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Factors affecting stunting among 3–12 years old girls of Purba Medinipur, West Bengal, India

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Abstract: Stunting is the impaired growth and development in children caused due to poor nutrition, recurrent infections and lack of psychosocial stimulus. Because stunting affects physical development and inhibits the child from attaining his full cognitive development as an adult, children may never regain the height lost due to stunting. Stunting (Low height-for-age) in infants and young children is a simple, well-known indicator of undernutrition. The current study sought to determine the effects of socio-economic and demographic factors on the frequency of stunting among Bengalee girls. The study was carried out in the Deshopran block and Haldia municipality area (West Bengal, India). The total number of participants included in the study was 530 Bengalee girls. 53.39% (283) of study participants were urban residents while 46.61% (247) were rural residents. Stunted growth in children was defined as the height for a given age in children less than two standard deviations of the WHO Child Growth Standards. The prevalence of stunting among girls in our study was 11.13%. The predictor variables with substantial associations with stunting in the binary logistic regression (BLR) analyses were further used in the multiple binary logistic regression (MBLR) analyses. Odds ratios with 95% confidence intervals were used to calculate the stunting risk. Results showed that the risk of stunting was significantly associated with low birth weight, presence of younger brothers, a large number of family members and place of delivery. Improving maternal and child access to nutrient-rich food, decreasing infectious disease, and promoting women empowerment initiatives are the main recommendations for resolving the issue.

Key words: Girls, Stunting, India, West Bengal.

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Introduction

Internationally, child growth is recognized as a significant measure of a population's nutritional health and status. One of the three anthropometric indicators that are frequently used to assess a child's growth is stunting. Stunting, generally referred to as low height for age, is considered to be the outcome of chronic undernutrition often associated with poverty, poor maternal nutrition and health, recurrent sickness, and/or inappropriate feeding and care for young children. Stunting prevents children from developing to their full physical and intellectual potential (WHO 1995a). Due to its great prevalence and significant negative effects on development and health, stunted linear growth has emerged as the primary measure of childhood undernutrition (Black et al. 2013a). Stunting is characterized as having a height for age Z (HAZ) score that is less than 2 in the WHO growth reference standard (WHO 1995b). Height for age Z-score measures linear growth that occurs before and after birth; deficiencies show long-term, cumulative impacts of poor health, food quality and care. It is a significant predictor of human capital and social advancement since it is linked to higher illness and mortality, delayed mental development, low educational attainment, and diminished intellectual capacity (Victora et al. 2008; Srivastava et al. 2012; De Onis et al. 2012; Prendergast et al. 2014). During maturity, stunting can lead to decreased labour capacity, weakened social skills, behavioural issues, and metabolic illnesses (Grantham-McGregor 2014; Rengma et al. 2016; Akseer et al. 2017).

Stunting is one of the biggest and most difficult public health issues in today's world. Although it is invisible in many nations, it affects 165 million children worldwide, 90% of whom reside in Asia and Africa (UNICEF 2012a) and is a significant cause of concern in developing nations. This makes it a bigger problem than being wasted or underweight. The incidence of stunting, linked to several determinant variables along with prolonged malnutrition, is a serious issue among those living in resource-poor nations. WHO estimates that among school-age children aged 5 to 18 in Africa, the prevalence of stunting was 37% in 2015, whereas Asia had the second-highest prevalence rate at 23% (De Onis 2012). Numerous studies have already reported the prevalence of stunting in West Bengal (India) boys and girls (Mondal and Sen 2010; Soumyajit et al. 2011; McGuir 2015; Bishwajit 2015; Rengma et al. 2016; Akseer et al. 2017; Kwon and Kim 2017). Stunting among early adolescent girls is associated with different factors. For instance, several studies have reported significant associations between poor socio-economic, demographic and environmental conditions and chronic nutritional deficiencies (WHO 2006; Bishwajit 2015; McGuire 2015; Akseer et al. 2017).

