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Abstract: Introduction: Child stunting remains a public health concern. It is characterized as poor cognitive and physical development in children due to inadequate nutrition during the first 1,000 days of life. Across South Asia, Pakistan has the second-highest prevalence of stunting. This study has assessed the most recent nationally representative data, the National Nutrition Survey (NNS) 2018, to identify the stunting prevalence and determinants among Pakistani children under five. **Methods:** The NNS 2018, a cross-sectional household-level survey, was used to conduct a secondary analysis. Data on malnutrition, dietary practices, and food insecurity was used to identify the prevalence of stunting among children under five years by demographic, socioeconomic, and geographic characteristics. The prevalence of stunting was calculated using the World Health Organization (WHO) height for age z-score references. Univariate and multivariable logistic regressions were conducted to identify factors associated with child stunting. **Results:** Analysis showed that out % of 52,602 children under five, 40.0% were found stunted. Male children living in rural areas were more susceptible to stunting. Furthermore, stunting was more prevalent among children whose mothers had no education, were between 20 and 34, and were employed. In the multivariable logistic regression, male children (AOR=1.08, 95% CI[1.04-1.14], P<0.001) from rural areas (AOR=1.07, 95% CI [1.01-1.14], P=0.014), with the presence of diarrhea in the last two weeks (AOR=1.15, 95% CI [1.06-1.25], P<0.001), with mothers who have no education (AOR=1.57, 95% CI [1.42-1.73], P<0.001) or lower levels of education (Primary: AOR=1.35, 95% CI [1.21-1.51], P<0.001; Middle: AOR=1.29, 95% CI [1.15-1.45], P<0.001) had higher odds of stunting. Younger children aged <6 months (AOR=0.53, 95% CI [0.48-0.58], P<0.001) and 6-23 months (AOR=0.89, 95% CI [0.84-0.94], P<0.001), with mothers aged 35-49 years (AOR=0.78, 95% CI [0.66-0.92], P=0.003) had lower odds of stunting. At the household level, the odds of child stunting were higher in the poorest households (AOR=1.64, 95% CI [1.46-1.83], P<0.001), with ≥7 members (AOR=1.09, 95% CI [1.04-1.15], P<0.001), with no access to improved sanitation facilities (AOR=1.14, 95% CI [1.06-1.22], P<0.001) and experiencing severe food insecurity (AOR=1.07, 95% CI [1.01-1.14], P=0.02). **Conclusion:** Child stunting in Pakistan is strongly associated with various factors, including gender, age, diarrhea, residence, maternal age and education, household size, food and wealth status, and access to sanitation. To address this, interventions must be introduced to make locally available food and nutritious supplements more affordable, improve access to safe water and sanitation, and promote female education for long-term reduction in stunting rates.

Keywords: stunting; determinants; children under five; national nutrition survey; Pakistan

1. Introduction

The introduction should briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be carefully reviewed and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work and

highlight the principal conclusions. As far as possible, please keep the introduction comprehensible to scientists outside your particular field of research. References should be numbered in order of appearance and indicated by a numeral or numerals in square brackets—e.g., [1] or [2,3], or [4–6]. See the end of the document for further details on references. Child stunting remains a global public health concern [1,2]. It is characterized as poor cognitive and physical development in children due to inadequate nutrition during the first 1,000 days of life – from conception to two years of age [2]. These children cannot attain their full potential and face disadvantages and difficulties in their schooling, careers, and ability to contribute and engage within their communities. In 2020, almost 150 million children under five experienced stunting worldwide [3]. Over the past three decades, the number of children experiencing stunting has decreased by 109 million, with one of the highest reductions observed in South Asia (44 million fewer stunted children from 1990-2020) [1]. However, these numbers are expected to increase due to the negative impact of COVID-19 on livelihoods, affordability of nutritious diets, and access to essential health and nutrition services [4].

