

## Frequency and Risk Factors of Malnutrition in the under 5-year Population in Low and Middle-income areas

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### ABSTRACT

**Background:** Malnutrition remains a major public health challenge among children under five years of age, particularly in low- and middle-income communities. It contributes substantially to impaired physical growth, delayed cognitive development, weakened immunity, and increased vulnerability to infectious diseases. Despite ongoing nutritional programs, the burden of undernutrition in resource-limited settings continues to be high.

**Objective:** To determine the frequency and associated risk factors of malnutrition among children under five years of age residing in low- and middle-income areas, and to generate evidence that may guide targeted nutritional interventions and policy development.

**Methods:** A cross-sectional study was conducted over a six-month period from June to December 2024 at the Department of Pediatric Medicine, University of Lahore, and its affiliated hospitals. A total of 339 undernourished children under five years of age were enrolled. Anthropometric measurements, including height and weight, were recorded using standardized procedures. Data regarding socioeconomic and clinical risk factors were collected through a structured questionnaire. Nutritional status was assessed using indicators of stunting, wasting, and underweight.

**Results:** The prevalence of stunting, wasting, and underweight was 67.0% (95% CI: 62.0–72.0), 61.7% (95% CI: 56.5–66.9), and 69.6% (95% CI: 64.7–74.5), respectively. Malnutrition was most frequently observed among children aged 1–2 years (34.5%). Stunting was slightly more prevalent among boys compared to girls (69.9% vs. 65.3%;  $p < 0.001$ ). Children from low-income households demonstrated markedly higher rates of stunting (78.9% vs. 23.1%) and underweight (78.4% vs. 21.6%) compared with those from middle-income households. Household poverty was significantly associated with underweight status (OR: 2.18; 95% CI: 1.72–2.77;  $p < 0.001$ ). Inadequate caloric intake and poor dietary practices were strongly associated with wasting (83.7%),

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stunting (78.9%), and underweight (80.8%). Chronic diarrhea and cerebral palsy were notable clinical factors associated with underweight status. In contrast, maternal education, prematurity, timing of weaning, number of under-five siblings, vaccination status, and food fads did not show statistically significant associations with malnutrition.

**Conclusion:** Malnutrition remains highly prevalent among children under five years of age, particularly in low-income populations. Socioeconomic deprivation and inadequate nutritional intake were identified as the major determinants of undernutrition. These findings highlight the urgent need for targeted nutritional policies, community-based awareness programs, and poverty-focused interventions to reduce the burden of childhood malnutrition in resource-constrained settings.

**Key words:** frequency, malnutrition, risk factor, low-income, middle-income, Pakistan.

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### INTRODUCTION:

Malnutrition poses a significant threat to the health and well-being of children under the age of five, leading to stunted growth and development, weakened immune systems, and increased susceptibility to infections. According to WHO report of 2020, 149 million children under 5 years were estimated to be stunted, 45 million were estimated to be wasted. [1] The report further showed that around 45% of mortality among under 5 years are linked to undernutrition which is more prevalent in low- and middle-income countries. Understanding the complex web of risk factors contributing to malnutrition in this population is essential for designing targeted interventions.[2] .The determinant of malnutrition are intrauterine growth retardation, prematurity, lack of breast feeding, inappropriate weaning ,maternal education, births pacing, socioeconomic status, vaccination, chronic diseases and inadequate caloric intake[5–7] Factors such as poverty, inadequate access to healthcare, lack of proper education about nutrition, and food insecurity all play a role in the prevalence of malnutrition among children under five. Additionally, cultural beliefs and practices around infant and child feeding, as well as limited resources for breastfeeding support, can also impact a child's nutritional status.[8] Malnutrition is a complex issue influenced by a variety of factors like genetics and individual health conditions [9]. Additionally, focusing solely on socio-economic and cultural factors may overlook the individualized and biological aspects of malnutrition, potentially leading to ineffective interventions. It is important to consider the diverse array of factors contributing to malnutrition in order to develop comprehensive and effective solutions. [10,11]

