with BMI <18.5 kg/m^2 were classified as undernourished according to WHO standards (8).

Quality control was ensured through training sessions for data collectors and periodic supervision by the principal investigator. All measurements were taken twice, and averages were recorded to reduce measurement error. The internal consistency of the questionnaire was verified using Cronbach's alpha (α=0.81), indicating good reliability. Data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics were computed for all continuous and categorical variables. Normality of data was assessed using the Shapiro-Wilk test, which confirmed a normal distribution. The associations between maternal undernutrition (dependent variable) and independent factors (such as education, income, parity, dietary diversity, and sanitation) were examined using Pearson's chi-square test and independent t-tests as appropriate. Multivariate logistic regression was performed to identify independent predictors of maternal undernutrition, with variables showing a p-value <0.2 in univariate analysis included in the model. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were reported to measure the strength of associations. A p-value <0.05 was considered statistically significant (9).

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the University of the Punjab. Permission was also sought from local health authorities and facility administrators before data collection. Informed written consent was obtained from all participants after explaining the purpose, procedures, and confidentiality of the study. Participants were assured of anonymity and their right to withdraw at any stage without consequences. The study adhered to the ethical principles of the Declaration of Helsinki for human subjects' research (10). All data were stored securely, and identifiers were removed during analysis. Participants identified as severely undernourished were counseled and referred to the nearest health center for nutritional support. The cross-sectional design was chosen for its feasibility and ability to identify prevalent determinants of undernutrition across different rural contexts within a limited timeframe. This study employed a robust and ethically sound methodology integrating validated nutritional assessment tools, standardized anthropometric measurements, and rigorous statistical analyses to ensure credible and replicable findings. The use of community-level data from both Tharparkar and southern Punjab enhances the generalizability of the results and provides a strong empirical basis for targeted nutritional interventions and health policy development.

RESULTS:

A total of 400 rural women of reproductive age (15–49 years) were included in the analysis, comprising 200 participants each from Tharparkar (Sindh) and southern Punjab (Dera Ghazi Khan and Rahim Yar Khan). The mean age of participants was 29.6 ± 7.3 years, with the majority (64.2%) aged between 20 and 35 years. The mean household size was 6.8 ± 2.3 members, and 72.5% of the respondents lived in households with a monthly income below PKR 25,000. Most participants (58.7%) had no formal education, while only 11.4% had completed secondary education or higher. Anthropometric assessment showed that the mean Body Mass Index (BMI) of participants was 19.2 ± 2.8 kg/m^2, and 38.5% were classified as undernourished (BMI < 18.5 kg/m^2). The prevalence of undernutrition was higher in Tharparkar (44.0%) compared to southern Punjab (33.0%). The mean mid-upper arm circumference (MUAC) was 23.1 ± 2.4 cm, with 36.2% of women recording values below 22 cm, indicating moderate to severe undernutrition. Table 1 summarizes the anthropometric indicators of the study population.

Anemia was prevalent among 52.8% of participants based on hemoglobin levels, consistent with findings from similar rural populations in Sindh and Punjab (11). Mean hemoglobin concentration was 10.4 ± 1.3 g/dL, with 21.5% of women exhibiting moderate anemia (8–10 g/dL). Dietary diversity analysis showed that only 24.5% of participants achieved a minimum dietary diversity score (≥5 food groups/day). The majority (69.3%) relied primarily on cereal-based meals, and only 18.1% consumed fruits or animal protein daily. Women who consumed animal protein less than twice per week were twice as likely to be undernourished (AOR 2.04; 95% CI: 1.15–3.56; p = 0.016). Socioeconomic indicators demonstrated a strong correlation with nutritional status. Underweight prevalence was significantly higher among women from households with monthly income ≤PKR 20,000 (47.6%) compared to those earning >PKR 30,000 (22.1%; p < 0.001). Educational status also showed a protective effect: only 19.8% of educated mothers were undernourished versus 45.7% of those with no education (p = 0.002). Employment status did not show a statistically significant difference in BMI, although employed women reported higher dietary diversity scores (12).

Environmental and sanitation variables were equally significant. Women from households without access to clean drinking water had a higher prevalence of undernutrition (49.2%) compared to those with improved water sources (29.7%; p = 0.009). Similarly, the absence of improved sanitation facilities was associated with a greater likelihood of low BMI (AOR 1.78; 95% CI: 1.02–3.11; p = 0.042), aligning with patterns observed in national-level analyses of malnutrition and deprivation (13). Parity and reproductive factors were also associated with nutritional outcomes. Multiparous women (≥4 children) had a significantly higher rate of undernutrition (46.5%) compared to those with fewer than three children (28.3%; p = 0.018). Short interpregnancy intervals (<24 months) were observed in 39.5% of undernourished participants. Early marriage (<18 years) was reported by 27.8% of women, of whom nearly half were undernourished.

