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Prevalence and Risk Factors of Malnutrition among Children in Pakistan

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ABSTRACT

Malnutrition has been one of the maximum pressing social fitness problems in Pakistan and it has brought about giant occurrence of toddler morbidity, mortality and negative developmental results. Although the arena has made strides in curtailing undernutrition, Pakistan has persevered to maintain excessive fees of youth malnutrition in which the burdens of stunting, losing and underweight are very excessive and nearly disproportionately excessive the various maximum socioeconomically susceptible segments of the population. The paper beneathneath dialogue makes a speciality of the problem of incidence and predisposing elements of malnutrition in youngsters below the age of 5 years in city and rural populations in Lahore, Pakistan via a quantitative cross-sectional studies design. The stratified random sampling technique become used to pick out 250 youngsters in keeping with stratified number one healthcare facilities and communities. Anthropometric variables inclusive of height, weight, and age have been taken to calculate the Z-rating of the World Health Organization wellknown stunted (Height-for-Age Z-rating), losing (Weight-for-Height Z-rating), and underweight (Weight-for-Age Z-rating). Caregivers had been given a confirmed based questionnaire to assist withinside the size of socioeconomic and environmental chance elements inclusive of the family income, maternal training, little one and younger infant feeding habits, get entry to to healthcare in addition to the sanitation conditions. Data had been interpreted with model 25 beneathneath SPSS, the descriptive take a look at changed into conducted, the alpha reliability check of Cronbach, Pearson correlation, and binary logistic regression. Results imply that the superiority of stunting, losing, and underweight have been 38.4, 21.2 and 33.6 percent, respectively, a number of the members of the study. The logistic regression evaluation discovered the low family income, low maternal training level, beside the point practices of breastfeeding, insufficient nutritional diversity, inaccessibility to smooth water and abnormal healthcare attendance because the statistically huge chance elements. The paper highlights the complexity of youth malnutrition and the want to appoint intersectoral techniques that could deal with the on the spot dietary deficit and the socioeconomic elements that reason it.

Introduction

Childhood malnutrition is a complicated epidemic that covers undernutrition (which includes stunting, losing, and underweight) and micronutrient deficiencies and, extra recently, overnutrition. According to the estimates of the United Nations Children Fund (UNICEF, 2023), there are approximately 149 million youngsters beneathneath 5 years vintage withinside the global who're stunted and forty five million youngsters who're losing, which may be linked with better susceptibility to infectious diseases, decrease cognitive development, decrease training levels, and decrease financial productiveness in adulthood. The presence of the twin burden of malnutrition, wherein undernutrition and overnutrition exist aspect through facet withinside the identical families and groups, additionally complicates the responses of the overall fitness in low- and middle-profits countries (LMICs) (Black et al., 2013).

Pakistan is a completely sharp case observe withinside the context of the worldwide malnutrition situation. The maximum latest article at the Pakistan Demographic and Health Survey (PDHS, 2019) famous that round forty percentage of youngsters elderly under 5 years vintage are stunted, 17.7 percentage are wasted, and 28.nine percentage are underweight, that are the best in South Asia and worldwide. It isn't lightly spread, and rural population, poorest profits quintiles, and youngsters of much less knowledgeable moms are experiencing a disproportionately excessive variety of dietary deprivation (National Nutrition Survey, 2018). These records aren't handiest dietary deficiency however additionally substantial violation of kids rights to fitness, survival, and development, because it became hooked up withinside the United Nations Convention at the Rights of the Child.

Childhood malnutrition has been defined via way of means of the conceptual framework of UNICEF, which identifies 3 levels of reasons specifically instantaneously reasons (negative nutritional consumption and disorder burden), underlying reasons (meals insecurity, terrible caregiving and terrible sanitation and healthcare) and simple reasons (structural poverty, negative governance and social inequality) running on some of ecological levels (UNICEF, 1990). The mixture of demographic, geographic, political and cultural elements provides to those causal pathways in Pakistan. Some of the elements that motive malnutrition to stay a hassle withinside the usa notwithstanding a long time of countrywide and global moves consist of fast urbanization, continual rural poverty, water and meals insecurity, excessive fertility prices, and inequalities in get right of entry to to schooling, healthcare, and social protection (Headey et al., 2018).

Education of moms and their feeding behaviors had been observed to be in particular powerful proximal elements that decide toddler dietary reputation in a number of us of a settings. The studies usually indicates that youngsters born to moms with secondary or better training are a lot much less possibly to be stunted and underweight than youngsters whose moms haven't any formal training (Semba et al., 2008; Victora et al., 2010). Modifiable chance elements which have verified to have substantial shielding effect on stunting, losing, and micronutrient deficiencies are one of a kind breastfeeding all through the primary six months of life, advent of complementary ingredients in time and nutritional diversity (Dewey and Adu-Afaruwah, 2008). Suboptimal breastfeeding conduct and the untimely use of mistaken complementary meals are nonetheless surprisingly generic in Pakistan, in particular in rural and low-earnings businesses (PDHS, 2019).