Due to their customary early marriage and pregnancy, teenage girls may be more susceptible to stunting (Black et al. 2013a; Prentice et al. 2013). Importantly, because of fetal programming, stunted adolescent girls are more likely to deliver underweight and stunted babies (Prentice et al. 2013; Kwon and Kim 2017). NFHS-5 (National Family Health Survey) has reported that 6.8% of teenage girls were pregnant in India. The proportion of women who have started childbearing rises sharply from 15% at the age of 17 years to

24% among women aged 18, indicating a very high proportion compared to NFHS- 4, which is a very crucial stage for child and maternal nutrition in West Bengal. The proportion of women who have started childbearing is much higher among those who have no schooling (IIPS 2021). Several causes of malnutrition among children include poverty, living in a rural area and family size (UNICEF WHO and World Bank 2012; Bhutta and Salam 2012; Black et al. 2013b). Improving maternal and child access to nutrient-rich food, decreasing infectious disease, and empowering maternal empowerment initiatives are the main recommendations for resolving the issue (WHA 2012). However, reducing the differential vulnerability of girls is also necessary, at least in the context of South Asia, where sons is preferred over daughters (Baqui et al. 2001; Bhuiya et al. 2003; Jain et al. 2004; Koenig et al. 2006; Silverman et al. 2007; Silverman et al. 2011). Gender discrimination among siblings may play a major role in high rates of child malnutrition observed in South Asia, a region that exhibits higher rates of under-5 mortality for girls than boys (UNICEF 2012b; Basu et al. 2018; Mumtaz et al. 2019).

A girl's risk of acute malnutrition (wasting) is increased by having brothers, whereas her risk of chronic malnutrition (stunting/underweight) is increased by having many sisters. In contrast, siblings have less of an impact on boys malnutrition (Raj et al. 2015). According to previous studies, stunting affects teenage girls at a rate of 48% in Bangladesh and 47% in Nepal (WHO 2006; Bishwajit 2015). Stunting prevalence among teenage girls in Ethiopia ranges from 26.5% to 41.8% (Mulugeta et al. 2009; Wassie et al. 2015). The percentage of stunted children increased marginally from 33% to 34% between NFHS- 4 to NFHS- 5 which suggests that higher levels of undernutrition are still a major problem in West Bengal (IIPS 2021). According to the fourth National Family Health Survey (NFHS) 2015–2016, 38.4% of children in India were found to be stunted (IIPS 2017). According to numerous research (Chirande et al. 2015; Rengma et al. 2016; Dubey et al. 2018; Abbasi et al. 2018; Mazengia and Biks 2018; Titaley et al. 2019), the prevalence of stunting in India ranges from 10.9% to 55.9% in boys and 18% to 58.4% in girls. In West Bengal the prevalence of stunting has been reported to be above 12% in both sexes (Bisai et al. 2008; Bisai and Mallick 2011; Sarkar 2016; Giri et al. 2017; Pal et al. 2017; Khanra et al. 2022). The objective of the current study was to determine the effects of socio-economic and demographic factors on the frequency of stunting among Bengalee girls.

Methodology

Participants and settings

Haldia Municipality and Deshopran Block (Rural Areas) in Purba Medinipur District of West Bengal, India, were selected for this study. This cross-sectional study was conducted from December 2014 to April 2016. Of those, 628 (urban: 313; rural: 315) participated in the survey, and 530 (84.39%) provided complete information. Of them, 283 (53.39%) were urban residents, and 247 (46.60%) were rural Bengalee girls aged 3–12 years. In the state's public education system, children go to daycare for half a day's meals and some pre-school education around the age of 3. Children start attending childcare facilities at the age of 3 years

for a mid-day meal and introductory pre-nursery education. According to Indian government regulations, every child enrolled and attending school in classes from one to eight between the ages of six and fourteen must get a free lunch every day, except from school holidays. On the other hand, since the purpose of the study was to limit the pre-adolescent age of girls, the upper age of study participants was limited to 12 years. A detailed description of the sample recruitment procedures has been described by Khanra et al. (2020; 2021). Data were collected from one rural and one urban area of Purba Medinipur District (PMD). Rural girls were recruited from the following villages (n=3): Kultalia, Sikdarchak and Uttar Amtalia, PMD Desopra Block of Contai subdivision and urban girls from three settlement colonies (CPT, IOC and HREL) and Rairarchak district under Haldia municipality. The study followed the ethical guidelines of the 2000 Declaration of Helsinki (Touitou et al. 2000).

