ORIGINAL ARTICLE

WILEY | Maternal & Child Nutrition

Birthweight and feeding practices are associated with child growth outcomes in South Asia

Kassandra L. Harding[1] | Víctor M. Aguayo[2] | Patrick Webb[1]

[1] Friedman School of Nutrition Science and Policy, Tufts University, Boston, Massachusetts

[2] United Nations Children's Fund (UNICEF) Programme Division, New York, New York

Correspondence
Kassandra L. Harding, Friedman School of Nutrition Science and Policy, Tufts University, 150 Harrison Avenue, Boston, MA 02111.
Email: kassandra.harding@yale.edu

Abstract

Although there has been a focus on preventing stunting over the past decade, wasting has received less policy and programmatic attention. Recent national surveys from six South Asian countries were pooled to generate a dataset of 62,509 children aged 0 to 59 months to explore associations between low birthweight (LBW) and suboptimal infant and young child feeding (IYCF) practices with child wasting, severe wasting, and the co-occurrence of wasting and stunting. Logistic regression models accounted for the surveys' clustered designs and adjusted for a potential confounding factors. Children with reported LBW had significantly higher odds of being wasted (adjusted odds ratio [95% CI]: 1.60 [1.45, 1.76]) or severely wasted (1.57 [1.34, 1.83]), compared with non-LBW children. Similarly, children aged 0 to 23 months who were not breastfed within the first hour post-partum, those who were provided prelacteal feeds, and those aged 0 to 5 months who were not exclusively breastfed, were more likely to be wasted ($P < 0.05$ for all three feeding practices). In India, not achieving minimum diet diversity and minimum adequate diet were significantly associated with the co-occurrence of stunting and wasting. In other words, many key domains of concern to development agents who seek to address stunting are also of direct concern to those focused on wasting. The co-occurrence of wasting and stunting requires more integrated interventions. That is, programmes aimed at preventing LBW and poor IYCF to avert stunting should be linked more effectively with actions aimed at the management of wasting.

KEYWORDS

breastfeeding, complementary feeding, low birthweight, South Asia, stunting, wasting

1 | INTRODUCTION

Worldwide, roughly one in 13 children under 5 years of age was wasted (too thin for their length or height) in 2017 (United Nations International Children's Emergency Fund [UNICEF], World Health Organization [WHO], & World Bank, 2017). At 16%, the prevalence of child wasting in South Asia still exceeds the 15% WHO threshold that indicates a critical public health emergency (UNICEF, 2016). This challenge exists in tandem with the persisting problem of child stunting (being too short for their age). South Asia still has a stunting prevalence of 36%, making this region the locus of two of the world's most serious forms of child malnutrition (UNICEF et al., 2017).

Achievement of the Sustainable Development Goals (SDGs) by 2030 requires a significant reduction in both stunting and wasting (WHO, 2014). Although many governments of South Asia have increasingly accepted the challenge of stunting prevention, mainly through the

---

*The license statement for this article was changed on 18 January 2019 after original online publication.

adoption of targeted nutrition interventions during pregnancy and through 2 years of age (the 1,000 days agenda), effective actions to resolving child wasting have lagged; there are as many wasted children globally today (52 million in 2017) as there were half a decade earlier.

There are numerous reasons why this is a policy priority that requires urgent attention. First, wasting (measured as a weight-for-height z-score [WHZ] of <−2) accounts for 18% of mortality among children aged 0 to 59 months (Black et al., 2013). Being even moderately wasted carries a mortality risk that is three times higher than that of a well-nourished individual, rising to nine times greater risk among the severely wasted (Black et al., 2008). Thus, South Asia's drive to reduce child mortality, another SDG target, must include efforts to address wasting. Since, around 68% of all wasted children in the world live in Asia; thus, global targets cannot be achieved without effective and large-scale action by this region's governments.

Second, there is growing demand for a better understanding of the extent to which the aetiology of stunting (measured as a height-for-age z-score [HAZ] < −2) overlaps with that of wasting (Bergeron & Castleman, 2012; Kinyoki et al., 2016). There have been recent explorations of the relationship between wasting and stunting. For example, a pooled longitudinal analysis concluded recent wasting in children over 6 months, and high variability in WHZ was associated with linear growth faltering, concluding that prevention of wasting could increase linear growth in children (Richards et al., 2012). This relationship may be working through reductions of fat and muscle mass, related hormones (e.g., leptin), and fat's role in bone mass and linear growth regulation (Briend, Khara, & Dolan, 2015; Dewey et al., 2005), though this is not well understood.

The co-occurrence of wasting and stunting represents a highly vulnerable subset of children with a mortality risk that mirrors that of server wasting (McDonald et al., 2013). Thus, there is an urgent call to not only capture the prevalence and programme coverage of this co-occurrence but also understand the joint aetiology. There are important gaps in our understanding of the direction and nature of the relationship between wasting and stunting, and it is possible that interventions for either form of malnutrition may affect the other (Angood, Khara, Dolan, Berkley, & WaSt Technical Interest, 2016; Khara, Mwangome, Ngari, & Dolan, 2017). Although there is evidence that maternal nutritional status during pregnancy and stature both play critical roles in determining the baby's length and weight at birth (Black et al., 2013), the research prioritization exercise conducted by Angood et al. (2016) highlighted a need for studies designed to understand the origins of wasting and stunting and the programmatic opportunities and implications of breaking the intergenerational cycle of undernutrition. There have been many calls for rethinking policies and programmes to support treatment of wasting (to save lives), while simultaneously preventing stunting (Bergeron & Castleman, 2012; Richards et al., 2012; Saaka & Galaa, 2016), but this agenda is still poorly supported empirically.