The South Asia region comprises seven countries: Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka. Regardless of the reduction in the number of stunted children, the region continues to experience a high prevalence of stunting (31.7%), which is significantly higher than the global average (21.3%) [1,3]. Among these seven countries, Pakistan has the second-highest prevalence of stunting after Afghanistan [5–14]. Pakistan, an agricultural country, has a rapidly growing population of 207 million, headed towards 300 million by 2050 [6,15]. The population consists of a considerable youth bulge (28% between 15-29 years), with 31 million children under five years of age and 56 million women of reproductive age (15-49 years) [6,8]. With a fertility rate of 3.56 children per woman, about 50% of young Pakistani women of reproductive age (15-19 years) leave school, marry and bear their first child before their 20th birthday [6]. As the main contributor to the rapidly growing population, these young women's ability to access education, nutritious diets, healthcare services, and maintain adequate birth intervals and water, sanitation, and hygiene practices is a growing concern, as these are strong drivers of healthy child growth [1]. In Pakistan, the failure to tackle the high prevalence of stunting may severely impact economic growth and human capital development, leading to delays in the demographic dividend anticipated for the country [6].

With the country's efforts towards achieving the 17 Sustainable Development Goals (S.D.G.s), especially S.D.G. 2: Zero Hunger and S.D.G. 3: Good Health and Wellbeing, the national health and nutrition indicators have shown some progress, with stunting prevalence decreasing from 44% to 40% from 2011-2018 [6,16]. Similarly, the wasting prevalence (15% in 2011 to 7.1% in 2018), the maternal mortality rate (276/100,000 live births in 2007 to 186/100,000 live births in 2019), exclusive breastfeeding rate (37.7% in 2011 to 48.4% in 2018), and child immunization coverage (54% in 2013 to 76.5% in 2021) have improved over the last few years [5,16,17]. No improvements have been made in anemia rates among women of reproductive age and the prevalence of low birth weight [16]. Against this backdrop, we aimed to assess the most recent nationally representative data, the National Nutrition Survey 2018, to describe the prevalence of stunting by socioeconomic and geographic characteristics. We also aimed to identify the child, maternal, and household-level determinants of stunting in Pakistan. These determinants, once identified, may help improve understanding and enable strategic strengthening of nutrition-specific and -sensitive interventions and programs.

2. Materials and Methods

The Materials and Methods should be described with sufficient details to allow The National Nutrition Survey 2018 used a cross-sectional survey design, which collected data at the household level using quantitative and qualitative approaches [6]. In Pakistan, population diversity is entirely hinged on culture, influencing attitudes, practices, political affiliations, and social cohesion [18]. With this in mind, quantitative data was collected at the district level (district representative), while qualitative data was collected at the regional level (regionally representative) [6]. Data on malnutrition, dietary practices (caloric and micronutrient intakes), and food insecurity was collected from all districts of Punjab, Sindh, Khyber Pakhtunkhwa (including erstwhile Federally

Administered Tribal Areas [FATA]), Balochistan, Azad Jammu and Kashmir (A.J.K.), Gilgit-Baltistan (G.B.) and Islamabad Capital Territory (I.C.T.). The target population was women of reproductive age (15-49 years), children under five (0-59 months), school-aged children (6-12 years), and adolescents (10-19 years).

The survey used a two-stage stratified sample design, where the primary sampling units (P.S.U.s) were provided by the Pakistan Bureau of Statistics based on the Population and Housing Census of 2017 [6]. The households within the P.S.U.s were treated as secondary sampling units (S.S.U.s). Moreover, the prevalence of undernutrition (wasting, stunting, and micronutrient deficiencies) among children under five, adolescents, and women of reproductive age was used to calculate the district-specific sample size. Across the 156 districts of the country, 115,600 households (S.S.U.s) were sampled from 5,780 PSUs to obtain reliable estimates of key survey indicators. A detailed description of the National Nutrition Survey design, sampling methodology, and results are presented elsewhere [6].