Demographic, socio-economic and birth-related information

Demographic, socio-economic, maternal health and childbirth-related data were collected directly from the parents, usually from the mothers, through a structured questionnaire. The information included social category (general or scheduled caste), place of residence (urban or rural), number of family members, number of elder and/or younger sisters and brothers, number of living rooms, house ownership, family income and expenditure, parental education, type of cooking fuel and sanitary system. Information regarding the mother's age at childbirth, height and nutritional status were also recorded. The place of delivery and birth weight of the child were also recorded. Information about birth weight was obtained from the mothers. Low birth weight was defined as less than 2,500 grams of body weight (WHO 2001).

Anthropometry

One researcher (PK) recorded all anthropometric measurements from the studied children. Height (in cm) was measured from all children, following standard procedures (Lohman et al. 1988). Height-for-age 'Z Score' (HAZ) was computed to determine stunting among the children. The WHO Anthro 3.2.2 and Anthro Plus 1.0.4 software was used to calculate the Z score. Stunting was defined as HAZ less than two standard deviations (WHO 1995b).

Statistics

Percentages were used to report the distribution of the population according to categories of different variables. Mean, and standard deviation (SD) statistics were used to describe continuous variables. Binary logistic regression (BLR) analyses (univariate model) were performed for each independent factor to assess whether it is significantly associated with stunting. In each BLR, odds ratio (OR) with 95% confidence interval (CI) was calculated to show the magnitude of association of a particular predictor category with stunting relative to the other category of the variables. To assess the effects of the factors relative to one another and identify the most potent predictor variables, the factors significantly associated with the bivariate analyses were also included in stepwise multivariate logistic regression analyses (enter method). In the regression models the dependent variable (i.e., stunting), was coded as 1 for "stunted" and 0 for "non-stunted". Social category (general or scheduled castes), place of residence (urban or ru-

ral), family size (≥ 5 members), number of elder or younger siblings (Nil vs. either or both present), number of living rooms (≤2 or >2 rooms), house ownership (own or rental), monthly family income per capita (Rs. ≤2000 or Rs. >2000), parental education (both above secondary level or not), and type of cooking fuel (smoky or smokeless) were the categories used to group the predictor variables in the current study. The better possibilities (like smokeless fuel) or higher values (like birth weight 2,500 grams) for each of these predictors were coded as 0, whereas the corresponding worse conditions or qualities (such as smoky fuel) or lower values (such as birth weight 2,500 grams) were coded as 1, respectively.

According to their relative 50th%iles, family size, the number of living rooms, the number of younger and elder sisters and brothers, and parity data were all categorized. The vaccination document verified the mother's age at delivery, birth weight, place of delivery, and date of birth. Birth weight data were categorized according to the relevant standards (WHO 2001). Body mass index (BMI), which is computed as weight in kilograms (kg) divided by height in meters (m) squared (kg/m^2), was used to determine the mother's nutritional condition. The nutritional status of the mother was categorized as undernourished (BMI <18.5 kg/m^2) or normal (>18.5 kg/m^2) based on BMI values. Statistical significance is defined as a p-value < 0.05. SPSS-16 for Microsoft Windows was used to conduct all statistical analyses.