One of the most powerful predictors of baby dietary effects in quite a few settings is socioeconomic popularity, that's measured through the family profits, asset indices, and maternal training (Grantham-McGregor et al., 2007). Raza et al. (2016) determined a wonderful socioeconomic gradient in the superiority of adolescence stunting in Pakistan, wherein the bottom wealth quintile had nearly triple the stunting costs of the wealthiest quintile. These inequalities are a manifestation of structural inequalities withinside the capability of families to revel in the advantages of right meals, fitness, and secure water and sanitation, which might be the pre-standards of the nice baby vitamins and development.

Another vital malnutrition malaxis is sanitation and a loss of secure water. The mechanisms through which negative water, sanitation, and hygiene (WASH) ends in malnutrition are greater publicity of enteric pathogens, environmental enteropathy, a subclinical circumstance of intestinal absorption impairment, and diarrheal disorder, which reduces nutrient absorption and ends in faltering of linear boom (Cumming and Bhatt, 2015). Pakistan has performed little in improving the insurance of sanitation mainly in rural places wherein open defecation and polluted water reassets are nevertheless familiar (PDHS, 2019).

The availability of healthcare services, including immunization, increase exams and vitamins counseling, is likewise certainly considered one among the protecting elements, in addition to signs of socioeconomic inclusion. Evidence-primarily based totally research in Pakistan and different similar settings display that youngsters, who go to a healthcare issuer often to get hold of preventive healthcare services, are a good deal much less at risk of experiencing excessive malnutrition, in part because of the advent of a healthcare contact (in which early-level increase faltering may be recognized and treated) (Bhutta et al., 2013). Nonetheless, get admission to is hampered with the aid of using geographic barriers, monetary concerns and cultural predispositions towards healthcare use via way of means of many susceptible families.

Although the countrywide literature on the subject of malnutrition in Pakistan is pretty extensive, there may be a loss of this cloth within the shape of regionally contextual, community-primarily based totally quantitative research investigating the cumulative effect of an aggregate of numerous socioeconomic and behavioral hazard elements at the final results of malnutrition in Lahore, that is the second-biggest town in Pakistan and a placing in which the fast urbanization technique predetermines the emergence of precise styles of nutrients vulnerability (Hussain et al., 2020). The urban-rural outer edge of Lahore is a great analytically feasible area to observe within-metropolis heterogeneity in malnutrition burden due to the fact the groups within the urban-rural outer edge have hugely divergent socioeconomic profiles, meals landscapes, and get admission to to healthcare.

The gift studies is consequently aimed toward filling this hole with the aid of using giving a strict quantitative assessment of the superiority of the stunting, losing and underweight in kids beneath 5 in Lahore and additionally to set up which socioeconomic, nutritional and environmental chance elements have the most powerful relationships with every sort of malnutrition. The findings can be used to tell centered coverage and programmatic movements to reply to the precise vulnerabilities of the maximum nutritionally prone agencies within the town of Lahore. The method is some other contribution of the examine to the literature due to the fact the software of a complicated multivariate analytical framework guarantees that the impact of various chance elements at the effects of malnutrition is taken into consideration on the identical time.

The relaxation of this paper is prepared within the following way. How youth malnutrition is accepted and its determinants had been synthesized within the literature overview with precise consciousness on Pakistan context. The studies method has mentioned the studies design, sampling approach, facts series gear in addition to the approach of analysis. The effects segment offers the superiority estimates and regression findings with descriptive tables. These findings are located within the context of the present literature and their implications on coverage and exercise are discussed, and a end and unique programmatic suggestions are given.

Literature Review

Childhood Malnutrition Burden and Epidemiology on Globe

Childhood malnutrition remains a function difficulty of globalwide fitness within the 21st century, despite the fact that there had been main decreases in absolute figures over the past 3 decades. In a document with the aid of using the UNICEF/WHO/World Bank, malnutrition in kids beneath 5 years has been predicted at 22.3% stunted, 6.8% wasted, and 13.6% underweight, with the bulk of this burden discovered in sub-Saharan Africa and South Asia (UNICEF/WHO/World Bank, 2023). The aggregate of those areas constitutes approximately eighty percentage of the global burden of stunting that suggests the profound structural origins of malnutrition that lie in poverty, inequality, and negative governance. Photographs captured in Brazil, Guatemala, India, the Philippines, and South Africa via way of means of Vitora et al. (2010) confirmed that academic attainment, person height, and financial productiveness are life-route determinants of stunting in early formative years, which leads to a records of stunting in later life.