The secondary analysis in this article presents the prevalence of stunting among children under five years by maternal age, education, and employment; child gender, age, and presence of disease; household socioeconomic status and place of residence. Data from 52,602 children under five were used for the secondary analysis. Since stunted was the primary outcome measure, children whose height for age z-scores was less than -2SD (Standard Deviation) of the World Health Organization (WHO) Child Growth Standard median were considered stunted. The frequencies, along with weighted percentages, were reported for selected predictors. The analysis started with simple univariate analysis followed by multivariate logistic regression. Unadjusted odds ratio with their 95% C.I.s were reported for the bivariate analysis. Variables significant at p<0.25 were considered for inclusion in the multivariate model. Covariates that were not significant at the multivariate level were dropped consecutively from the model after careful assessment of confounding. The final model was selected based on the theoretical and statistical significance of the predictors. The Type 1 error was set to 0.05. The model estimates are presented with the adjusted odds ratios (A.O.R.) and 95% CI.

The analysis was adjusted for the child's gender, age, diarrhea in the last two weeks, mother's education, age, family size, sanitation facilities, household food insecurity status, wealth status, rural/urban, and Province. All analysis was performed using Stata statistical software (version 18).

The National Nutrition Survey's methodology and strategy were approved by the Ethical Review Committee (ERC) at Aga Khan University (A.K.U.) [5176-WCH-ERC-17, dated December 27, 2017]. The ethical clearance was obtained from the National Bioethics Committee (N.B.C.) [NBC-278, dated November 7, 2017]. Informed consent was obtained from all participants and confidentially ensured as part of the survey. Approval for the secondary data analysis was obtained from the ERC, A.K.U.

3. Results

3.1. Child, Maternal, and Household Characteristics

Out of the 52,602 children enrolled, 50.7% were male, with the majority aged 24-59 months (63.0%) and living in rural areas (63.4%) [Table 1]. Across the provinces, most children were from Punjab (52.8%), 27.9 % were from Sindh, and 0.5% were from Gilgit Baltistan. A larger proportion of children had no reported presence of diarrhea (90.7%), acute respiratory infection (97.7%), or fever (85.5%) in the last two weeks. More than ½ of the mothers of the children had no education (55.3%), while a ¼ had completed secondary (12.3%) or higher education (11.1%). Most of these women were aged 20-34 (75.0%) and were housewives (89.4%). Most households were comprised of ≤6 family members (51.7%), had <5 children under the age of five (98.0%), had access to improved drinking water (92.0%), and improved sanitation facilities (82.5%). Furthermore, 58.4% of households reported being food secure, with 20.2% reporting severe food insecurity. Six out of 100 households (5.5%) reported receiving financial assistance from the Government in the last 12 months. A similar proportion of the children (about 20%) were found across the five wealth quintiles, with a 2.1% increase in the poorest quintile.

Table 1. Child, Maternal, Household, and Community Characteristics among Children Aged 0-59 Months from the NNS 2018 (N=52,602).

Maternal, child, household, and community characteristics	n (%)
Maternal Characteristics	
Mother's Education	
None	30883 (55.3)
Primary	5639 (12.1)
Middle	4671 (9.2)
Secondary	5836 (12.3)
Higher	5573 (11.1)
Maternal Working Status	
Housewife	46344 (89.4)
Others	6258 (10.6)
Mother's Age	
Less than 20 years	1047 (1.9)
20-34 years	38368 (75.0)
35-49 years	13187 (23.0)
Child Characteristics	
Gender	
Male	26826 (50.7)
Female	25776 (49.3)
Child's Age	
<6 months	4388 (8.7)
6-23 months	14618 (28.3)
24-59 months	33596 (63.0)
Diarrhea in the last 2 Weeks	
Yes	5071 (9.3)
No	47531 (90.7)
A.R.I. in the last 2 Weeks	
Yes	1652 (2.3)
No	50950 (97.7)
Fever in the last 2 Weeks	
Yes	8043 (14.5)
No	44559 (85.5)
Household Characteristics	
Family Size	
<=6 members	26054 (51.7)
7 or more members	26548 (48.3)
Number of Children under five	
<5	51612 (98.0)
>=5	990 (2.0)
Drinking Water Sources	
Improved sources	47203 (92.0)
Unimproved sources	5399 (8.0)
Sanitation facilities	
Improved sanitation facility	41341 (82.5)
Unimproved sanitation facility	11261 (17.5)
Food Insecurity Status	
Food Secure	30741 (58.4)
Mild food insecure	6157 (12.5)
Moderate food insecure	4337 (8.9)