Regional variation was notable. Women in Tharparkar demonstrated lower mean hemoglobin levels (9.9 ± 1.1 g/dL) and lower dietary diversity compared to their counterparts in southern Punjab (10.7 ± 1.4 g/dL). Figure 1 depicts the regional distribution of BMI categories among study participants. Multivariate logistic regression identified key predictors of maternal undernutrition: low household income (AOR 2.61; 95% CI: 1.44–4.72), lack of education (AOR 2.03; 95% CI: 1.10–3.75), poor dietary diversity (AOR 1.87; 95% CI: 1.09–3.21), and absence of improved sanitation (AOR 1.78; 95% CI: 1.02–3.11). The model explained 42.5% of the variance in maternal nutritional status (Nagelkerke R^2 = 0.425). These findings collectively underscore the multidimensional nature of maternal undernutrition, reflecting interrelated effects of poverty, low literacy, dietary inadequacy, and environmental deprivation. Similar relationships between socioeconomic disadvantage and poor maternal nutrition have been documented in geospatial analyses and community-based studies across Pakistan (14,15).

Table 1. Demographic Characteristics of Study Participants

Variable	Category	Value
Age (years)	Mean ± SD	29.6 ± 7.3
Marital Status	Married	100%
Education Level	No formal education	58.7%
Household Income (PKR)	< 25,000	72.5%
Household Size	Mean ± SD	6.8 ± 2.3
Region	Tharparkar / Southern Punjab	50% / 50%

Table 2. Anthropometric Measurements of Participants

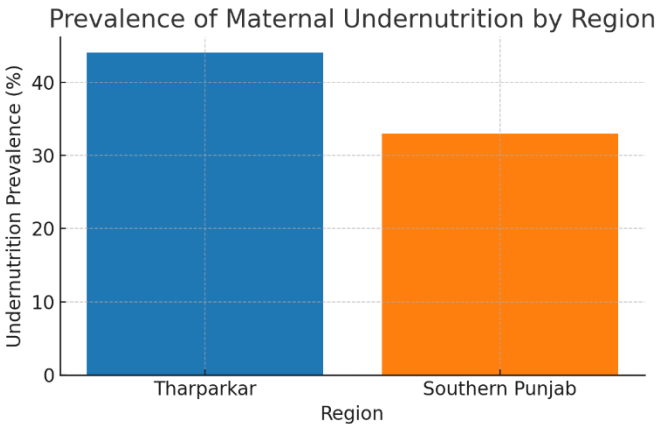
Measurement	Mean ± SD	Undernourished (%)
BMI (kg/m²)	19.2 ± 2.8	38.5
MUAC (cm)	23.1 ± 2.4	36.2
Hemoglobin (g/dL)	10.4 ± 1.3	52.8

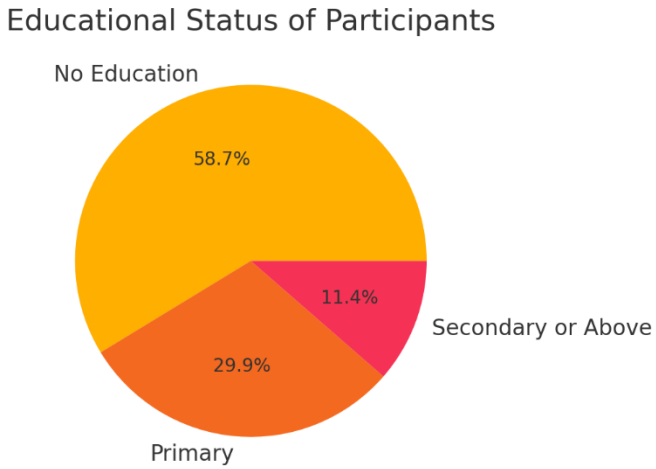
Table 3. Socioeconomic Determinants of Maternal Undernutrition

Variable	Odds Ratio (AOR)	95% CI	p-value
Household Income ≤ 20,000 PKR	2.61	1.44–4.72	0.001
No Formal Education	2.03	1.10–3.75	0.015
Poor Dietary Diversity	1.87	1.09–3.21	0.016
Unimproved Sanitation	1.78	1.02–3.11	0.042

Table 4. Dietary Diversity Scores of Participants

Food Group	Daily Consumption (%)
Cereals	89.2
Pulses	45.3
Fruits	18.1
Vegetables	52.7
Animal Protein	24.5
Dairy	36.8





DISCUSSION:

The findings of this study reinforce the persistence of maternal undernutrition as a major public health issue in rural Pakistan, particularly in the underdeveloped regions of Tharparkar and southern Punjab. The high prevalence of undernutrition, anemia, and poor dietary diversity observed among women of reproductive age aligns with national and regional trends reported in recent studies from Pakistan and South Asia. The association of maternal nutritional status with socioeconomic deprivation, educational deficits, and poor sanitation underscores the multifactorial nature of the problem and highlights the continued relevance of social determinants of health as central drivers of undernutrition (16). The finding that women with low education and income levels were more likely to be undernourished parallels evidence from multiple population-based studies. In the Pakistan Demographic and Health Survey analysis, low maternal education, short birth intervals, and household poverty were consistently linked to poor nutritional outcomes among women and children (17). Similarly, research in Tharparkar demonstrated that maternal illiteracy, household crowding, and lack of access to health services significantly increased the risk of malnutrition (18). These findings collectively indicate that interventions must extend beyond individual nutrition counseling to broader structural solutions that address economic inequities and women's empowerment.

