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Indicators of Malnutrition in Under 5 Pakistani Children: A DHS Data Secondary Analysis

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Abstract

Objective: To assess the rates of stunting, wasting and underweight in under 5 Pakistani children and identify their associated indicators.

Methodology: Data was retrieved from DHS program website for sub-analysis. The outcome variables were constructed according to WHO standards for malnutrition indicators. The three study outcomes of stunting, wasting and underweight were defined on the basis of -2 SD levels of the standard corresponding Z-scores for age of children. STATA 10.0 software was used for measurements of final dataset of 3071 children.

Results: High prevalence of stunting, wasting and underweight (45.1%, 10.4% and 26.7% respectively) was identified in this study. Maternal and fathers secondary or above education, health facility delivery, cesarean section and rich SES children have less odds of becoming stunted. Whereas children of older mothers, child age above 2 years, small birth size, 5 or above birth order, rural residence with no toilet facility had greater odds to develop stunting. Similar characteristics of children with underweight were identified; however, very few indicators for wasting were identified.

Conclusion: A very high number of under 5 Pakistani children are malnourished. Health budget should be increased and new facilities for educating and counseling patients are required to prevent malnutrition.

Keywords: Children; Stunting; Wasting; Underweight; Indicators; DHS

Introduction

Malnutrition refers to either over or under-nutrition [1]. It is directly related to child growth and health [2]. Of the two forms of malnutrition, under-nutrition occurs with inadequate intake of protein, calories, iron or other nutrients [1]. Such malnourished children especially those aged less than 5 years are at risk of having poor brain development and are more prone to repeated infections. Due to frequent illnesses they get locked into the vicious circle of repeated sickness affecting their growth [3]. Additionally, their low immunity and repeated episodes of infection like diarrhea, pneumonia and other infectious diseases increase risk of severe morbidity and mortality [4]. Thus, it significantly contributes to more than 2 million under 5 deaths globally every year especially, in the under privileged areas of Africa and Asia where it is a major public health problem [5].

There are three main indicators of under nutrition in which reflects different histories of nutritional insults to the health of children. These are referred to as stunting, wasting and underweight [6]. World Health Organization measures these indicators as low in height-for-age z-scores (HAZ) defined as stunted, low weight-for-height (WHZ) known as wasted and low weight-for-age (WAZ) termed as underweight according to their referral age group and sex [7,8]. Stunting is associated with poor energy intake, poor sanitation, and poor socioeconomic conditions. Underweight is associated with recurrent illness and starvation whereas wasting is usually associated with a recent illness and failure to gain weight [6].

The trends of malnutrition are variable in the South Asian region, with Pakistan and India being the most affected countries having stunting and underweight rates in the range of 40-50% and 30-40% respectively [9]. These rates are constantly high and no signs of improvement have been seen in the linear trends of malnutrition in the last two decades. On the other hand demographically and economically similar

countries like Bangladesh and Sri Lanka have achieved significant betterment in child malnutrition in recent years [10].

Reduction in malnutrition has not only a role in health and quality of life of populations but is also related to increase in economic productivity and thus, GDP of countries [11]. Well-nourished children grow naturally and perform to the best of their abilities in academics, they remain healthy both physically and mentally and result in less burden on hospitals and parental worries.

Various country level evidence based studies have highlighted causative factors and suggested gaps for implementation to ministries of health, programme managers and other stakeholders associated with maternal and child health [12,13]. In Pakistan there are limited trials that have assessed childhood malnutrition and those too at regional level; however, national level data has not so far been analyzed in detail. We, therefore, aim to measure various contributing factors of childhood malnutrition in terms of stunting, wasting and underweight using nationally representative DHS data (2012-13), so that evidence can be shared with involved stakeholders who can take action to target this constantly deprived condition.

Materials and Methods

Study definitions

Stunting: stunting reflects low height for age z scores (standard deviation). The cut off level of -2.0 z score was used for stunting in this study.

Wasting: Wasting is based on low weight for height z scores (standard deviation) level. A cutoff level of -2.0 was considered as wasted child.

Underweight: Underweight is defined as low weight for age z scores (standard deviation). It was based on cutoff value of -2.0 standard deviation z score.