Result

Overall, 11.13% of the study's girl participants had stunting. The% distribution of the subjects for each category of independent factor is shown in Table 1, along with the significance of the relationship between each independent factor and stunting as determined by the outcomes of univariate BLR analyses. The results of BLR indicated that the risk of stunting was significantly higher among the girls whose parents were less educated. Girls whose mothers were homemakers exhibited better nutritional indices compared to those born to working mothers. The higher risk of stunting (ORs = 2.22, $p<0.01$) was found in girls who were living with more than four family members. The risk of stunting was significantly higher in girls living in homes with a smaller number rooms (up to two) and with no proper sanitary system. Poor household income (ORs = 2.15, $p<0.01$) and expenditure were also significantly associated with higher prevalence of stunting (ORs = 1.95, $p<0.05$). Girls who had a very low weight at birth were significantly (ORs = 10.44, $p<0.001$) more likely to be stunted. A higher prevalence of stunting (ORs = 1.41) was found in the category of the undernourished mother. Girls who were nutritionally stunted their mothers had low height (ORs = 1.21). Girls who had younger brothers were significantly more likely to be stunted (ORs = 2.53, $p<0.001$). Girls delivered at home were more likely to be stunted compared to those delivered at health institutions (ORs= 3.36, $p<0.01$). The risk of stunting was higher in girls in the category of mother age at childbirth, and mothers who have started childbearing at the age of below 20 years (ORs = 1.66).

Table 2 presents the results of MBLR analysis to identify independent risk factors predicting stunting. MBLR analyses were performed on those predictor variables that showed significant associations with stunting in the univariate BLR

analyses. Girls who had a large family (above four members) were more likely to be stunted (ORs = 2.28, p<0.01) compared to those who belonged to a small-sized family (up to four members). The risk of stunting was significantly higher in those girls who had younger brothers than those who had no younger brothers (ORs = 1.99, p<0.05). Girls who exhibited low weight at birth were significantly more likely to be stunted compared to girls who had a normal or healthy weight (p<0.001). The girls delivered at home were more likely to be stunted (ORs = 2.00, p<0.05) than those delivered at health institutions.

Table 1. Logistic regression of associated factors with stunting among the girls

Variables	Categories	Stunting (n)	Total	Stunting (%)	B	Wald	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
									Lower	Upper
Place of residence	Haldia®	25	283	8.83						
	Rosulpur	34	247	13.76	0.45	3.19	0.74	1.65	0.95	2.84
Social category	General®	37	387	9.56				1		
	Others	22	143	15.38	0.54	3.52	0.06	1.72	0.98	3.03
Fathers education	Above upper primary®	17	237	7.17				1		
	Upto upper primary	42	293	14.33	0.77	6.55	0.01	2.17	1.2	3.91
Mothers education	Above upper primary®	17	228	7.46				1		
	Upto upper primary	42	302	13.91	0.7	5.3	0.02	2	1.11	3.62
Fathers occupation	Nonmanual®	20	242	8.26				1		
	Manual	39	288	13.54	0.55	3.63	0.06	1.74	0.98	3.07
Mothers occupation	Home-maker®	45	458	9.83				1		
	Working mothers	14	72	19.44	0.8	5.58	0.02	2.22	1.15	4.28
Numbers of family members	Upto 4 members®	20	272	7.35				1		
	Above 4 members	39	258	15.12	0.81	7.76	0.01	2.24	1.27	3.96
Numbers of employed persons	Above 1 persons®	15	111	13.51				1		
	1 person	44	419	10.5	-0.29	0.8	0.37	0.75	0.4	1.4
Parity	1st parity®	37	311	11.9				1		
	2nd and others parity	22	219	10.05	-0.19	0.44	0.51	0.83	0.47	1.44
Numbers of elder brothers	Have no elder brothers®	49	414	11.84				1		
	Have elder brothers	10	116	8.62	-0.35	0.94	0.33	0.7	0.34	1.43