Despite the global recognition of malnutrition as a critical issue for children under the age of five, there is a literature gap in understanding the frequency and specific risk factors associated with malnutrition in Pakistani population although there is extensive support from the “United Nations International Children’s Emergency Fund (UNICEF)”, “World Health Organization (WHO)” and “World Bank” in achieving the nutritional freedom , we are still far from the world to combat the issues of malnutrition[9].Existing studies have primarily focused on general risk factors without rooting about into the specific factors that may be prevalent in this particular setting.[12]Understanding the literature gap in this area is crucial as it highlights the need for localized and targeted research to identify the unique risk factors contributing to malnutrition in the under 5-year population [13]

By conducting this study through quantitative analysis, we aim to fill this gap in the literature and provide valuable insights that can inform the development of tailored interventions and strategies to address malnutrition effectively. Moreover, the findings of this study can contribute to the existing body of knowledge and serve as a foundation for future research and policy making in this critical area. [14]

### Methods:

#### STUDY DESIGN:

A cross-sectional study design was used to collect data during 6 month duration between June to December 2026.

#### STUDY SETTING:

The data was collected at University of Lahore Teaching Hospital and its affiliated hospitals (Punjab

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Social Security Institute teaching hospital and Al-Khidmat teaching hospital.

### Sample size:

Sample size calculation considered the prevalence of underweight in Pakistan which was 33 percent so 339 malnourished children were enrolled in study.

### Data collection

The data included the collection of anthropometric measurements, such as height, weight of children under the age of five year who were presented to the hospital in specific time duration. This data was used to assess their nutritional status (through Gomez classification, Water low classification and Z scoring). A structured questionnaire was used to collect data through face to face interview from mothers on various factors that may contribute to malnutrition in the under 5-year population. The information collected include gestational age, breast feeding practices, weaning, maternal education, household income, food fads, daily caloric intake, immunization status and chronic illness. and nutritional status.

### Statistical analysis

Three anthropometric indicators were constructed on height-for-age (HAZ), weight-for age (WAZ) and weight for-height (WHZ) in the form of z-scores using WHO charts. Stunting was defined as height-for-age ( $Z\text{-score} < -2$ ), wasting as weight-for-height ( $Z\text{-score} < -2$ ), and underweight as weight-for-age ( $Z\text{-score} < -2$ ) using child growth standards published by the World Health Organization (WHO). The data was analyzed using statistical method SPSS to identify associations between wasting, stunting and underweight with associated risk factors. Univariate regression analysis was conducted to determine independent effect of each predictor on outcomes. Then all predictors were included in multivariate analysis to investigate net effect of each predictor on outcomes adjusting for all other factors in the model. Adjusted OR were calculated to study the predictive power of independent study variables in relation to childhood malnutrition. All statistical analyses were performed using SPSS version 15.0 with the statistical significance set at a  $p$  value  $\leq 0.05$

### RESULTS:

A total of 339 children under the age of five from low- and middle-income areas were included in the study. The mean age of participants was  $2.18 \pm 1.15$  years (range: 0.3–4.9 years), with 49% ( $n=166$ ) being male and 51% ( $n=173$ ) female. Anthropometric measurements revealed a mean weight of  $8.61 \pm 2.21$