Severe food insecure	11367 (20.2)
The household received financial assistance in the last 12 months.	
Yes	2853 (5.5)
No	49749 (94.5)
Wealth Status (quintiles)	
Poorest	14682 (22.1)
Second	12152 (20.2)
Middle	10435 (20.2)
Fourth	8817 (20.0)
Richest	6516 (17.5)
Community Characteristics	
Area	
Urban	15497 (36.6)
Rural	37105 (63.4)
Province	
Punjab	19396 (52.8)
Sindh	10643 (27.9)
KP	6136 (9.6)
Balochistan	7849 (5.4)
ICT	719 (1.1)
FATA	1043 (1.0)
AJK	3646 (1.6)
GB	3170 (0.5)

Abbreviations: A.R.I., acute respiratory infection; K.P., Khyber Pakhtunkhwa; I.C.T., Islamabad Capital Territory; FATA, erstwhile Federally Administered Tribal Areas; A.J.K., Azad Jammu & Kashmir; G.B., Gilgit Baltistan.

3.2. Determinants of Stunting in Children Under Five

Of the 52,602 children under five enrolled in the survey, 40.0% were stunted. In the univariate logistic analysis, the odds of stunting were higher among male children (OR = 1.08, 95% CI [1.03-1.13], P=0.001), from rural areas (OR=1.43, 95% CI [1.36-1.50], P<0.001), with the presence of diarrhea (OR = 1.26, 95% CI [1.16-1.36], P<0.001), respiratory infection (OR = 1.21, 95% CI [1.06-1.38], P=0.005) or fever (OR = 1.08, 95% CI [1.01-1.15], P=0.017) in the last two weeks compared with female children, from urban areas, with no diarrhea, respiratory infection or fever [Table 2]. Children under two years of age (<6 months: OR = 0.54, 95% CI [0.50-0.59], P<0.001; 6-23 months: OR = 0.87, 95% CI [0.83-0.92], P<0.001) had lower odds of stunting compared with children aged 24-59 months. Compared with children whose mothers had higher education, the odds of stunting were higher among children born to mothers with no education (OR=2.30, 95% CI [2.11-2.51], P<0.001) or lower levels of education (Primary: OR=1.62, 95% CI [1.46-1.80], P<0.001; Middle: OR=1.45, 95% CI [1.29-1.62], P<0.001; Secondary: OR=1.17, 95% CI [1.05-1.30], P=0.004). Children with employed mothers (OR=1.13, 95% CI [1.05-1.21], P<0.001) had higher odds of stunting compared with children whose mothers were housewives. Expectedly, the odds of child stunting decreased with an increase in the mother's age; however, the odds ratios were not statistically significant for mothers aged 20-34 years (OR =0.88 (95% CI [0.76-1.03], P=0.11) and 35-49 years (OR=0.91, 95% CI [0.78-1.07], P=0.26), relative to mothers < 20 years of age. The odds of child stunting were higher in households with ≥7 members (OR=1.08, 95% CI [1.01-1.15], P=0.01), with no access to improved sources of drinking water (OR=1.15, 95% CI [1.06-1.26], P=0.001) and no improved sanitation facilities (OR=1.79, 95% CI [1.69-1.89], P<0.001) compared with households having ≤ 6 members, and access to improved drinking water and sanitation facilities. The odds of stunting increased with the severity of food insecurity experienced by households. Households experiencing severe food insecurity (OR=1.52, 95% CI [1.43-1.61], P<0.001) were most at risk compared with food-secure households. Like food insecurity, the odds of child stunting increased as the wealth status of households deteriorated. Across the wealth quintiles,