Variables	Categories	Stunting (n)	Total	Stunting (%)	B	Wald	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
									Lower	Upper
Numbers of elder sisters	Have no elder sisters®	44	414	10.63				1		
	Have elder sisters	15	116	12.93	0.22	0.48	0.49	1.25	0.67	2.33
Numbers of younger brothers	Have no younger brothers®	34	399	8.52				1		
	Have younger brothers	25	131	19.08	0.93	10.58	0	2.53	1.45	4.43
Numbers of younger sisters	Have no younger sisters®	43	433	9.93				1		
	Have younger sisters	16	97	16.49	0.58	3.38	0.07	1.79	0.96	3.34
House ownership	Own®	51	405	12.59				1		
	Rental	8	125	6.4	-0.75	3.56	0.06	0.47	0.22	1.03
Numbers of living rooms	Above 2 rooms®	5	100	5				1		
	Upto 2 rooms	54	430	12.56	1	4.35	0.04	2.73	1.06	7.01
Sanitary system	Have proper sanitary system®	46	458	10.04				1		
	Have no proper sanitary system	13	72	18.06	0.68	3.91	0.05	1.97	1.01	3.87
Cooking system	Non smoking®	21	251	8.37				1		
	Smokey	38	279	13.62	0.55	3.62	0.06	1.73	0.98	3.03
Income	≥ Rs. 10001®	17	236	7.2				1		
	≤ Rs. 10000	42	294	14.29	0.76	6.4	0.01	2.15	1.19	3.88
Expenditure	≥ Rs. 8001®	18	235	7.66				1		
	≤ Rs. 8000	41	295	13.9	0.67	5.01	0.03	1.95	1.09	3.48
Birth weight	2.500gm & Above®	27	450	6				1		
	Below 2.500gm	32	80	40	2.35	60.16	0	10.44	5.77	18.89
Mother's height	149.05cm & Above®	27	265	10.19				1		
	Below 149.04cm	32	265	12.08	0.19	0.48	0.49	1.21	0.7	2.08
Place of delivery	Institutional®	22	336	6.55				1		
	Home	37	194	19.07	1.21	17.94	0	3.36	1.92	5.89
Mother's age at child birth	20years & Above®	32	344	9.3				1		
	Below 20years	27	186	14.52	0.5	3.27	0.07	1.66	0.96	2.86
Mother's nutrition	Normal®	53	489	10.84				1		
	Undernutrition	6	41	14.63	0.34	0.55	0.46	1.41	0.57	3.51

® - reference category, Binary logistic regression analysis (univariate model) considering effect of one predictor variables, significant variables are marked in bold.

Table 2. Results of a multivariate logistic regression model (enter method) to predict stunting

Variables	B	S.E.	Wald	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
						Lower	Upper
Numbers of younger brothers	0.69	0.34	4.13	0.04	1.99	1.02	3.84
Fathers education	0.11	0.47	0.05	0.82	1.11	0.45	2.78
Mothers education	-0.19	0.46	0.17	0.68	0.83	0.33	2.04
Mothers occupation	0.66	0.41	2.56	0.11	1.93	0.86	4.31
Number of family members	0.82	0.35	5.54	0.01	2.28	1.14	4.52
Numbers of living rooms	0.73	0.6	1.5	0.22	2.09	0.64	6.76
Sanitary system	0.1	0.46	0.04	0.84	1.1	0.44	2.72
Income	0.52	0.58	0.81	0.37	1.69	0.54	5.26
Expenditure	0.07	0.58	0.02	0.90	1.08	0.34	3.37
Birth weight	2.25	0.33	46.49	0.00	9.48	4.97	18.04
Place of delivery	0.69	0.35	3.98	0.05	2.00	1.01	3.94

CI – confidence interval, significant variables are marked in bold.