kg and a mean height/length of  $78.92 \pm 10.61$  cm. Based on Z-score weight-for-height(wasting) 30.1% were severely acutely malnourished (SAM), 31.6% moderately acutely malnourished (MAM), and 38.3% had normal nutritional status and on combining SAM and MAM 61.7% (95% CI: 56.5–66.9) were wasted while prevalence of stunting and underweight were 67% (95% CI: 62.0–72.0) and 69.6 (95% CI: 64.7–74.5) respectively. According to the Gómez classification, 56.9% of children had grade 2 malnutrition, 30.4% grade 1, and 12.7% grade 3. Water low classification identified 28.3% with mild, 23.3% moderate, and 15.6% severe malnutrition, while 32.7% had normal growth. Regarding perinatal and feeding history, 14.2% were preterm. Breastfeeding was reported in 85.3% of children, but only 30.7% were breastfed for the WHO-recommended duration of two years; 17.1% stopped before six months. Weaning was practiced by 87.9%, with 58.4% starting between 6 months and 1 year. Household factors revealed that 59.6% had at least one under-five sibling, and 16.8% had two such siblings. Maternal education was reported in 72.3% of cases; however, 26.8% of mothers were uneducated, and only 21.2% had education above matric level. In terms of socio-economic status, 77% of households earned less than PKR 32,000 per month. Immunization coverage was high, with 73.7% fully vaccinated, 20.4% partially vaccinated, and 5.9% unvaccinated. Chronic illnesses were present in 22.7% of children, with chronic diarrhea (8%), cerebral palsy (5.3%), and asthma (3.2%) being the most common. Food fads were reported in 23.6% of households. Alarmingly, 80.5% of children had inadequate daily caloric intake. In Table 2, binary logistic regression analysis of risk factor associated malnutrition showed male gender was significantly associated with higher odds of wasting (OR = 4.77; 95% CI: 1.92–11.87;  $p < 0.001$ ). Children <1 year showed significantly lower odds of wasting (OR = 0.029;  $p = 0.015$ ) and underweight (OR = 0.062;  $p = 0.012$ ), while no significant association was found with stunting while children aged 1-4 years had significantly higher odds of stunting (OR = 14.03; 95% CI: 2.09–93.93;  $p = 0.006$ ) and lower odds of wasting (OR = 0.047;  $p = 0.001$ ). The association with underweight was not statistically significant. Unvaccinated children had higher odds of stunting (OR = 1.60; 95% CI: 0.18–13.96;  $p = 0.045$ ) and significantly lower odds of wasting (OR = 0.109; 95% CI: 0.017–0.689;  $p = 0.018$ ). The association with underweight was not significant while partially vaccinated children had significantly higher odds of stunting (OR = 3.47; 95% CI: 1.03–11.68;  $p = 0.008$ ), wasting (OR = 5.09; 95% CI: 1.49–17.34;  $p = 0.009$ ), and underweight (OR =

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2.60; 95% CI: 1.09–6.17; p = 0.030). Monthly household income showed no statistically significant association with stunting or wasting. However, children from low-income area showed a borderline association with higher odds of underweight (OR = 2.31; 95% CI: 1.07–4.99; p = 0.052). children belonging to low income less than 32000 had higher prevalence of stunting, wasting and underweight, although statistical significance was not reached likely due to group imbalance and limited power. Low daily caloric intake showed significant association with wasting (OR = 4.09; 95% CI: 1.35–12.35; p = 0.013). No statistically significant association was found between caloric intake and stunting or underweight. Children with chronic ailment had 5.763, 4.07- and 6.1-times higher odds of stunting, wasting and underweight respectively (OR = 5.763; 95% CI: 1.566-21.212; p = 0.008), (OR = 4.070; 95% CI: 1.270-13.047; p = 0.018) and (OR = 6.105; 95% CI: 2.156-17.294; p < 0.001) indicating strong association with malnutrition. While other risk factor like gestational age, breastfeeding, weaning, under five siblings, maternal education and food fads were found to be statistically insignificant.

**Table 1 Socioeconomic characteristics descriptive statistics of the study**

Characteristics	Number	Percentage	Mean	Standard deviation
<b>Gender</b>				<b>1.51</b>
<b>0.51</b>				
Male	166	49		
Female	173	51		
<b>Age Groups</b>				<b>2.85</b>
<b>1.28</b>				
< 1 year	48	14		
1-2 years	117	34.5		
2-3years	56	16.5		
3-4years	73	21.5		
4-5 years	45	13.3		
<b>Under 5 Siblings</b>				<b>1.40</b>
<b>0.49</b>				
Yes	202	59.6		
No	137	40		
<b>Number of Under five Siblings</b>				<b>0.84</b>
<b>0.829</b>				
0	136	40.1		
1	134	39.5		

2	57	16.8	
3	12	3.5	
<b>Breastfeed</b>			<b>1.15</b>
<b>0.355</b>			
Yes	289	85.3	
No	50	14.7	
<b>Duration of Breastfeed</b>			<b>2.42</b>
<b>0.937</b>			
< 6 months	58	17.1	
6 months to 1 year	128	37.8	
2 years	104	30.7	
No Breastfeeding	49	14.5	
<b>Weaning</b>			<b>1.12</b>
<b>0.327</b>			
Yes	298	87.9	
No	41	12.1	
<b>Age of weaning</b>			<b>2.3</b>
<b>0.89</b>			
< 6 Months	38	11.2	
6 months to 1 year	198	58.4	
> 1 year	66	19.5	
No weaning	37	10.9	
<b>Maternal Education</b>			<b>1.28</b>
<b>0.448</b>			
Yes	245	72.3	
No	94	27.2	
<b>Level of Maternal Education</b>			<b>1.41</b>
<b>1.097</b>			
None	90	26.5	
Under-Matric	92	27.1	
Matric	84	24.8	
Above Matric	72	21.2	
<b>Immunization Status</b>			<b>2.68</b>
<b>0.581</b>			
Unvaccinated	20	5.9	
Partial Vaccination	69	20.4	
Full Vaccinated	250	73.7	
<b>Income per month</b>			<b>1.23</b>
<b>0.422</b>			
< 32 k	261	77	
> 32 k	78	23	
<b>Prematurity</b>			<b>1.86</b>
<b>1.15</b>			
Yes	48	14.2	
No	291	85.8	
<b>Daily calories intake</b>			<b>1.194</b>
<b>0.396</b>			

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Inadequate	273	80.5		3.210		5.472	.227		
Adequate	66	19.5		(.482, 21.373)	.228	(.598, 50.042)	.132	(.030, 1.725)	.152
<b>Food Fads</b>			<b>1.77</b>						
<b>0.422</b>									
Yes	80	23.6		7.162		1.299	.093		
No	259	76.4		(.924, 55.510)	.060	(.119, 14.221)	.830	(.011, .774)	.028
<b>Chronic ailment</b>			<b>1.77</b>						
<b>0.423</b>									
Yes	79	23.3			1.000		1.000		1.000
No	260	76.7			0	.000	0	.000	0

Table:2parameter estimates of logistic regression model and risk factor affecting stunting, wasting and underweight

Stunting		Wasting		Under-weight							
OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value						
1.281 (.571, 2.871)	.548	4.779 (1.924, 11.870)	<.001	1.053 (.535, 2.073)	.881	11397037	.999	.000	.999	.000	.999
395.122 (71.702, 2177.383)	<.001	.299 (.084, 1.068)	.063	14.038 (4.831, 40.792)	<.001	.000	.999	.999	.999	.999	.999
1.061 (.068, 16.485)	.966	.029 (.002, .496)	.015	.062 (.007, .548)	.012	.000	.999	.441 (.001, 141.488)	.781	.000	.999
14.026 (2.094, 93.928)	.006	.047 (.007, .303)	.001	2.023 (.492, 8.322)	.329	.000	.999	3.403 (.009, 1313.835)	.687	.000	.999
.000	1.000	.000	1.000	1.000	1.000	1.474 (.476, 4.567)	.501	1.339 (.400, 4.482)	.636	.348 (.132, .916)	.032
.000	1.000	.000	1.000	1.000	1.000	2.445 (.659, 9.067)	.181	1.798 (.546, 5.920)	.334	.572 (.217, 1.512)	.260

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1.602 (.184, 13.961)	.045	.109 (.017, .689)	.018	.374 (.082, 1.711 )	.205
3.469 (1.030, 11.683)	.008	5.087 (1.492, 17.343)	.009	2.597 (1.09 4, 6.166 )	.030
.517 (.196, 1.364)	.182	1.458 (.518, 4.106)	.475	2.313 (1.07 3, 4.987 )	.032
1.467 (.465, 4.629)	.513	1.809 (.558, 5.860)	.323	.337 (.122, .932)	.036
1.046 (.352, 3.113)	.935	4.085 (1.352, 12.346)	.013	1.385 (.557, 3.445 )	.484
2.565 (.832, 7.908)	.101	1.426 (.481, 4.232)	.522	1.032 (.403, 2.642 )	.948
5.763 (1.566, 21.212)	.008	4.070 (1.270, 13.047)	.018	6.105 (2.15 6, 17.29 4)	<.00 1

**Discussion:**

In the present study we identified prevalence and determinants of malnutrition in under five children in low- and middle-income areas which is essential for the implementation of preventive and control measures to reduce the burden of malnourished children and the south Asian sub-region is facing a serious malnutrition burden. In the present analysis, gender did not show a statistically significant

association with stunting or underweight; however, male children showed significantly higher odds of wasting compared with females. Similar findings have been reported in several South Asian studies where male children demonstrated greater vulnerability to acute malnutrition. This difference has been attributed to biological susceptibility and higher nutritional demands among boys during early childhood. [15,16,17] Child age showed a strong association with stunting and underweight in the present study. Children in the 1–4 year age group had significantly higher odds of stunting compared with those aged 4–5 years. This finding is consistent with previous research indicating that growth faltering commonly occurs during the transition period from exclusive breastfeeding to complementary feeding, usually between 6 and 24 months of age. During this period children are highly susceptible to nutritional deficiencies and infections, which may impair linear growth. [17,18] Although the presence of under-five siblings was not significantly associated with stunting or wasting, children from households with a greater number of young siblings demonstrated a higher likelihood of underweight. This may reflect resource dilution, where household food and caregiving resources are shared among multiple children. Previous demographic studies have shown that larger family size is associated with poorer nutritional outcomes due to limited household resources and reduced individual attention for feeding and care. [19] In the present study, breastfeeding practices and duration did not show a statistically significant association with stunting, wasting or underweight. This finding might be explained by the fact that almost all children in the study population were breastfed, reducing variability in the exposure variable. However, global evidence indicates that appropriate breastfeeding and timely complementary feeding play a critical role in preventing childhood malnutrition. Inadequate complementary feeding practices are frequently identified as key determinants of growth failure among under-five children. [20,21,22] Household income showed a trend toward association with underweight, although the relationship was not statistically significant in all models. Children from lower-income households were more likely to experience poor nutritional outcomes. Socioeconomic status influences food security, dietary diversity, sanitation and healthcare access, which collectively affect child growth and development. Several studies conducted in developing countries have highlighted poverty as one of the strongest predictors of childhood

malnutrition. Inadequate caloric intake showed a significant association with wasting, indicating that acute malnutrition is closely related to insufficient dietary energy consumption. [23,24] Wasting often reflects short-term nutritional deficiency or recent illness, whereas stunting represents chronic nutritional deprivation. These findings support previous evidence showing that inadequate dietary intake is a major contributor to acute malnutrition in young children.[25,26] risk factor like gestational age, breastfeeding, weaning, under five siblings, maternal education and food fads were found to be statistically insignificant although they were found significant in other studies.

#### **Limitations**

The study's main limitation was its small sample size, with data gathered from limited centers, which reduced the statistical power for robust subgroup analyses and limited the ability to detect significant differences across categories, This also affects the generalizability of the findings to a broader population. We recommend a large multicenter study which would provide robust evidence that could guide clinical practices and policymaking, ultimately improving outcomes for neonates at risk of respiratory distress syndrome.

#### **Conclusion:**

The findings of this study emphasize that childhood undernutrition is a multifactorial problem influenced by demographic, socioeconomic and health-related factors. Improving maternal education, strengthening immunization coverage, promoting adequate child feeding practices and addressing household poverty are essential strategies for reducing the burden of malnutrition among under-five children.

#### **Recommendations**

Based on the findings of this study, a set of targeted and evidence-informed recommendations is proposed to reduce the burden of malnutrition among under-five children in low- and middle-income settings.

1. **Strengthening Maternal Nutrition and Child Health Education:** Structured community-based education programs should be prioritized to improve maternal knowledge regarding optimal infant and young child feeding practices, dietary diversity, hygiene, and early recognition of malnutrition. Enhancing caregiver awareness is likely to translate into improved feeding

behaviors and better nutritional outcomes in children.

2. **Promotion of Exclusive and Continued Breastfeeding:**

Health systems should reinforce adherence to optimal breastfeeding practices, including exclusive breastfeeding for the first six months of life and continued breastfeeding up to two years, as recommended by the World Health Organization. Integration of breastfeeding counseling into antenatal, postnatal, and primary healthcare services is essential to improve compliance.

3. **Improvement of Complementary Feeding Practices:**

Timely initiation of complementary feeding at six months, along with adequate dietary quantity, quality, and diversity, should be emphasized. Targeted nutrition education should focus on age-appropriate meal frequency, energy density, and locally available nutrient-rich foods to prevent growth faltering during the critical window of 6–24 months.

4. **Addressing Food Insecurity and Household Poverty:**

As socioeconomic deprivation remains a key determinant of undernutrition, strengthening social protection mechanisms, conditional cash transfer programs, and food supplementation schemes is essential. Policies aimed at improving household food security should be prioritized for vulnerable populations.

5. **Integration of Nutrition Services into Primary Healthcare Systems:**

Routine growth monitoring, nutritional screening, and counseling should be systematically integrated into existing maternal and child health services, including immunization programs and outpatient pediatric clinics. Early identification and timely management of at-risk children can prevent progression to severe acute malnutrition.

6. **Strengthening Immunization and Management of Comorbidities:**

Given the observed association between chronic illness and malnutrition, improving immunization coverage and ensuring early diagnosis and management of chronic

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pediatric conditions are critical components of malnutrition prevention strategies.

### REFERENCE:

1. World Health Organization, United Nations Children's Fund. Levels and trends in child malnutrition: key findings of the 2020 edition. UNICEF/WHO/World Bank Group joint child malnutrition estimates. World Health Organization; 2020 Mar 31.
2. Sand A, Kumar R, Shaikh BT, Somrongthong R, Hafeez A, Rai D. Determinants of severe acute malnutrition among children under five years in a rural remote setting: A hospital based study from district Tharparkar-Sindh, Pakistan. *Pakistan journal of medical sciences*. 2018 Mar;34(2):260.
3. Pasricha SR, Biggs BA. Undernutrition among children in South and SouthEast Asia. *J Paediatr Child Health*. 2010;46:497–503.
4. Jesmin A, Yamamoto SS, Malik AA, Haque A. Prevalence and determinants of chronic malnutrition among preschool children: a cross-sectional study in Dhaka City, Bangladesh. *J Health Popul Nutr*. 2011;29:494–9.
5. Pruss-Ustun A, Bos R, Gore F, Bartram J. Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health. Geneva: WHO; 2008.
6. Boschi-Pinto C, Velebit L, Shibuya K. Estimating child mortality due to diarrhoea in developing countries. *Bull World Health Organ*. 2008;86:710–7.
7. Guerrant RL, DeBoer MD, Moore SR, Scharf RJ, Lima AAM. The impoverished gut—a triple burden of diarrhoea, stunting and chronic disease. *Nat Rev Gastroenterol Hepatol*. 2013;10:220–9.
8. Nikhurpa M, Nikhurpa V, Pangty S. Pediatric Review-International Journal of Pediatric Research. *International Journal of Pediatric Research*. 2021;8:82-7.
9. Ningtias LO, Solikhah U. Perbedaan Pola Pemberian Nutrisi pada Balita dengan Stunting dan Non-Stunting di Desa Rempoah Kecamatan Baturaden. *Jurnal Ilmu Keperawatan Anak*. 2020 May 31;3(1):1-8.
10. Obasohan PE, Walters SJ, Jacques R, Khatab K. Risk factors associated with malnutrition among children under-five years in sub-Saharan African countries: a scoping review. *International journal of environmental research and public health*. 2020 Dec;17(23):8782.
11. Bhutta ZA, Berkley JA, Bandsma RH, Kerac M, Trehan I, Briend A. Severe childhood malnutrition. *Nature reviews Disease primers*. 2017 Sep 21;3(1):1-8.
12. UNICEF, WHO, World Bank. Levels and trends in child malnutrition: Key findings of the 2020 Edition of the Joint Child malnutrition estimates. Geneva: WHO, 2020;24(2):1–16.
13. Manzoor, M S., & Saeed, M A. (2021, April 21). Possible Risk Factors Related to Malnutrition in 6-59-Month Children with Severe Acute Malnutrition in District Pakpattan, Punjab. *Journal of nutrition and food security*. <https://doi.org/10.18502/jnfs.v6i2.6069>
14. Khare S, Gupta D, Prabhavathi K, Deepika MG, Jyotishi A. Health and nutritional status of children: survey, challenges and directions. In *International Conference on Cognitive Computing and Information Processing 2017 Dec 15* (pp. 93-104). Singapore: Springer Singapore.
15. Siddiqua, M., Zubair, A., Kamal, A. *et al*. Prevalence and associated factors of stunting, wasting and underweight of children below five using quintile regression analysis (PDHS 2017–2018). *Sci Rep* **12**, 20326 (2022). <https://doi.org/10.1038/s41598-022-24063-2>
16. Gebre A, Reddy PS, Mulugeta A, Sedik Y, Kahssay M (2019) Prevalence of malnutrition and associated factors among under-five children in pastoral communities of afar regional state, Northeast Ethiopia: A community-based cross-sectional study. *J Nutr Metabolism* 2019:9187609. <https://doi.org/10.1155/2019/9187609>
17. Tadesse A, Hailu D, Bosha T (2018) Nutritional status and associated factors among pastoralist children aged 6–23 months in Benna Tsemay Woreda, South Omo zone, Southern Ethiopia. *Int J Nutr Food Sci* **7**(1):11–23. <https://doi.org/10.11648/j.ijnfs.20180701.13>
18. Burki, A.A. Assessing the relative significance of key risk factors for child undernutrition in Punjab, Pakistan. *BMC Public Health* **25**, 1416 (2025). <https://doi.org/10.1186/s12889-025-22626-2>
19. Das J, Das SK, Hasan T, Ahmed S, Ferdous F, Begum R, et al. Childhood malnutrition in households with contemporary siblings: a scenario from urban Bangladesh. *Eur J Clin Nutr*. 2015;69(10):1178–1179. doi:10.1038/ejcn.2015.75
20. Mardani RAD, Wu WR, Nhi VTN, Huang HC. Association of breastfeeding with undernutrition among children under 5 years of age in developing countries: a systematic review and meta-analysis. *J Nurs Scholarsh*. 2022;54(6):692–703. doi:10.1111/jnu.12799

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21. Khaliq A, Wraith D, Miller Y, Nambiar S. Association of infant feeding indicators and infant feeding practices with coexisting forms of malnutrition in children under six months of age. *Nutrients*. 2022;14(20):4242. doi:10.3390/nu14204242
22. Ayub F, Anjum M, Bibi S, Khan A, Soomro S, Sardar A. Nutritional status and its association with breastfeeding and complementary feeding practices among children visiting tertiary care health centre. *Pak Armed Forces Med J*. 2023;73(4). doi:10.51253/pafmj.v73i4.7895
23. Ara G, Fawad B, Shabbir S. Malnutrition in children under five years in a squatter settlement of Karachi: a case-control study. *BMC Public Health*. 2024;24:848. doi:10.1186/s12889-024-18359-3
24. Farooq R, Khan H, Khan MA, et al. Socioeconomic and demographic factors determining the underweight prevalence among children under-five in Punjab. *BMC Public Health*. 2020;20:1817. doi:10.1186/s12889-020-09675-5
25. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet*. 2013;382(9890):427–451. doi:10.1016/S0140-6736(13)60937-X
26. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition. *Lancet*. 2013;382(9890):452–477. doi:10.1016/S0140-6736(13)60996-4