The cutoffs for stunting, wasting and underweight were based on child growth standard published by World Health Organization [8]. Z-scores for stunting were defined as the difference of a child's height and the age- and sex-specific median height of the WHO reference population over the standard deviation of their age group within the reference population.

Study indicators: The outcome anthropometric variables were constructed on height-for-age (HAZ), weight for age (WAZ) and weight-for-height (WHZ). Each z-score shows deviation from the reference median height or weight of a child of the same age and sex.

The study indicators were selected as individual level factors like maternal age, maternal and paternal education, child age, child gender, baby size at birth, place of delivery, mode of delivery; normal or cesarean section, preceding birth interval and birth order. The household level factors included socioeconomic status of families as poor, middle and high income. Community level factors were place of residence and geographical region.

Data source

Data was downloaded from Demographic Health Survey (DHS) Program website after getting permission for sub-analysis. The DHS data is available in public domain for access on the website www.measuredhs.com. This survey was originally conducted to retrieve information regarding maternal and child health. DHS surveys are conducted by National Institute of Population Studies in collaboration with DHS program with funding from USAID. The multistage stratified cluster sampling was used and rural and urban samples were separately drawn. The sample was nationally represented according to the demographics of each province of Pakistan. Randomization according to household was utilized to select respondents for this survey. In this cross sectional survey consent and ethical approval was taken at the point of conducting survey, so we did not seek any consent. There were 12943 respondents in DHS 2012-13 and the overall response rate was 93.1%. The data was assessed for completeness and only cases with complete entries regarding malnutrition parameters of stunting, wasting and underweight were included in the study. There were 3957 cases with responses on childhood malnutrition. We excluded the cases with incomplete information, children not living with mothers, flagged cases and cases with missing values. The complete data on 3071 children under 5 years of age regarding malnutrition was, therefore, analyzed.

Statistical considerations

STATA 10.0 software was used for data analysis. Frequency and percentages were calculated for stunting, wasting and underweight. The indicators of malnutrition were dichotomized on the basis of presence or absence of these malnutrition parameters and were associated with the individual, household and community level factors. The variables included maternal age, maternal education, father's education, child gender, child age, place of delivery, birth order, preceding birth interval, cesarean delivery, residence, socioeconomic status and geographical region. χ^2 tests was used to associate the trends of stunting, wasting and underweight individually with selective study factors. A significance level of <0.05 was considered statistically significant. Logistic regression analysis was done to find out final significant predictors of malnutrition. Outcome variables were dichotomized and response of interest was coded as '1' and non-interest as '0'. The study indicators were categorized and recoded for this analysis.

Results

For this sub-analysis, a total of 3071 children were selected from PDHS 2013 for assessment of malnutrition. The overall prevalence of stunting, wasting and underweight was 45.1%, 10.4% and 26.7% respectively **(Figure 1)**.