the poorest households (OR=2.65, 95% CI [2.45-2.87], P<0.001) were most at risk of experiencing child stunting compared with the wealthiest households. However, unexpectedly, the odds of stunting were lower among children whose households did not receive financial assistance in the last 12 months (OR=0.62, 95% CI [0.56-0.68], P<0.001) and were located in Punjab (OR=0.64, 95% CI [0.59-0.70], P<0.001), K.P. (OR=0.733, 95% CI [0.66-0.81], P<0.001), I.C.T. (OR=0.54, 95% CI [0.45-0.65], P<0.001), and A.J.K. (OR=0.74, 95% CI [0.66-0.84], P<0.001) compared with households who received assistance and were located in G.B.

Table 2. Determinants of Stunting among Children aged 0-59 months in the NNS 2018 (N=52,602).

Characteristic	Stunted	Normal	Unadjusted Odd Ratio (OR) [95%CI]	P-values	Adjusted Odd Ratio (OR) [95%CI]	P-values
Overall	22005 (40.0%)	30597 (60.0%)				
Maternal Characteristics						
Mother's Education						
None	14517 (46.1%)	16366 (53.9%)	2.308 (2.116-2.518)	<0.001	1.571 (1.423-1.735)	<0.001
Primary	2193 (37.6%)	3446 (62.4%)	1.626 (1.462-1.809)	<0.001	1.358 (1.215-1.518)	<0.001
Middle	1730 (35.0%)	2941 (65.0%)	1.45 (1.295-1.623)	<0.001	1.293 (1.151-1.453)	<0.001
Secondary	1914 (30.3%)	3922 (69.7%)	1.174 (1.053-1.308)	0.004	1.109 (0.993-1.239)	0.066
Higher	1651 (27.0%)	3922 (73.0%)	Ref.		Ref.	
Maternal Working status						
Housewife	19316 (39.7%)	27028 (60.3%)	Ref.			
Others	2689 (42.7%)	3569 (57.3%)	1.134 (1.058-1.215)	<0.001		
Mother's Age						
Less than 20 years	456 (42.7%)	591 (57.3%)	Ref.		Ref.	
20-34 years	15997 (39.8%)	22371 (60.2%)	0.885 (0.76-1.032)	0.119	0.895 (0.765-1.048)	0.168
35-49 years	5552 (40.6%)	7635 (59.4%)	0.914 (0.781-1.07)	0.264	0.783 (0.665-0.922)	0.003
Child Characteristics						
Gender						
Male	11520 (41.0%)	15306 (59.0%)	1.083 (1.035-1.133)	0.001	1.089 (1.04-1.141)	<0.001
Female	10485 (39.0%)	15291 (61.0%)	Ref.		Ref.	
Child's Age						
<6 months	1360 (28.4%)	3028 (71.6%)	0.545 (0.5-0.595)	<0.001	0.534 (0.488-0.585)	<0.001
6-23 months	5899 (38.9%)	8719 (61.1%)	0.874 (0.83-0.921)	<0.001	0.893 (0.847-0.942)	<0.001
24-59 months	14746 (42.1%)	18850 (57.9%)	Ref.		Ref.	
Diarrhea in the last 2 weeks						
Yes	2366 (45.2%)	2705 (54.8%)	1.262 (1.169-1.363)	<0.001	1.155 (1.067-1.25)	<0.001
No	19639 (39.5%)	27892 (60.5%)	Ref.		Ref.	
ARI. in the last 2 weeks						
Yes	778 (44.6%)	874 (55.4%)	1.211 (1.061-1.383)	0.005		
No	21227 (39.9%)	29723 (60.1%)	Ref.			
Fever in last 2 weeks						
Yes	3533 (41.6%)	4510 (58.4%)	1.081 (1.014-1.151)	0.017		
No	18472 (39.7%)	26087 (60.3%)	Ref.			
Household Characteristics						
Family Size						
<=6 members	10679 (39.1%)	15375 (60.9%)	Ref.		Ref.	
7 or more members	11326 (41.0%)	15222 (59.0%)	1.081 (1.014-1.151)	0.017	1.098 (1.048-1.151)	<0.001
Number of Children under Five						
<5	21567 (40.0%)	30045 (60.0%)	Ref.			
>=5	438 (39.6%)	552 (60.4%)	0.981 (0.834-1.154)	0.817		
Drinking Water Sources						
Improved sources	19505 (39.7%)	27698 (60.3%)	Ref.			
Unimproved sources	2500 (43.3%)	2899 (56.7%)	1.158 (1.062-1.262)	0.001		
Sanitation Facilities						
Improved sanitation facility	16276 (37.5%)	25065 (62.5%)	Ref.		Ref.	
Unimproved sanitation facility	5729 (51.9%)	5532 (48.1%)	1.796 (1.699-1.898)	<0.001	1.144 (1.068-1.226)	<0.001
Food Insecurity Status						
Food Secure	11930 (36.7%)	18811 (63.3%)	Ref.		Ref.	
Mild food insecure	2670 (41.6%)	3487 (58.4%)	1.225 (1.14-1.317)	<0.001	1.099 (1.021-1.182)	0.012
Moderate food insecure	1986 (43.8%)	2351 (56.2%)	1.343 (1.231-1.465)	<0.001	1.057 (0.968-1.156)	0.217
Severe food insecure	5419 (46.9%)	5948 (53.1%)	1.523 (1.439-1.612)	<0.001	1.078 (1.012-1.149)	0.020