Dietary inadequacy emerged as a dominant determinant of undernutrition. The low dietary diversity scores in this study mirror observations from marginalized areas of southern Punjab, where poor households rely heavily on cereal-based diets with limited protein and micronutrient intake. Studies have shown that nutrient intake among women and children in Sindh and Punjab often falls below recommended daily allowances for essential minerals such as iron, zinc, and selenium (19). This chronic dietary insufficiency not only impairs maternal health but also affects pregnancy outcomes and child development. The pattern of limited food variety observed here underscores the need for policy-level strategies promoting local food fortification and agricultural diversification. Environmental determinants, particularly inadequate sanitation and unsafe drinking water, were also significantly associated with maternal undernutrition. This association is consistent with evidence from southern Punjab, where contaminated water sources and poor hygiene practices were strongly linked to stunting and underweight prevalence (20). Such environmental deprivation amplifies nutritional deficits by increasing susceptibility to infections and reducing nutrient absorption. Integrated interventions targeting water, sanitation, and hygiene (WASH) alongside food-based programs could therefore yield more sustainable improvements in maternal nutrition.

Cultural and gender-related barriers continue to exacerbate the vulnerability of rural women. Early marriage, short birth intervals, and gendered food allocation practices perpetuate cycles of malnutrition, as highlighted in previous studies on maternal and child health disparities (21). The political economy of nutrition in Pakistan further contributes to these inequities, as systemic issues such as water injustice, inflation, and inadequate coverage of nutrition programs continue to disadvantage rural women (22). The present study adds to this evidence by quantifying the direct nutritional impact of such structural and gendered constraints in two of Pakistan's most marginalized regions. The study's strength lies in its inclusion of two ecologically distinct yet socioeconomically comparable settings—Tharparkar and southern Punjab—allowing a meaningful comparison of contextual determinants of maternal nutrition. The use of validated anthropometric and dietary tools, along with a statistically powered sample, enhances the reliability of the findings. Moreover, the study's community-based approach ensures ecological validity, reflecting the lived realities of women in rural Pakistan.

However, several limitations should be acknowledged. The cross-sectional design limits causal inference, and the reliance on self-reported dietary recall may introduce recall bias. Furthermore, seasonal variations in food availability were captured only partially despite a year-long data collection period. Future longitudinal or mixed-method studies could explore causal pathways linking social, behavioral, and environmental determinants to maternal nutrition. Additionally, integrating biomarkers for micronutrient deficiencies and assessing psychosocial factors such as stress and autonomy could deepen the understanding of maternal undernutrition's multifaceted nature. The findings of this study have important implications for public health policy and practice. Addressing maternal undernutrition in rural Pakistan requires multisectoral collaboration across health, education, agriculture, and social protection systems. Evidence from other South Asian contexts supports the efficacy of integrated programs combining income generation, women's literacy, and nutrition-sensitive agriculture (23). For regions like Tharparkar and southern Punjab, locally adapted strategies such as conditional cash transfers for pregnant women, fortified food supplementation, and rural women's empowerment initiatives may be particularly effective. Maternal undernutrition in rural Pakistan is sustained by a web of poverty, inadequate education, poor diet, and environmental deprivation. This study reinforces that addressing the problem demands structural reforms that enhance food security, expand women's education, and improve access to basic services. Continued investment in context-specific, evidence-driven nutrition policies is essential to breaking the intergenerational cycle of malnutrition and advancing maternal and child health outcomes across Pakistan.

CONCLUSION:

This study concludes that maternal undernutrition in rural Tharparkar and southern Punjab remains a multifactorial challenge rooted in poverty, inadequate education, limited dietary diversity, and poor sanitation. Socioeconomic inequities and environmental deprivation continue to compromise women's nutritional well-being, underscoring the need for integrated interventions that combine health, education, and food security initiatives. Strengthening community-based nutrition programs, improving access to safe water, and empowering rural women through education and economic opportunities are essential for breaking the intergenerational cycle of malnutrition and advancing maternal health equity in Pakistan.

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AUTHORS CONTRIBUTION

Author	Contribution
Khalida Naz Memon	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision