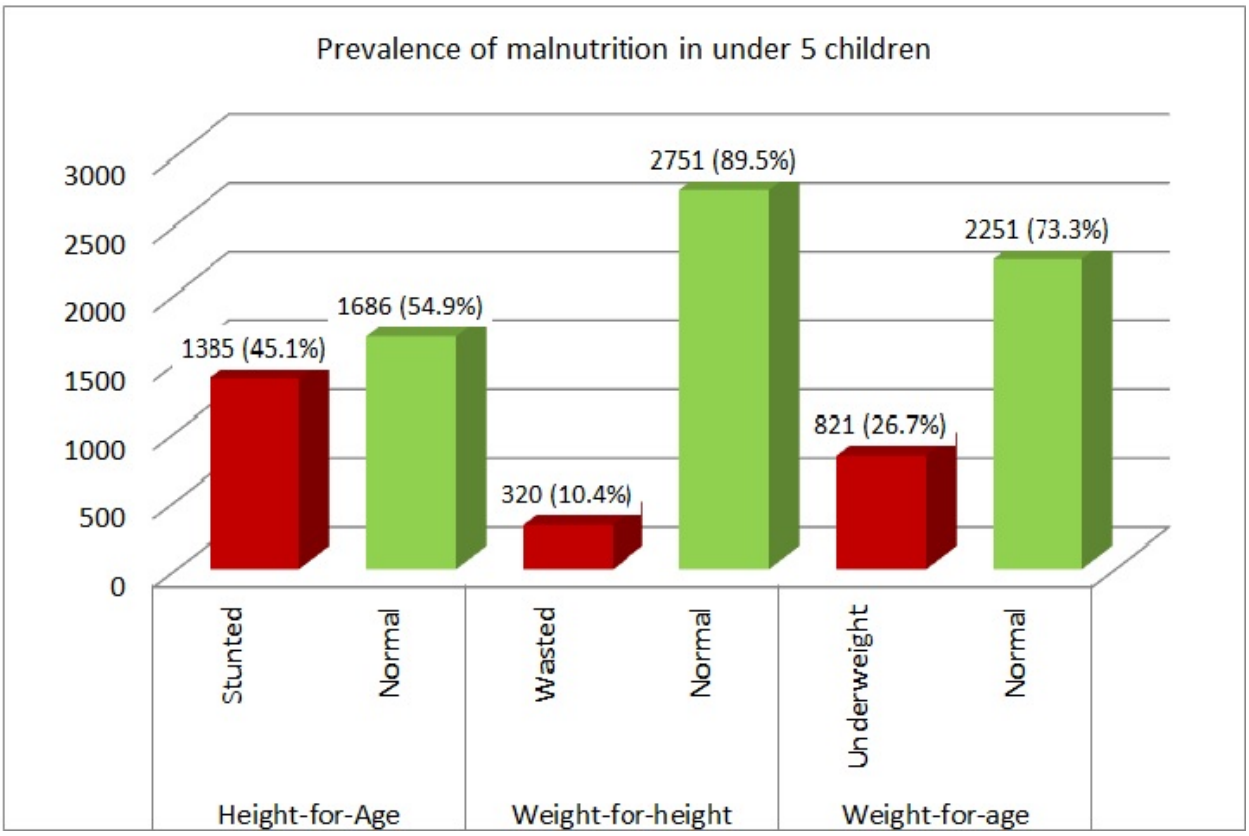

Figure 1 Trends of malnutrition in Pakistani children (PDHS 2012-13).

Various individual, household and community level factors were associated with stunting, wasting and underweight status of children. Stunting was significantly greater in children whose mothers were above 31 years of age and were uneducated (p-value, <0.001). Children who were delivered at home were more likely to have stunting than those born in a health facility (55.6% vs 36.1%, p-value, <0.001). Similarly non-cesarean delivery status was found related to stunting. Child age of above 2 years was significantly associated with stunting than less than 6 months (54.4% vs 22.8%). Small baby size at birth (52.1% vs 32.3%) and birth order of 5 or above (54.9% vs 40.5%) was also found significantly associated with stunting. Children belonging to poor socioeconomic status, those living in rural areas and belonging to Sindh and Baluchistan provinces were significantly associated with stunting in this study (p-value, <0.001).

Further analysis revealed that maternal non-education was significantly related to wasting (12.2% vs 8.3%) and underweight (34.1% vs 14.2%). Children born at home (31.5% vs 22.5%) and those having non-cesarean section deliveries (28.1% vs 17.2%) were more likely to be underweight than those born in a health facility and on cesarean section (p-value, <0.001). Child age of 2 years or above was less likely to have wasting than below 2 years whereas child age had no relation with underweight in this study. Low birth weight was significantly associated with underweight than large size (34.9% vs 18.4%). Children belonging to poor socioeconomic status and living in rural areas were significantly more likely to have underweight (p-value, <0.001). Similarly, geographical regions of Sindh and Baluchistan were found significantly associated with wasting and underweight than other regions (p-value, <0.001). Other details are shown in **Table 1**.

Table 1 Indicators of stunting, wasting and underweight according to PDHS 2012-13.

	Height-for-Age			Weight-for-age			Weight-for-height		
	Stunted (n=1385)	Normal (n=1686)	p-value	Wasted (n=320)	Normal (n=2751)	p-value	Underweight (n=821)	Normal (n=2251)	p-value
Individual level factors									
Maternal age (years)									

Up to 20	69 (43.4%)	90 (56.6%)	0.01	26 (16.3%)	133 (83.6%)	0.03	47 (29.5%)	112 (70.4%)	0.51
21 to 30	750 (43.0%)	994 (57.0%)		180 (10.3%)	1564 (89.6%)		473 (27.1%)	1271 (72.8%)	
31 or above	566 (48.4%)	602 (51.5%)		114 (9.7%)	1054 (90.2%)		301 (25.7%)	867 (74.2%)	
Maternal education									
No education	886 (55.1%)	720 (44.8%)	<0.001	197 (12.2%)	1409 (87.7%)	0.002	549 (34.1%)	1057 (65.8%)	<0.001
Primary	228 (45.8%)	269 (54.1%)		45 (9.5%)	452 (90.9%)		133 (26.7%)	364 (73.2%)	
Secondary or above	271 (28.0%)	697 (72.0%)		78 (8.6%)	890 (91.9%)		139 (14.3%)	829 (85.6%)	
Father's education									
No education	520 (57.2%)	389 (42.7%)	<0.001	108 (11.8%)	801 (88.1%)	0.13	309 (33.9%)	600 (66.0%)	<0.001
Primary	221 (48.6%)	234 (51.4%)		54 (11.8%)	401 (88.1%)		149 (32.7%)	306 (67.2%)	
Secondary or above	643 (37.7%)	1061 (62.2%)		158 (9.2%)	1546 (90.8%)		362 (21.2%)	1342 (78.8%)	
Place of delivery									
Home	788 (55.6%)	631 (44.4%)	<0.001	160 (11.2%)	1259 (88.7%)	0.15	448 (31.5%)	971 (68.4%)	<0.001
Health facility	597 (36.1%)	1055 (63.8%)		160 (9.6%)	1492 (90.3%)		373 (22.5%)	1279 (77.4%)	
Delivery by cesarean									
Yes	121 (29.8%)	284 (70.1%)	<0.001	374 (92.3%)	31 (7.6%)	0.12	70 (17.2%)	335 (82.7%)	<0.001
No	1260 (47.4%)	1398 (52.6%)		2369 (89.1%)	289 (10.8%)		749 (28.1%)	1909 (71.8%)	
Child sex									
Male	733 (47.0%)	825 (52.9%)	0.02	180 (11.5%)	1378 (88.4%)	0.03	442 (28.3%)	1116 (71.6%)	0.03
Female	652 (43.1%)	861 (56.9%)		140 (9.2%)	1373 (90.7%)		379 (25.0%)	1134 (74.2%)	
Child age (mon)									
Up to 6	64 (22.8%)	216 (77.1%)	<0.001	41 (14.6%)	239 (85.3%)	<0.001	66 (23.5%)	214 (76.4%)	0.43
6 to 11	81 (27.0%)	219 (73.0%)		47 (15.6%)	253 (84.3%)		74 (24.6%)	226 (75.3%)	
12 to 17	139 (42.9%)	185 (57.1%)		60 (18.5%)	264 (81.4%)		95 (29.3%)	229 (70.6%)	
18 to 23	111 (48.9%)	116 (51.1%)		26 (11.4%)	201 (88.5%)		63 (27.7%)	164 (72.2%)	
24 to 35	355 (54.4%)	297 (45.5%)		53 (8.13%)	599 (91.8%)		187 (28.6%)	465 (71.3%)	
36 to 59	635 (49.3%)	653 (50.7%)		93 (7.2%)	1195 (92.7%)		336 (26.0%)	952 (73.9%)	
Size of baby at birth									