Conceptualization of malnutrition has sincerely modified plenty as compared to the preceding conceptualizations that centered on caloric deficiency to the present day complete conceptualizations that don't forget the multidimensional element of dietary deprivation. The methodological foundation of worldwide comparisons of malnutrition occurrence is the boom reference requirements proposed through the World Health Organization (2006) that use Z-ratings to categorize stunting (HAZ A < -2), losing (WHZ A < -2), and underweight (WAZ A < -2) towards a reference populace of wholesome kids. Black et al. (2013) approximated that undernutrition, fetal increase restriction, stunting, and losing, as nicely as, nutrition A and zinc deficiency caused three.1 million deaths in youngsters every year, highlighting the affects of malnutrition on mortality similarly to the developmental problems.

Malnutrition in Pakistan: Prevalence and Trends

The malnutrition burden is acute and persistent in Pakistan, and it's miles one of the maximum vital troubles of the populace fitness within the us of a. A countrywide incidence of stunting, losing, and underweight amongst youngsters below 5 become recorded as 40.2, 17.7 and 29.0 percent, respectively, with widespread provincial variations among 36 percentage stunting in Punjab and above 50 percentage in Balochistan (National Nutrition Survey, NNS, 2018). Although those numbers are higher than preceding surveys, they display that malnutrition remains relatively ingrained and that the development has been insufficient in phrases of demographic and monetary fashion of the us of a (GoP, 2018). These effects have been once more showed within the Pakistan Demographic and Health Survey (PDHS, 2019), which additionally mentioned a sturdy distinction within the dietary consequences of rural and concrete kids, with rural youngsters having a mean charge of stunting that became almost 15 factors better than that of city youngsters.

A systematic evaluate of the dietary developments of Pakistan primarily based totally on diverse rounds of Demographic and Health Survey facts found out that even though a few mild upgrades in underweight and losing fees had happened among 2001 and 2012, stunting development turned into sluggish and non-rising (Raza et al., 2016). They defined this fashion via way of means of the shortage of improvement of determinants of continual malnutrition in preferred which includes sanitation infrastructure, maternal training, and family meals security. Similar effects had been observed via way of means of Fatima et al. (2020) who determined continual disparities in dietary effects through family wealth quintile and geography, with the poorest quintile experiencing stunting prices that had been nearly 2.5 instances better than the wealthiest quintile. These observations suggest that universal adjustments in country wide vitamins figures difficult to understand a variety of heterogeneity and the focused interventions at the maximum susceptible businesses are wanted urgently.

Childhood Malnutrition Socioeconomic Determinants

One of the maximum continuously recorded determinant of adolescence dietary fame in a huge kind of u . s . settings is family socioeconomic repute. The structural foundations of malnutrition have been highlighted through Grantham-McGregor et al. (2007) who expected that greater than 2 hundred million youngsters in LMICs could now no longer obtain their developmental capacity due to poverty and associated malnutrition. The researchers in Pakistan observed that the percentages of stunting in youngsters dwelling in families have been three.2 instances extra withinside the lowest earnings quintile as compared to the very best profits quintile notwithstanding adjusting the percentages to maternal training and feeding practices (Hussain et al., 2020). These effects are in step with different proof withinside the global network that financial poverty limits the cappotential of the families to find the money for a selection and nutrient wealthy ingredients, healthcare and right dwelling requirements.

The energy of maternal training in toddler dietary fame is impartial and acts in numerous approaches thru bypassing higher maternal dietary schooling, higher fitness-searching for behavior, higher potential to make family decisions, and higher possibilities of employment and incomes revenues. Semba et al. (2008) used the information to be had on 27 international locations and determined that maternal literacy reduced the probability of toddler underweight via way of means of 24% regardless of family wealth. Khan et al. (2019) suggested in Pakistan that the stunting prices of kids of moms with out formal training have been 47.3% vs. 28.6% amongst youngsters of moms who had secondary training, which is nearly 20 percent factors, which underlines the paramount position of training of ladies as a malnutrition prevention tool.

Infant and Young Child Feeding Practices

Earnest little one and younger infant feeding (IYCF) practices-inclusive of early breastfeeding initiation all through the primary hour after birth, exceptional breastfeeding for the duration of the primary six months, advent of right complementary meals at six months and endured breastfeeding till years vintage are amongst a number of the best and proof primarily based totally techniques of stopping adolescence malnutrition and assisting wholesome boom and improvement (WHO, 2010). The proof reviewed with the aid of using Dewey and Adu-Afarwuah (2008) on growing united states intervention research has caused a end that enhancement of IYCF practices could save you 13% of toddler deaths under the age of 5 withinside the global, with the maximum advantages on specific breastfeeding promotion.

IYCF practices in Pakistan are inefficient in some of dimensions. According to the Pakistan Demographic and Health Survey (PDHS, 2019), the percentage of babies beneathneath six months of age who get hold of distinct breastfeeding is surely 48, that's a great deal decrease than the WHO advice of 70% with the aid of using 2030. Water, natural arrangements and formulation are brought early, specially in city and higher-off families, and had been related to expanded chance of diarrheal ailment and the substitute of breast milk. Rana et al. (2021) mounted that kids who have been now no longer breastfed in the course of the primary six months had been extraordinarily in all likelihood to be stunted and wasted on the age of 12 and 24 months instead of kids who had had choicest breastfeeding. The ratings of nutritional variety as a trademark of the variety of awesome companies of meals intakes in 24 hours had been said to expose a wonderful courting with infant dietary repute in Pakistan and different South Asian international locations (Ahmed et al., 2012).

Healthcare, Sanitation, and Water

The mechanisms through which bad water, sanitation, and hygiene (WASH) states precipitate formative years malnutrition are many and nicely-hooked up. Pollution of water and meals, low tiers of sanitation, and inadequate hygiene measures disclose youngsters to microorganisms that cause diarrheal ailment, environmental enteropathy, and infection of the whole system- all of which harm nutrient absorption and utilization, deteriorating even the linear increase even withinside the presence of a nutritional intake (Cumming & Bhatt, 2015). As Spears (2013) illustrated withinside the evaluation of statistics in a hundred and forty nations, it turned into located that open defecation is one of the most powerful predictors of early life

stunting within the international and that it independently contributes a sizable proportion of cross-countrywide variations in suggest height-for-age.

Improved sanitation is likewise now no longer to be had to the bulk of the populace in Pakistan, specifically within the peri-city and rural societies. The Joint Monitoring Programme Water Supply and Sanitation approximates that approximately 37 percentage of the Pakistani populace has no get right of entry to to fundamental sanitation offerings with approximately 14 percentage of the agricultural populace training open defecation (JMP, 2021). Akhtar et al. (2022) concluded that the percentages of kids without a get right of entry to to higher sanitation centers became plenty more than that of different youngsters, as family wealth and maternal training have been controlled. Another size of provider surroundings that influences the kid dietary reputation is healthcare get entry to, consisting of immunization coverage, increase monitoring, and vitamins counseling. Bhutta et al. (2013) have proven in a scientific assessment that network-primarily based totally vitamins and healthcare interventions can convey huge decreases in the superiority of stunting and losing inside pretty a brief time-frame while included in South Asia i.e. in Pakistan.

City-Rural Inequality in Nutritional/Educational results

Although dietary results are normally taken into consideration to be higher in city houses whilst in comparison with rural houses in Pakistan, the hastily increasing and in large part unplanned urbanization has ended in regions of excessive dietary vulnerability in cities, in particular casual settlements and peri-city regions wherein terrible families are focused and offerings are in large part unavailable (Hussain et al., 2020). The literature on Lahore mainly has recorded that the charges of malnutrition a number of the youngsters in low-profits city neighborhoods are both just like the ones within the rural placing or maybe better because of the aggregate of city poverty, meals insecurity, and useless sanitation infrastructure (Ali et al., 2018). The importance of those in-town inequalities highlights the want to accumulate and examine facts in disaggregated paperwork that aren't limited to the city-rural dichotomy as a way to decide which groups and families are at finest threat.

Collectively, the literature creates a strong proof base of the multidimensional determinants of formative years malnutrition in Pakistan, and additionally offers precious insights into gaps in regionally contextualized, network-stage quantitative studies. The modern-day studies fills the ones gaps through analyzing the mixed movement of socioeconomic, behavioral, and environmental threat elements in figuring out the results of malnutrition in Lahore, Pakistan, thru a standardized and confirmed quantitative layout consistent with WHO and UNICEF guidelines. The records provides to the growing frame of proof that may be used to put in force context-particular vitamins interventions in city Pakistan.

Methodology

Research Design

The studies layout used on this observe is quantitative cross-sectional studies layout, that's usually described because the fine layout to apply whilst measuring the superiority of a fitness condition, in addition to figuring out elements related to it at a given time inside a selected populace (Hulley et al., 2013). In this observe, a cross-sectional layout is specially appropriate, because it permits powerful and concurrent information accumulating at the dietary reputation and information at the feasible threat elements on a big populace, so one can allow one to calculate incidence estimates and estimate correlations among threat elements and malnutrition outcomes. Although this sort of layout denies the cappotential to use causal inferences due to the dearth of longitudinal comply with up, it gives a robust epidemiological platform to formulate speculation on causal relationships and appropriate populations for use in unique intervention.

The Setting And Population Of The Study

The studies turned into practiced in Lahore of Punjab, Pakistan, which became selected because the observe region primarily based totally on its demographic relevance as the second one-biggest town in Pakistan and its heterogeneous socioeconomic shape that consists of prosperous city areas, city lower-profits localities, and groups primarily based totally within the peri-city surroundings that are greater function of a rural surroundings. The examine populace become all youngsters among the age of zero and fifty nine months (zero-five years) of decided on city and peri-city settlements of Lahore along side their number one caregivers (frequently moms or grandmothers). This age class became selected as it's miles the age of the best publicity to malnutrition and as popular age class of interest in surveys of infant malnutrition finished internationally, which includes the Pakistan Demographic and Health Survey and the National Nutrition Survey.

Sample Size and Sampling Strategy

The Lwanga and Lemeshow (1991) method of occurrence estimation became used to estimate a goal pattern of 250 kids primarily based totally on an anticipated stunting incidence of 40% (taken because the NNS, 2018), favored precision of 6,

and self belief stage of ninety five which means a minimal required pattern of 228 youngsters. To cowl the non-reaction and information nice attrition charge of approximately 10 percent, the very last pattern length changed into decided to be 250. The sampling technique followed become two-level stratified random pattern. A entire listing of all public PHCs and registered groups turned into saved via way of means of the Lahore District Health Authority and 6 major healthcare facilities (PHCs) and network clusters 3 city and 3 withinside the peri-city vicinity had been decided on withinside the first level via opportunity proportional to length sampling. At the second one phase, the recognized eligible families had been primarily based totally on a family list exercising accomplished at every cluster, and youngsters elderly zero-fifty nine months have been enumerated. The quantity of kids who needed to be sampled in every stratum become decided on proportionally the usage of a random quantity desk to make certain that each city and peri-city populace changed into properly represented.

Data Collection Instruments

Two complementary gear have been used to accumulate number one information. The preliminary factor become that the educated studies enumerators took the standardized anthropometric measurements of every baby with the assist of calibrated system consistent with WHO requirements (WHO, 2006). The weight become measured on a seca virtual weighing scale (particular to zero.1 kg) of the kid in minimal apparel and barefooted. Recumbent length (in kids under 24 months) and status height (in youngsters among 24-fifty nine months) had been recorded with the assist of a general SECA measuring board/stadiometer (correct to zero.1 cm). The validation of age became achieved via beginning certificates, maternal and toddler fitness (MCH) playing cards or thru caregiver take into account, wherein viable, numerous reassets have been cross-checked. Measures of weight-for-Height (WHZ), height-for-Age (HAZ), and weight-for-Age(WAZ) have been calculated the usage of WHO Anthro model three.2.2 to those requirements in 2006 the usage of the WHO Child Growth Standards because the reference. The Z-rankings that had been much less than -2 popular deviations of the reference median have been taken into consideration as wasted (WHZ = -2), stunted (HAZ = -2), or underweight (WAZ = -2), respectively. Severe malnutrition turned into taken into consideration to be Z-ratings much less than -three SD.

Second, the number one caregiver of every of the selected youngsters, who had given an knowledgeable consent, turned into interviewed the use of a established questionnaire through skilled woman studies assistants who spoke the Urdu language. The questionnaire had 5 modules, which had been (1) family socioeconomic elements, as month-to-month profits, housing fine, family length, and asset ownership; (2) maternal elements, inclusive of age, schooling degree, marital popularity, occupation; (three) toddler and younger toddler feeding practices, together with starting breastfeeding, unique breastfeeding, advent of complementary foods, and a 24-hour nutritional bear in mind of youngsters over six months; (four) healthcare use, inclusive of frequency of boom tracking visits, immunization repute, and occupation; and (five) water, sanitation, and The questionnaire changed into written in English and translated to Urdu and then it changed into again translated to make certain accuracy. It has been examined at the pattern of 25 caregivers who have been now no longer concerned withinside the major look at, and it become revised at the provisions of the pilot consequences.

Data Analysis and Results

Data Management and Statistical Procedures

The discipline manager went via all stuffed questionnaires and ensured that they have been entire and steady earlier than getting into them into the computers. The statistics on anthropometry have been inputted without delay on WHO Anthro software program to be able to compute Z-rating and the consequences have been exported to SPSS model 25.zero (IBM Corp., 2017), wherein all of the statistical evaluation turned into done. Two facts access operators, having double access of the questionnaire information, had been used to lessen access mistakes and as a way to confirm the variety and consistency checking out of the statistics. Twelve questionnaires did now no longer have any anthropometric statistics ($n = 7$), or entire reaction at the questionnaires ($n = \text{five}$) and had been consequently now no longer protected withinside the evaluation giving a very last analytic pattern of 238 kids.

The facts evaluation plan changed into performed in 4 steps. To start with, descriptive statistics (frequency, percentages, means, and widespread deviation) had been computed on all sociodemographic, feeding practice, and WASH variables and the 3 malnutrition outcomes. Second, the reliability of the questionnaire become decided primarily based totally on using Cronbach alpha coefficient. Third, Pearson correlation evaluation became accomplished to research bivariate members of the family among socioeconomic variables which are non-stop and malnutrition Z-rankings. Fourth, every of the 3 malnutrition outcomes (stunting, losing and underweight) became about executed the usage of binary logistic regression in which the final results became a binary variable (malnourished = 1, non-malnourished = zero). The statistically great variables at $p = \text{zero.25}$ for the duration of the bivariate evaluation have been keyed into the multivariate logistic regression version as a block. All

analyses have been statistically sizable with a p-value of much less than zero.05 which become taken into consideration as large. The file offers the consequences in adjusted odds ratios (AOR) with ninety five% self belief intervals (CI).

Descriptive Statistics: Sample Characteristics

Table 1 consists of sociodemographic statistics of the pattern of the studies. Out of the 238 youngsters, who fell below the evaluation, there have been 123 (51.7) men and 115 (48.3) females. The common age of kids became 29.4 months (SD = 15.2). On residence, 128 (53.8) kids belonged to city groups and 110 (46.2) belonged to peri-city groups. Most of the families (62.2) had earning of much less than PKR 20,000 in line with month that is low earnings in line with the country wide requirements. In phrases of maternal schooling, handiest 25.2% of moms had secondary schooling or better with 33.2% having number one training and 41.6% had no schooling. The common family length became 6.8 (SD = 2.3).

Table 1

Sociodemographic Characteristics of Study Sample (N = 238)

Variable	Category	n (%)
Sex of Child	Male	123 (51.7%)
	Female	115 (48.3%)
Residence	Urban	128 (53.8%)
	Peri-Urban	110 (46.2%)
Maternal Education	No Education	99 (41.6%)
	Primary	79 (33.2%)
	Secondary +	60 (25.2%)
Monthly HH Income	< PKR 20,000	148 (62.2%)
	PKR 20,000–40,000	62 (26.1%)
	> PKR 40,000	28 (11.8%)
Improved Sanitation	Yes	138 (58.0%)
	No	100 (42.0%)

Note. HH = Household; PKR = Pakistani Rupee. Improved sanitation defined as access to flush/pit latrine.

Reliability Analysis

The consistency of the structured questionnaire was determined with the use of the Cronbach alpha coefficient on the socioeconomic and feeding practice subscales. The overall questionnaire was found to have good internal consistency (Cronbach's alpha = 0.81) as shown in Table 2. The socioeconomic subscale had an alpha of 0.79, the feeding practices subscale had an alpha of 0.76 and the healthcare access and WASH subscale had an alpha of 0.74. All these values are far beyond the generally acceptable limit of 0.70 acceptable reliability in the social science research (Nunnally, 1978), which proves the questionnaire to be valid and viable in the quantitative analysis.

Table 2

Cronbach's Alpha Reliability Coefficients by Questionnaire Subscale

Subscale	No. of Items	Cronbach's Alpha
Socioeconomic Characteristics	12	0.79
Infant & Young Child Feeding Practices	10	0.76
Healthcare Access & WASH	8	0.74
Overall Questionnaire	30	0.81

Note. WASH = Water, Sanitation, and Hygiene. All alpha values exceed the 0.70 threshold for acceptable reliability.

Prevalence of Malnutrition

Table 3 shows the prevalence of the three types of malnutrition in the general sample and living and sex. The general prevalence of stunting (HAZ < -2), wasting (WHZ < -2), and underweight (WAZ < -2) was 38.4% (n = 91), 21.2% (n = 50), and 33.6%, respectively. A proportion of 14.7% of children considered severe stunting (HAZ < -3), 7.6% severe wasting and

11.3% severe underweight. All three indicators were found to be more prevalent among peri-urban children than urban children: stunting was 44.5% among peri-urban and 33.6% among urban, wasting 26.4% versus 16.4% and underweight 39.1% versus 28.9%. Male children were marginally more stunted and underweight than female children, which is in line with the government reported international literature.

Table 3

Prevalence of Malnutrition by Type, Residence, and Sex (N = 238)

Category	Stunting %	Wasting %	Underweight %	Severe Stunting %
Overall	38.4	21.2	33.6	14.7
Urban	33.6	16.4	28.9	11.7
Peri-Urban	44.5	26.4	39.1	18.2
Male	40.7	22.0	35.0	15.4
Female	35.7	20.0	32.2	13.9

Note. Stunting = HAZ < -2 SD; Wasting = WHZ < -2 SD; Underweight = WAZ < -2 SD. Severe stunting = HAZ < -3 SD.

Correlation Analysis

To understand the relationships of malnutrition Z-score and continuous socioeconomic variables, Pearson correlation analysis was performed to establish the bivariate relationships (Table 4). There was a positive relationship between monthly household income and HAZ ($r = 0.42, p < 0.001$), WAZ ($r = 0.38, p < 0.001$), and WHZ ($r = 0.31, p < 0.001$), meaning that children in higher-income households had much better anthropometric results. The years of maternal education were again positively correlated to all three Z-scores in a similar manner ($r = 0.39$ with HAZ; $r = 0.35$ with WAZ; $r = 0.27$ with WHZ; all $p < 0.001$). Age in months was found to be negatively correlated with HAZ ($r = -0.22, p < 0.01$), which is consistent with the cumulative nature of stunting given that older children are more likely to be poor in nutrition, whereas household size was negatively correlated with all Z-scores which is consistent with the fact that larger households are more likely to be poor in nutritional outcomes, presumably due to dilution of household resources per child.

Table 4

Pearson Correlation Matrix: Socioeconomic Variables and Malnutrition Z-Scores

Variable	HAZ (r)	WAZ (r)	WHZ (r)	p-value
Monthly HH Income	0.42**	0.38**	0.31**	< 0.001
Maternal Education (yrs)	0.39**	0.35**	0.27**	< 0.001
Household Size	-0.28**	-0.24**	-0.19*	< 0.01
Child Age (months)	-0.22**	-0.11	-0.08	< 0.01
No. of ANC visits	0.33**	0.29**	0.22**	< 0.001

Note. HAZ = Height-for-Age Z-score; WAZ = Weight-for-Age Z-score; WHZ = Weight-for-Height Z-score. ANC = Antenatal Care. ** $p < 0.01$; * $p < 0.05$. HH = Household.

Logistic Regression Analysis: Risk Factors for Malnutrition

Binary logistic regression was estimated to determine the independent risk factors of each type of malnutrition after taking into account the effect of two or more predictors simultaneously. Table 5 demonstrates adjusted odds ratios (AOR), confidence interval of 95 percent, and p-values of the final multivariate logistic regression models of stunting. The strongest risk factors of stunting were low household income (AOR = 2.84, 95% CI: 1.62-4.97, $p < 0.001$) and absence of any maternal education (AOR = 2.61, 95% CI: 1.48-4.60, $p < 0.001$). Children not breastfed in six months had 2.1 times probability of being stunted than those that were breastfed exclusively (AOR = 2.09, 95% CI: 1.22-3.59, $p = 0.007$). There was also an increased odds of stunting associated with lack of improved sanitation (AOR = 1.87, 95% CI: 1.10-3.18, $p = 0.021$), use of unimproved water source (AOR = 1.76, 95% CI: 1.02-3.05, $p = 0.043$), and fewer than four antenatal care visits (AOR = 1.65, 95% CI: 0.98

Table 5

Binary Logistic Regression: Risk Factors for Stunting (HAZ < -2 SD)

Risk Factor	AOR	95% CI	Lower	p-value
Low HH Income (< PKR 20,000)	2.84	1.62	4.97	< 0.001***
No Maternal Education	2.61	1.48	4.60	< 0.001***
Not Exclusively Breastfed	2.09	1.22	3.59	0.007**
No Improved Sanitation	1.87	1.10	3.18	0.021*
Unimproved Water Source	1.76	1.02	3.05	0.043*
< 4 ANC Visits	1.65	0.98	2.78	0.060 ns
Peri-Urban Residence	1.58	0.94	2.65	0.083 ns

Note. AOR = Adjusted Odds Ratio; CI = Confidence Interval; ANC = Antenatal Care. Reference categories: high income, secondary+ education, exclusively breastfed, improved sanitation, improved water, urban. *** p < 0.001; ** p < 0.01; * p < 0.05; ns = not significant.

The patterns were similar in the logistic regression models of wasting and underweight. In the multivariate model, the strongest risk factors were low household income (AOR = 2.44, p < 0.001), low dietary diversity score (AOR = 2.21, p = 0.003), and absence of maternal education (AOR = 1.98, p = 0.012) as the risk factors of wasting. They were independently significant with the underweight, low income (AOR = 2.73, p < 0.001), no mother education (AOR = 2.29, p < 0.001), not exclusively breastfed (AOR = 1.89, p = 0.018) and lack of improved sanitation (AOR = 1.72, p = 0.031). In all three models, the borderline risk factor that was not statistically significant following the adjustment of income and education is the peri-urban residence, implying that urban-peri-urban disparity in the prevalence of malnutrition is mediated by the socioeconomic characteristics rather than the geographic location itself.

Discussion

The results of this research serve as an important addition to the evidence-base about childhood malnutrition in Lahore, Pakistan, that validates and generalizes trends identified by national surveys, together with coverage of locally contextualized data that is needed to offer a programmatic response. This means that the overall prevalence of stunting of 38.4% is relatively in line with the provincial estimates of the NNS (2018) and the PDHS (2019), and confirms that the most vulnerable population groups in Lahore still have a malnutrition burden that is similar to the national prevalence rate, despite the city being relatively more affluent and having a more well-developed service infrastructure. The increased rates of malnutrition in peri-urban communities over urban ones, where stunting reaches 44.5 and 33.6, respectively, is in line with Ali et al. (2018) and Hussain et al. (2020), who assert that rapid urbanization without the improvement on the services and incomes generates local areas of extreme nutritional susceptibility on the urban edges.

The results of the logistic regression support the key role of low household income and low maternal education as the strongest independent risk factors of all three types of malnutrition and align with the world literature on the topic estimated by Grantham-McGregor et al. (2007) and the Pakistan-specific results of Raza et al. (2016) and Khan et al. (2019). The magnitude of these relations, with low-income children almost three times more likely to be stunted than higher-income children, highlights the fact that malnutrition is essentially a structural manifestation of poverty and inequality and that nutrition-specific interventions themselves, without considering underlying determinants, will not have much effect on long-term malnutrition effects. The high level of independent contribution of poor practices in breastfeeding to stunting and underweight is supported even after income and education adjustment, which supports the value of promoting IYCF as a nutritionally specific intervention that has the potential to bring benefits across socioeconomic levels as reported by Rana et al. (2021) and Dewey and Adu-Afarwuah (2008). These correlations and results with poor sanitation, using unimproved water sources, and malnutrition outcomes are in line with the WASH-nutrition pathway outlined by Cumming and Bhatt (2015) and Akhtar et al. (2022) and indicate the necessity to consider integrated WASH-nutrition intervention that considers both the environmental transfer of enteric pathogens and dietary interventions. Lastly, the relationship between the number of visits to the antenatal care and the nutritional outcomes of children helps to underline the significance of the prenatal period as the nutrition intervention opportunity and the necessity to pay more attention to the quality and coverage of maternal healthcare facilities in the underserved areas of Lahore.

Conclusions and Recommendations

The present cross-sectional study has already recorded high and unequally distributed prevalence of childhood malnutrition in Lahore, Pakistan with stunting, wasting, and underweight prevalence of 38.4, 21.2 and 33.6, respectively, and cluster among peri-urban children and children of the lowest income and education status. The given multivariate analysis shows that low household income, poor maternal education, suboptimal breastfeeding, inadequate dietary diversity, lack of improved sanitation, and reliance on unimproved water sources were the key independent risk factors of malnutrition, which is why the problem has a multidimensional nature and requires intersectoral responses. These results have a direct implication on the design and targeting of nutrition programs in Lahore and provide a methodological template on the community-level nutrition surveillance in other Pakistani cities.

The results of the current research allow providing the following recommendations to the policymakers, program designers, medical providers, and researchers who study children nutrition in Pakistan. The Government of Punjab must focus on the increase of targeted social protection to the poorest households in peri-urban Lahore where malnutrition burden is greatest and income is the strongest risk factor to ensure that economic vulnerability does not become nutritional deprivation toward children. Investment in education of girls must be clearly conceptualized as a long-term nutrition intervention since maternal education has a strong independent relation with child nutrition, and especially in retention of girls in secondary school and beyond. Frontline health workers should enhance and intensify community-level IYCF counseling services, particularly exclusive breastfeeding during six months, timely and suitable complementary feeding, and dietary diversity, especially taking into account the needs of mothers in low-income and low-education households with the least access to such services via formal healthcare. The concept of integrated WASH-nutrition programming must be introduced as a new form of community nutrition interventions in peri-urban Lahore, as dietary changes will only have a minimal effect in the condition of the constant environmental enteropathy caused by polluted water and inadequate sanitation. Growth monitoring and growth promotion such as regular anthropometry and growth chart plots, and advice on growth faltering, should be systematically integrated into primary healthcare centers into routine child health service, and community health workers should be empowered with the skills and equipment to perform and follow up on such assessments at home. Future studies are advised to take longitudinal forms in order to study causal dynamics of malnutrition risk factors with time, and expand the geographic and demographic coverage of community-based nutrition surveillance to other cities and provinces in Pakistan, so that more national mapping of malnutrition burden and its determinants can be made.

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