The household received financial assistance in the last 12 months.

Yes	1402 (51.0%)	1451 (49.0%)	Ref.			
No	20603 (39.4%)	29146 (60.6%)	0.625 (0.569-0.687)	<0.001		
Wealth Status (quintiles)						
Poorest	7552 (51.9%)	7130 (48.1%)	2.659 (2.455-2.879)	<0.001	1.64 (1.468-1.832)	<0.001
Second	5429 (45.0%)	6723 (55.0%)	2.019 (1.861-2.191)	<0.001	1.477 (1.341-1.627)	<0.001
Middle	4124 (39.6%)	6311 (60.4%)	1.612 (1.483-1.752)	<0.001	1.285 (1.172-1.409)	<0.001
Fourth	2972 (32.3%)	5845 (67.7%)	1.177 (1.079-1.283)	<0.001	1.035 (0.946-1.132)	0.452
Richest	1928 (28.9%)	4588 (71.1%)	Ref.		Ref.	
Community Characteristics						
Area						
Urban	5714 (34.7%)	9783 (65.3%)	Ref.		Ref.	
Rural	16291 (43.2%)	20814 (56.8%)	1.43 (1.36-1.504)	<0.001	1.078 (1.016-1.144)	0.014
Province						
Punjab	7146 (36.5%)	12250 (63.5%)	0.649 (0.594-0.709)	<0.001	0.799 (0.727-0.879)	<0.001
Sindh	4904 (45.7%)	5739 (54.3%)	0.95 (0.866-1.042)	0.273	0.942 (0.852-1.041)	0.241
KP	2536 (39.4%)	3600 (60.6%)	0.733 (0.662-0.813)	<0.001	0.748 (0.672-0.833)	<0.001
Balochistan	3870 (46.8%)	3979 (53.2%)	0.992 (0.894-1.101)	0.887	0.878 (0.785-0.982)	0.022
ICT	235 (32.6%)	484 (67.4%)	0.545 (0.452-0.658)	<0.001	0.808 (0.665-0.982)	0.032
FATA	463 (44.7%)	580 (55.3%)	0.911 (0.766-1.084)	0.294	0.717 (0.599-0.858)	<0.001
AJK	1395 (39.8%)	2251 (60.2%)	0.747 (0.663-0.841)	<0.001	0.91 (0.803-1.032)	0.142
GB	1456 (47.0%)	1714 (53.0%)	Ref.		Ref.	

Abbreviations: CI; confidence interval; ARI, acute respiratory infection; KP, Khyber Pakhtunkhwa; ICT, Islamabad Capital Territory; FATA, erstwhile Federally Administered Tribal Areas; AJK, Azad Jammu & Kashmir; GB, Gilgit Baltistan.

In the multivariable logistic regression, male children (AOR=1.08, 95% CI [1.04-1.14], P<0.001) from rural areas (AOR=1.07, 95% CI [1.01-1.14], P=0.014), with the presence of diarrhea in the last two weeks (AOR=1.15, 95% CI [1.06-1.25], P<0.001) remained at risk of stunting compared with female children, from urban areas, with no diarrhea in the last two weeks. Younger children aged <6 months (AOR=0.53, 95% CI [0.48-0.58], P<0.001) and 6-23 months (AOR=0.89, 95% CI [0.84-0.94], P<0.001) continued to experience lower odds of stunting as compared to older children aged 24-59 months. The relationship between the risk of child stunting and maternal education remained apparent; however, the odds ratios decreased with no maternal education (AOR=1.57, 95% CI [1.42-1.73], P<0.001) or lower levels of maternal education (Primary: AOR=1.35, 95% CI [1.21-1.51], P<0.001; Middle: AOR=1.29, 95% CI [1.15-1.45], P<0.001). The odds of stunting were lower among children whose mothers were 35-49 years old (AOR=0.78, 95% CI [0.66-0.92], P=0.003) compared with mothers < 20 years old, which was initially found to be not significant in the univariate analysis. At the household level, the risk of child stunting remained higher in households with ≥7 members (AOR=1.09, 95% CI [1.04-1.15], P<0.001), with no access to improved sanitation facilities (AOR=1.14, 95% CI [1.06-1.22], P<0.001) and experiencing severe food insecurity (AOR=1.07, 95% CI [1.01-1.14], P=0.02) compared with households having ≤ 6 members, access to improved sanitation facilities and experiencing food security. Similarly, the poorest households (AOR=1.64, 95% CI [1.46-1.83], P<0.001) remained most at risk of experiencing child stunting, with the risk gradually decreasing across the wealth quintiles relative to the wealthiest households. Households located in Punjab (AOR=0.79, 95% CI [0.72-0.87], P<0.001), K.P. (AOR=0.74, 95% CI [0.67-0.83], P<0.001) and I.C.T. (AOR=0.80, 95% CI [0.66-0.98], P=0.032) continued to experience higher odds of child stunting, with the new inclusion of Balochistan (AOR=0.87, 95% CI [0.78-0.98], P=0.022) and FATA (AOR=0.71, 95% CI [0.59-0. 85], P<0.001), compared with households located in G.B.

4. Discussion

The prevalence of child stunting in Pakistan remains very high (44%) compared with the regional (31.7%) and global (21.3%) estimates [6]. The national stunting prevalence is only surpassed by Afghanistan, a country experiencing protracted conflict over 20 years [5–14]. Our study presents selected determinants associated with stunting among children under five in Pakistan using the National Nutrition Survey 2018. The study shows child's gender, age, presence of diarrhea and place of residence, the mother's age and education, household size, food security status, wealth status, and

access to sanitation facilities are significantly associated with child stunting. Among these determinants, household wealth status and maternal education were most significantly associated with stunting in children under five. Children in the poorest households had the highest odds of being stunted, which can be linked to their inability to access safe, diverse, affordable, and nutritious foods and essential health services. This makes these households more vulnerable to food insecurity and poor child growth [19–21]. Similar findings have been reported by other countries within the region [19–21].