Large	79 (32.3%)	165 (67.6%)		21 (8.6%)	223 (91.3%)		45 (18.4%)	199 (81.5%)	
Average	1018 (44.7%)	1257 (55.2%)	<0.001	229 (10.0%)	2046 (89.9%)	0.12	583 (25.6%)	1692 (74.3%)	<0.001
Small	288 (52.1%)	264 (47.8%)		70 (12.6%)	482 (12.6%)		193 (34.9%)	359 (65.0%)	
Birth order									
1	281 (40.5%)	412 (59.4%)		72 (10.3%)	621 (89.6%)		176 (25.4%)	517 (74.6%)	
2-4	626 (41.5%)	882 (58.5%)	<0.001	144 (9.5%)	1364 (90.4%)	0.18	401 (26.5%)	1107 (73.4%)	0.49
5 or above	478 (54.9%)	392 (45.0%)		104 (11.9%)	766 (88.0%)		244 (28.05)	626 (71.9%)	
Birth interval (months)									
No previous birth	281 (40.5%)	412 (59.4%)		72 (10.3%)	621 (89.6%)		176 (25.4%)	517 (71.4%)	
9 to 14	90 (47.3%)	100 (52.6%)		17 (8.9%)	173 (91.0%)		48 (25.2%)	142 (74.7%)	
14 to 24	318 (47.3%)	353 (52.6%)	0.05	68 (10.1%)	603 (89.8%)	0.89	191 (28.4%)	480 (71.5%)	0.59
25 or above	689 (45.6%)	821 (54.3%)		161 (10.6%)	1349 (89.3%)		399 (26.42%)	1111 (73.5%)	
Household level factors									
Socio economic status									
Poor	733 (58.7%)	514 (41.3%)		149 (11.9%)	1098 (88.1%)		443 (35.5%)	804 (64.5%)	
Middle	246 (44.4%)	308 (55.6%)	<0.001	59 (10.6%)	495 (89.3%)	0.1	144 (25.9%)	410 (74.0%)	<0.001
Rich	406 (31.9%)	864 (68.1%)		112 (8.8%)	1158 (91.2%)		234 (18.4%)	1036 (81.6%)	
Community level factors									
Residence									
Urban	532 (40.0%)	798 (60.0%)		131 (9.8%)	1199 (90.1%)		287 (21.5%)	1043 (78.4%)	
Rural	853 (48.9%)	888 (51.0%)	<0.001	189 (10.8%)	1552 (89.1%)	0.36	534 (30.6%)	1207 (69.3%)	<0.001
Geographical region									
Punjab	387 (38.0%)	631 (61.9%)		84 (8.2%)	934 (91.7%)		244 (23.9%)	774 (76.0%)	
Sindh	388 (55.1%)	316 (44.8%)		92 (13.0%)	612 (86.9%)		284 (40.3%)	420 (59.6%)	
KPK	205 (37.8%)	336 (62.1%)		62 (11.4%)	479 (88.5%)		131 (24.2%)	410 (75.7%)	
Balochistan	230 (78.7%)	62 (21.2%)	<0.001	37 (12.6%)	255 (87.3%)	0.005	98 (33.5%)	194 (66.4%)	<0.001
Gilgit Baltistan	127 (42.1%)	174 (57.8%)		21 (6.9%)	280 (93.0%)		36 (11.9%)	265 (88.0%)	
Islamabad (ICT)	48 (22.3%)	167 (77.6%)		24 (11.1%)	191 (88.8%)		28 (13.0%)	187 (86.9%)	

Furthermore the analysis was done to see the trends of malnutrition according to health and basic life necessities. Though stunting and underweight were more prevalent in children not vaccinated, but the results were not statistically significant whereas wasting was significantly associated with non-vaccination (p-value, 0.02). Children with diarrhea in last 2 weeks were significantly more likely to have wasting and underweight (p-value, 0.006). Children drinking water from piped source and filter plant or bottled source were less likely to have stunting, wasting and underweight (p-value, <0.001) whereas children from households with no toilet facility were more likely to have under-nutrition (p-value, <0.001). Further details can be seen in **Table 2**.

Table 2 Relation of malnutrition according with health and living condition of children (PDHS 2012-13).

	Height-for-Age			Weight-for-age			Weight-for-height		
	Stunted (n=1385)	Normal (n=1686)	p-value	Wasted (n=320)	Normal (n=2751)	p-value	Underweight (n=821)	Normal (n=2251)	p-value
Vaccination									
Yes	985 (49.4%)	1009 (50.6%)	0.19	200 (10.0%)	1794 (89.9%)	0.02	574 (28.7%)	1420 (71.2%)	0.23
No	139 (55.6%)	111 (44.4%)		39 (15.6%)	211 (84.4%)		87 (34.8%)	163 (65.2%)	
Diarrhea (last 2 weeks)									
Yes	308 (45.8%)	364 (54.1%)	0.66	90 (13.3%)	582 (86.6%)	0.01	210 (31.2%)	462 (68.7%)	0.006
No	1076 (44.9%)	1319 (55.0%)		230 (9.6%)	2165 (90.4%)		611 (25.5%)	1784 (74.4%)	
Acute respiratory infection									
Yes	207 (43.7%)	266 (56.2%)	0.52	56 (11.8%)	417 (88.1%)	0.27	132 (27.9%)	341 (72.0%)	0.53
No	1178 (45.3%)	1420 (54.6%)		264 (10.1%)	2334 (89.8%)		689 (26.5%)	1909 (73.4%)	
Drinking water source									
Piped water	484 (42.4%)	655 (57.5%)	<0.001	97 (8.5%)	1042 (91.4%)	0.01	247 (21.6%)	892 (78.3%)	<0.001
Well/Hand pump	642 (47.8%)	701 (52.2%)		152 (11.3%)	1191 (88.6%)		428 (31.8%)	915 (68.1%)	
Spring river	116 (54.7%)	96 (45.2%)		25 (11.7%)	187 (88.2%)		56 (26.4%)	156 (73.5%)	
Tanker/cart	28 (47.4%)	31 (52.5%)		12 (20.3%)	47 (79.6%)		21 (35.5%)	38 (64.4%)	
Filter plant/bottled	47 (32.6%)	97 (67.3%)		11 (7.6%)	133 (92.3%)		20 (13.8%)	124 (86.1%)	
Others	68 (39.0%)	106 (60.9%)		23 (13.2%)	151 (86.7%)		49 (28.1%)	125 (71.8%)	
Toilet facility									
Flushed toilet	826 (39.5%)	1265 (60.5%)	<0.001	201 (9.6%)	1890 (90.3%)	0.01	491 (23.4%)	1600 (76.5%)	<0.001
Pit latrine	204 (61.4%)	127 (38.3%)		30 (9.0%)	301 (90.9%)		93 (28.1%)	238 (71.9%)	
No facility	279 (60.3%)	183 (39.6%)		66 (14.2%)	396 (85.7%)		187 (40.4%)	275 (59.5%)	
Others	76 (40.6%)	111 (59.3%)		23 (12.3%)	164 (87.7%)		50 (26.7%)	137 (73.2%)	

The final predictors of stunting, wasting and underweight were measured using logistic regression and findings recorded as odds ratio, 95% confidence intervals and probability value [OR (95% CI)]. Small size at birth and rural residence had

higher odds of stunting 1.45 (1.25-1.67). Similarly, maternal high education 0.56 (0.52-0.61), health facility delivery 0.45 (0.39-0.52) and rich socioeconomic class 0.68 (0.64-0.71) were less likely to have stunting. A similar, trend of association was observed with underweight children. Further details are shown in **Table 3**.

Table 3 Final predictors of stunting, wasting and underweight based on logistic regression analysis (PDHS 2012-13).

	Stunting			Wasting			Underweight		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Older maternal age (years)	1.18	1.04 - 1.34	0.008						
Secondary or above maternal education	0.56	0.52 - 0.61	<0.001	0.78	0.68 - 0.90	0.001	0.58	0.52 – 0.64	<0.001
Secondary or above father's education	0.73	0.68 - 0.78	<0.001				0.75	0.69 - 0.80	<0.001
Health facility delivery	0.45	0.39 - 0.52	<0.001				0.63	0.53 - 0.74	<0.001
Cesarean delivery	0.71	0.59 - 0.86	<0.001				0.71	0.56 - 0.89	0.004
Child age of above 2 years	1.24	1.18 - 1.29	<0.001	0.81	0.76 - 0.86	<0.001			
Small size of baby at birth	1.45	1.25 - 1.67	<0.001				1.54	1.31 - 1.82	<0.001
Birth order of 5 or above	1.35	1.22 - 1.50	<0.001						
Rich socioeconomic status	0.68	0.64 – 0.71	<0.001				0.74	0.70 - 0.78	<0.001
Rural residence	1.44	1.24 - 1.66	<0.001				1.6	1.36 - 1.89	<0.001
Geographical region							0.87	0.82 – 0.92	<0.001
Diarrhea (last 2 weeks)				1.16	1.03 - 1.31	0.01	1.11	1.02 - 1.21	0.01
No toilet facility	1.28	1.18 - 1.38	<0.001	1.16	1.03 - 1.30	0.01	1.25	1.15 – 1.36	<0.001

Discussion

This sub-analysis reveals that rates of stunting, wasting and underweight are very high in Pakistan. They are regarded as one of the significant contributors to under 5 deaths in which Pakistan ranks 5th globally with an estimated 250000 annual deaths [14]. Our analysis revealed that mother's and father's uneducated status was a continued cause of high malnutrition in all three domains that is stunting, wasting and underweight. Lack of education keeps parents unaware of proper feeding patterns and reduces their ability to pick apparent signs of undernourishment which results in serious health consequences for the child. Evidence from other countries of Asia and Africa also validates that lack of education translates to less awareness, lack of economic viability and thus, inappropriate nutritional intake, low resource living condition and improper health accessibility [15]. In a similar sub-analysis of DHS of low and middle income countries, it was highlighted that in 59% of malnourished children, maternal education was incomplete primary education. 49.6-49.7% of children had mothers and fathers with the same level of education, 16.1-16.2% had better-educated mothers and 34.2 had better-educated fathers [16]. Poor socioeconomic status is another contributing factor towards under-nutrition as reflected by our results which leads to lack of affordability to fulfill adequate nutritional needs. In a multi-country study conducted in Ethiopia, India, Peru and Vietnam on determining the association of poverty with under nutrition, analyses revealed that the coefficient on wealth was negative and statistically significant for all anthropometric outcomes in all countries [17]. Lack of affordability decreases the family's opportunities of access to basic facilities which in turn expose child to unhealthy environment and open invitation to diseases [18].

In this study child age of beyond 2 years was found significantly associated with malnutrition, specially stunting and wasting. This shows a picture where feeding patterns are not followed after first six months of exclusive breastfeeding. Continued breastfeeding after six months along with untimely and improper solid food leads the child to inadequate dietary intake and meeting demands of growing body with adequate variety of food results in inappropriate growth patterns. And this fact has been witnessed by many previous trials from

African region and South Asia [19,20]. In a multi-country data sub-analysis of infant and young child feeding practices and their association with under nutrition, it was identified that fewer than half newborns were put to breast within one hour after birth whereas only 36% were exclusively breastfed for first six months of life. Similarly, only 60% of infants received age appropriate breastfeeding and less than one-third of children aged 6 to 23 months met the minimum criteria for dietary diversity. This shows that improper infant and young child feeding practices have a significant association with under nutrition [21].

Moreover, small size at birth and birth order of 5 or above was found significantly associated with stunting in this study whereas preceding birth interval of less than 2 years was also found almost significantly associated with this condition. In a study conducted in Nigeria on identifying risk factors associated with malnutrition, a higher proportion of cases with malnutrition were of higher birth order (>4) as compared to their controls (20% versus 5.5%) [22]. nutritionally compromised mothers are prone to prematurity and intra growth retardation which translates into low birth weight [23]. A distinguished English epidemiologist stated that under-nutrition in utero can permanently change the body's structure, physiology and metabolism [24]. Though exclusive breastfeeding and proper nutritional intake can improve the condition of these children, inappropriate dietary intake exposes them to malnutrition and put them on risk of lifelong retardations and health issues.

We also noticed that rural residence especially of children from Sindh and Baluchistan more likely led to malnutrition. Although, in a recent study on healthcare seeking trends regarding pneumonia people in rural areas showed significant improvement in healthcare seeking behavior [25]. But the constant nature of malnutrition in these regions questions this finding. Health policy makers and managers need to improve the overall health services and ability of healthcare workers in proper counseling and education skills; this can be done by increasing health budget and improved training of health managers and future leaders. Lack of experienced and skillful leaders is a global phenomenon but Pakistan is facing huge brain drain [26]. Though no scientific evidence is available but apparent misuse of resources and mismanagement translates into lack of quality health managers and leaders.

Our analysis also measured relation of health indicators like vaccination and common childhood infections like diarrhea and ARI and living conditions of families with malnutrition. Non vaccination status was found associated with wasting, similarly, diarrhea in last 2 weeks was also found significantly related to wasting and underweight status. In a descriptive study conducted in India on identifying key predictors of under nutrition, it was highlighted that incomplete immunization status was significantly associated (Or 19.51, $p<0.001$) in development of underweight or severely underweight [27]. Significance of relation of episodes of diarrhea and malnutrition could be attributed to poor living conditions and lack of proper drinking water and sanitation resources which pollute surroundings and overall living environment [28]. Diarrhea and pneumonia impair children's growth and that underlying malnutrition is a major risk factor for these conditions. Episodes of diarrhea may predispose to pneumonia in undernourished children. Additional studies support breastfeeding and micronutrient supplementation for the prevention and control of diarrhea and pneumonia [29]. Our analysis also found that children using proper water sources like 'piped water' and 'filter plant/bottled water' were less likely to be malnourished. A study conducted to assess the impact of poor sanitation and poor WASH practices in low and middle income countries, showed that improved WASH has been shown to significantly reduce under nutrition,. In 2004, 881 000 deaths were attributed to water supply, sanitation and hygiene, mainly through the effect on under nutrition and its consequences [30]. Similarly, those cases with proper sanitation resources in terms of 'flushed toilet' were less like to have malnutrition.

The current study has many advantages; firstly it was based on nationally representative data and the findings can be generalized all over the country. Secondly, a very in-depth analysis was conducted and sub groups of children at individual, household and community level were analyzed. Final predictors were computed using logistic regression analysis, thus, limiting the chances of influencing variables and confounding variables.

There were few limitations of the study as well, this was a retrospective sub analysis of existing DHS data which is collected using cross sectional surveys. There is no detailed information regarding the fate of these children as no follow-up was done.

In summary, the final predictors of malnutrition on the basis of logistic regression analysis according to the three outcomes were measured. Mothers and fathers education level of secondary or above, deliveries at health facility and by cesarean section and children belonging to rich socioeconomic status were less likely to have stunting. On the other hand older maternal age, child age above 2 years, small size of baby at birth, birth order of 5 or above, rural residence and no toilet facility were found more likely to develop stunting. When predictors of wasting were assessed maternal education of secondary or higher and child age above 2 years were less likely to have wasting whereas children with diarrhea and those with no toilet facility were more likely to have wasting. A similar trend of underweight children was noted where mother and father education of secondary or above, health facility delivery and those conducted by cesarean section, children belonging to rich socioeconomic status and living in Punjab and KP regions were less likely to have underweight status. However, children who had small size at birth, living in rural areas, had diarrheal episodes in past two weeks and had no toilet facility were more likely to be underweight. There is a need to focus on these sub groups of population and through innovative strategies and proper counseling and education their condition should be targeted to reduce malnutrition in the under 5 years children in Pakistan.

Conclusion

In Pakistan the rates of childhood malnutrition are very high, these are attributed to various individual, household and community level characteristics like paternal education, baby size at birth, birth order, place of birth, cesarean section, and socioeconomic status, place of residence and toilet facility. By focusing on these subgroups of children the health departments, programme managers, healthcare providers, academicians, NGOs and policy makers can bring down the constant high rates of stunting, wasting and underweight in under 5 children. This analysis is based on nationally representative data and implications are multi-faceted and can be drawn according to geographical diversity.

It is suggested that the trends of malnutrition should be verified again using large scale data. This can be achieved by comparing the upcoming Pakistan DHS data with the existing reports.

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Disclosure Statement

The authors report no conflict of interest.

Contributions

SA conceived the study, retrieved and analyzed data, wrote results and method sections. AZ conceived the study and gave input in discussion section. BF and AM wrote introduction section and refined discussion section. ZS and HM critically reviewed the draft and finalized it.

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