Discussion

By lowering productivity, diminishing learning capacity, and raising dangers to maternal and reproductive health, poor diet is exacerbating gender disparities and causes intergenerational cycles of hunger and inequality to persist. Stunting, cognitive deficits, decreased immunity, and a higher risk of illness and death are all more common among offspring born to undernourished mothers. However, the workload is disproportionately heavier on women as they make up approximately 40% of formal labour force around the world, despite being more likely than men to work as an unpaid household laborer or in an unorganized sector. Still, women continue to provide the majority of childcare and feeding practically everywhere (UNICEF 2019a). Lack of nutritional diversity, skipping meals, exposure to a contaminated environment and poor hygiene (Wolde et al. 2015) are all linked to an increased risk of stunting (Prendergast et al. 2014). Indian society has prioritized males over females in terms of education, occupation, and provision of better household and dietary habits. Generally, women eat meals after all family members have finished and skip meals daily (Rao et al. 2010; Mumtaz et al. 2019; UNICEF 2019b), which is a common scenario of dietary habits of Indian women. In West Bengal, there is a strong preference for sons. For instance, 10% of women and 19% of men have been reported to prefer sons over daughters (As per NFHS-5 reports). 86% of men and 81% of women desire to have at least one or two sons. The parental desire to have more children is strongly affected by their current number of living children, particularly sons (IIPS 2021).

The present study showed a significant association of stunting with parental education, mother's occupation, family income and expenditure when their effects were assessed separately. In contrast to their higher levels, lower paren-

tal income and educational levels were associated with a higher prevalence of stunting. The higher risk of stunting was found in the girls who were living with above four family members. When they had younger brothers, they were also to be stunted. The risk of stunting was significantly higher in girls living in up to two rooms and with no proper sanitary system. Previous studies on the same dataset showed that the degree of education of mothers of rural children and family economic circumstances in urban counterparts were the most significant independent factors of undernutrition among 3–12-year-old children (Khanra et al. 2020; 2021). However, these studies used a composite index of anthropometric failure (CIAF), but not stunting as the measure of undernourishment. A recent study on the same dataset revealed that low birth weight is significantly associated with the prevalence of stunting among boys (Khanra et al. 2022). Previous researchers have shown that various measures of socio-economic status, such as income, education and family assets were associated with nutritional status in children (Victora et al. 2008; Nguyen et al. 2013; Mohammed et al. 2014). There is plenty of evidence showing a positive association between low income and the prevalence of stunting (Keino et al. 2014; Mondal et al. 2015; Sharma and Katoch 2016; Pal et al. 2017; Kirk et al. 2018).

The results of our study show that children who live in homes with two or fewer rooms had a higher prevalence of stunting. Other studies (Owoaje et al. 2014), including those conducted in the same Indian state, have reported similar findings (Biswas et al. 2013). This would suggest that having better housing circumstances, such as a greater space, is associated with more income and, consequently, with a reduced prevalence of undernourishment. Poor living conditions, unclean living standards, unsanitary conditions, dangerous drinking water, and a low-calorie diet are all directly related to low monthly income (Rahaman et al. 2016).

Child nutrition could benefit from income, a key socio-economic factor, and household consumption decisions only depend on production outcomes through total wages; cash from any source will be helpful (Svedberg 2000; Kirk et al. 2018). Children's respiratory illnesses, asthma, and mental health are all correlated with their living situations (Krieger and Higgins 2002; Harker 2006; Oudin 2017). Previous research has found a strong correlation between the number of living rooms and children's undernutrition (Biswas et al. 2011; Biswas et al. 2013).

As mentioned above, the present study also revealed a strong link between stunting and having younger brothers. This could, however, be the result of relatively increased attention towards the younger children, especially boys, by the parents in a resource-constrained setting, particularly regarding food distribution and health care (Pande 2003). Indeed, previous studies in similar populations in the same Indian state showed that a higher risk of stunting was associated with the presence of younger brothers (Biswas et al. 2013; Mondal et al. 2015). Large families (above four members) significantly impacted the prevalence of stunting. The risk of stunting was higher in girls in the category of maternal age at childbirth and mothers who have started childbearing at the age of below 20 years (ORs = 1.66). NFHS- 5 (2019–2020) has reported that among young women aged 15–19 in West Bengal, 16% have already begun childbearing. The proportion of

women who had started childbearing is much higher among young women (33%) who had no schooling (IIPS 2021). A previous study reported that low level of education among mothers is significantly associated with higher prevalence of undernutrition (Khanra et al. 2020). A higher risk of stunting was found in the category of low-height mothers and nutritionally undernourished mothers. Gender discrimination regarding food distribution, health care and other facilities in the household are a major problem in society. The psychosocial mind and beliefs (male preference) are solely responsible for this unequal food distribution during food distribution among family members (Ahmed 2018). The present study shows that the risk of stunting was higher among children with low weight at birth. In this study, the direction of the relationship between birth weight and childhood undernutrition was in line with the results of other studies showing that low birth weight had a significantly higher risk of stunting in childhood (Rahman et al. 2016; Ntenda and Chuang 2017; Khanra et al. 2022). The present study also shows that place of delivery was a significant predictor of stunting, as reported in another study in Malawi (Chirande et al. 2015).