Our analysis found that children living in rural areas were more at risk of stunting, consistent with regional surveys conducted in Bangladesh, Nepal, India, and Maldives [19–21]. However, the most recent National Demographic and Health Survey conducted in 2017 found that children living in urban areas had higher odds of stunting; this may be partly due to the rapidly growing population being accompanied by an even faster rate of urbanization [5,22]. One-third of the Pakistani population lives in urban areas [23]. This urban transition is expected to continue and brings informal settlements, where living conditions may be unsafe and access to affordable, nutritious food and essential services, such as water, electricity, sanitation, and health, is very difficult [24–26].

Moreover, male children aged 24-59 months were more at risk of stunting than younger (<24 months) and female children. This is consistent with previous research studies, which showed that male children were most at risk of stunting. In contrast, older children were at risk due to inappropriate initiation of complementary feeding practices. [19–21]. The study also found that children whose mothers had no education and were younger (<20 years) had a higher risk of stunting than children of older mothers with higher education. Several studies found a similar relationship between child stunting and maternal education and age [19–21]. Older, educated mothers are assumed to be better informed and, therefore, able to respond better and attain their children's essential nutrition and health requirements [21].

With an estimated 10.8 billion USD already invested in nutrition-specific and health system-geared interventions over the past decade, the study findings indicate the need for scaling-up nutrition-sensitive interventions, which focus on improving the affordability of locally available nutritious foods, access to safe, clean water, and sanitation and encouraging female education, to tackle child stunting in Pakistan [27]. Policies and programs focused on social protection, food, education, and water, sanitation, and hygiene systems are critical for positive nutrition and health outcomes, female secondary education attainment, and the transformation of local food systems.

Social protection consists of government policies and programs that prevent and protect people from poverty, vulnerability, and social exclusion throughout the lifecycle [28]. These programs can improve access to essential services, reduce negative coping strategies in response to shocks, and improve the accessibility and affordability of nutritious foods. Social protection is more effective and creates more remarkable change when food and nutrition security is integrated into national policies and programs. At the same time, the targeting of beneficiaries, the amounts, and the modalities of transfers are adapted to the primary and nutritional needs of the most vulnerable populations [29].

In Pakistan, efforts are underway to address child stunting by scaling up nutrition-sensitive social protection programs that integrate food security and nutrition outcomes and target the most nutritionally vulnerable populations (women and children). In this context, and with World Bank funds, the Government has implemented the Nashonuma project (2020-2023) [30]. The project focuses on demand-side interventions delivered through the national health and social protection systems. The interventions include providing conditional cash transfers upon consummation of locally produced specialized nutritious foods (a lipid-based nutrient supplement), uptake of maternal and child health services, and maternal participation in social and behavioral change communication activities to improve dietary and hygiene practices and prevent stunting in children. However, there is a lack of supply-side interventions across the food system, which positively influence food production, processing, availability, and affordability of locally produced nutritious foods – a critical approach to achieving nutritious diets for all.

Our study also has some strengths and limitations. The strengths include using the most recent and largest representative sample, with a high response rate (90%) nationwide. In contrast, using a

cross-sectional survey design is a limitation since it prevents the establishment of a causal relationship between child stunting and different determinants.

5. Conclusions

In conclusion, our study found that a child's gender, age, presence of diarrhea and place of residence, the mother's age and education, household size, food security status, wealth status, and access to sanitation facilities are significantly associated with child stunting in Pakistan. There is a need to scale up nutrition-sensitive interventions focused on improving the affordability of locally available nutritious foods & supplementation, access to safe, clean water and sanitation, and encouraging female education to sustain reduced child stunting in the country.

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