However, all the above associations faded out in the multiple regression analyses. In contrast, the number of younger brothers, number of family members, birth weight, and place of delivery showed a significant independent association with the prevalence of stunting, allowing for all other potential factors. Girls with younger brothers were more likely to be stunted compared to those with no younger brothers. Girls who had a large family (above four members) were more likely to be stunted compared to those who belonged to a small-sized family (up to four members). Several previous studies have reported that the presence of younger brothers and large family size is associated with a poorer child nutrition (Biswas et al. 2013; Zelellw and Gebreigziabher 2014; Mondal et al. 2015).

According to the patriarchal system, the practice of favouring sons over daughters in India is becoming more common (Marcoux 2002). A family without a boy is seen as inadequate and embarrassing in public. Daughters, in contrast, are viewed as a responsibility and it is commonly regarded that it is a waste of time and money to raise girls. After paying the obligatory dowry and entering her new family, a girl will leave her parents in a precarious financial situation. Daughters are consequently equivalent to low-yield investments (Basu et al. 2018).

Since the beginning, our culture has given more preference to sons over daughters in all spheres, including healthcare and household food distribution. During infancy there are established gender variations in nutritional status along with prejudiced nursing and supplementing patterns (Pande 2003). Unlike boys, infant girls are breastfed less frequently and for shorter periods of time (Barcellos et al. 2014). No matter how wealthy or how poor the household is, girls tend to consume less nutritious food compared to boys (Marcoux 2002). Gender discrimination regarding food distribution in the household is a major problem that prevails in society. Psychosocial causes for this unequal food distribution are commonly related to the mind and beliefs of society about male preference while giving food to family members (Basu et al. 2018; Ahmed 2018; Mumtaz et al. 2019). Lack of education and awareness might be a cause of

a greater trend of offering good and nutritious food preferentially to males while female members are considered second priority and, thus, insufficient and inadequate meals (Alam 2012). Moreover, with greater awareness and educational improvement observed in recent years, people all over the world have become more rational. However, the discrimination problem still exists particularly in the lower socio-economic community (Alesina et al. 2013; Berti 2012).

This study shows that girls with lower birth weight showed higher chances of being stunted at 3–12 years. Girls born at home were more likely to be stunted compared to those born at health institutions. Institutional childbirth is defined as childbirth that occurs in a hospital setting that is technologically advanced and is also supervised by trained birth attendants. Institutional childbirth is one of the most effective strategies for lowering mother and neonatal morbidity and mortality. In institutional deliveries, various medical devices and technology are employed to ensure the newborns' health (WHO 2018; UNICEF 2019a). A recent survey has reported that the percentage of births in a health facility increased in the four years, from 75% (NFHS -4) to 92% (NFHS- 5) although 8% of births still occur at home. Children who were delivered at home did not receive any vaccine. A recent study reported that stunting was frequently observed in under-vaccinated children in four countries (Solis-Soto et al. 2020). Children who were delivered at the hospital receive superior care for both the mother and the child's postpartum complications. Future maternal and fetal health may benefit from this. India alone supplied 40% of the world's LBW (Low Birth Weight) population, with an estimated 33% of all babies weighing less than 2,500 grams at birth (Jain and Singhal 2012). The prevalence of low birth weight in India was 21.4% in 2017 (ICMR 2019). As per NFHS-3, the prevalence of LBW in West Bengal was 22% (IIPS 2008). The WHO has set a goal of reducing LBW and stunted children aged 5 years by 40% between 2010 and 2025 (WHO 2014). Many different factors contribute to LBW. It is dependent on intricate interactions between a number of variables, including those related to genetics, reproduction, socio-demographics, culture, politics, and the immediate physical environment (Aries et al. 2012) and regional factors (Mazengia and Biks 2018; Titaley et al. 2019; Pal et al. 2019). The aetiology of LBW is maximally related to maternal risk factors (Dasgupta and Basu 2011; Golestan et al. 2011; Mumbare et al. 2011; Demelash et al. 2015) and socio-economic and psychological factors (Agarwal et al. 2012; Meshram et al. 2016). A recent study conducted in India found that women suffering from anemia are at higher risk of poor birth outcomes, such as preterm birth and low birth weight due to weak intrauterine growth (Sunuwar et al. 2020). A study has documented that half of the expectant mothers, children, and adolescent girls in India suffer from anemia (Singh et al. 2018). Teenage girls are more vulnerable to stunting due to early marriage and pregnancy and are more likely to deliver underweight babies. NFHS-5 has reported that 6.8% of teenage girls were pregnant in India. That is a very vulnerable condition for future generations (IIPS 2021). At least half of the burden of anemia is due to iron deficiency, and both folic acid and iron deficiency during pregnancy are important factors for preterm delivery, anemia, low birth weight,

and increased stunting among children (Shah 2016; Halli et al. 2022). Indeed, stunting has long-lasting effects on future generations. In addition, a high occurrence of anemia among women causes them to enter pregnancy in an anemic stage, which has well-documented adverse effects on fetal growth, birth weight and the mother's health (Sheila and Shoba 2021). These newborns' malnutrition and poor health tend to get worse after birth due to not getting enough nutrients, especially in the first 24 months of life. According to a recent study, about 68% of under-five child mortality in India is linked to malnutrition (Swaminathan et al. 2019). Stunting is generally regarded as an expression of chronic deprivation from nutritional requirements at the population level. According to our study, there is a link between low birth weight and childhood undernutrition that is in line with findings reported in other studies (Rahman et al. 2016; Ntenda and Chuang 2017; Khanra et al. 2022).

As many studies involving natural human populations, the present study also had some inherent limitations. For instance, it failed to reveal the sex-difference in the effects of living conditions and socioeconomic status on the nutritional status, as it included only female children. It also did not measure nutrient intake patterns or energy storage in terms of body fat deposition, such as skin fold measurements. Moreover, data were collected from parents of Bengalee girls aged between 3 and 12 year old. A limited number of girls at the upper end of the age group plausibly experienced menarche. The growth pattern of those pubertal girls could have been different from those who did not have their menarche yet during the study. However, the present study did not take into consideration this biological phenomenon. The WHO also does not provide separate reference values for pre- and post-menarcheal children.

Conclusion

The present study suggests that having a large number of family members and younger brothers is among high risk for being stunted among the girls between 3 and 12 years of age. Similarly, the study shows that the risk of stunting is significantly higher in children who were delivered at home and had low weight at birth. If the Indian government is to fulfil the World Health Organization's goal of reducing stunting by 40% by 2025, these primary risk factors for stunting among the children in India must be addressed. The present study emphasizes the necessity of increasing community involvement in various developmental programmes to eradicate poverty and raise female literacy rates. To enhance the nutritional status of mothers and children, particularly girls, it is necessary to strengthen health and nutrition education. More micro-level research should be undertaken to broaden our knowledge regarding the relative role of socioeconomic and demographic factors in determining the prevalence and magnitude of undernutrition among Indian children. This would enable a proper implementation of development projects aiming at eradication of undernutrition and achievement of the targeted outcome.

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Conflict of interests

The Authors declare no conflicts of interests.

Authors' contributions

PK collected and analyzed the data and prepared the draft manuscript. KB designed and supervised the study, analyzed the data and provided intellectual inputs to the manuscript. RC designed the study and prepared the final manuscript.

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