Low birthweight (LBW) and infant and young child feeding (IYCF) are important consideration in the first 1,000 days, a period widely recognized as a window of opportunity for optimal sustained nutrition and health. LBW has been reported as associated with wasting and stunting, independently (Christian et al., 2013), while also being identified as a risk factor for chronic disease later in life (Barker, 2004). Given the widespread prevalence of LBW in South Asia (approximately 28%), it is important to understand the potential implications

---

Key messages

- Approximately 19% of the sampled children had reported low birthweight (LBW), 60% were not breastfed within 1 hour of birth, 47% were fed prelacteal feeds, and 50% were not exclusively breastfeed for the first 6 months of life.

- LBW and poor IYCF practices were associated with child wasting, severe wasting, and the co-occurrence of wasting and stunting.

- Key predictors of stunting overlap with predictors of wasting and of the co-occurrence of joint nutrition insults. Better integrated of multisector interventions are needed to tackle root causes along with symptoms of wasting and stunting together rather than separately.

---

of LBW in this context. IYCF indicators encompass measures of breastfeeding and complementary feeding, which can translate into anthropometric outcomes (Aguayo, Badgaiyan, & Dzed, 2017; Aguayo, Badgaiyan, & Paintal, 2015). Suboptimal breastfeeding and complementary feeding practices are also widespread across South Asia, and understanding their implication on anthropometric indicators in this context could inform related policies and programmes.

Responding to such knowledge gaps, this paper explores the extent to which LBW and specific IYCF practices may contribute to moderate and severe wasting as well as to the co-occurrence of stunting and wasting among children across South Asia.

2 | METHODS

National level survey data were pooled for six South Asian countries to assess the association of LBW and IYCF practices with wasting, severe wasting, and the co-occurrence of wasting and stunting in early childhood and also to examine the influence of children's age and sex, maternal education, household wealth, and urban/rural residence on these relationships.

2.1 | Datasets

We identified the most recent available nationally representative surveys conducted in South Asia. For this analysis, we included the Afghanistan National Nutrition Survey (NNS) 2013, Bangladesh Demographic and Health Survey (DHS) 2014, India National Family Health Survey (NFHS) 2006, Maldives DHS 2009, Nepal DHS 2011, and Pakistan DHS 2013. The design of each survey has been described in detail elsewhere (International Institute for Population Sciences & Macro International, 2007; Ministry of Health and Population, New ERA, & ICF International, 2012; Ministry of Public Health, UNICEF, & Aga Khan University, 2014; National Institute of Population Research and Training, Mitra and Associates, & ICF International, 2016; National Institute of Population Studies [Pakistan] & ICF International, 2013). In brief, all surveys used multistage cluster sampling methodology, with some variation by country. Anthropometric measurements were conducted similarly across all surveys, and

standardized DHS tools were used across all surveys with the exception of the Afghanistan. Birthweight was not collected in Afghanistan or Bangladesh, and perceived birth size was not collected in Afghanistan. Furthermore, variables required to build standardized indicators for minimum diet diversity (MDD) and minimum acceptable diet (MAD) were not available in Afghanistan. Despite the limitations with the Afghanistan dataset, we chose to include Afghanistan in the analysis when possible (i.e., when all necessary variables were available). Data from each country were imported into Stata14.1 (Stata Corp), where datasets were merged for analysis. The six country datasets included have dates ranging from 2006 to 2014.

2.2 | Child anthropometry

Depending on the survey, each child's height and weight were measured one to three times. Age was determined by date of birth or maternal report of age. Anthropometric indices of WHZ and HAZ were calculated for each child using the sex-specific WHO growth reference standards, standardizing weight for lengths (WHZ) and length and weight for age (HAZ; WHO Multicentre Growth Reference Study Group, 2006). These indices were pre-existing variables in the DHS and NFHS datasets and were calculated for the Afghanistan NNS dataset using *zscore06* (Leroy, 2011). Wasting was defined as per DHS as WHZ ≤ −2, severe wasting as WHZ ≤ −3, and stunting as HAZ ≤ −2 (WHO Multicentre Growth Reference Study Group, 2006). It should be noted that the definition of wasting is different from that of global acute malnutrition in that mild wasting was not included. Additional variables were created to indicate that a child was both stunted and wasted.

2.3 | Child characteristics

The sex of each child was recorded. Caregivers were asked to report whether the child had experienced diarrhoea in the 14 days prior to the survey. The birth order and preceding birth interval of the child were recorded in the DHS and NFHS datasets. Birth order was recorded in the Afghanistan NNS, but birth month was only available for a subsample of the children and birth interval was not attainable.

2.4 | Low birthweight

Reported birthweights collected from a health card or maternal recall were available for a subsample of children among the four country that collected birthweight data due to missing entries. LBW was defined as a reported birthweight < 2,500 g. Given the limited and potentially biased nature of this sample (children of more educated mothers and wealthier households), in addition to the LBW variable, we used methods described by Rahman, Howlader, Masud, and Rahman (2016) to define a second variable for perceived LBW (pLBW; Rahman et al., 2016). Women were asked to report their child's size at birth, with the following options: very large, larger than average, average, smaller than average, and very small. pLBW was defined as children who were reported as very small or smaller than average, whereas very large, larger than average, and average were defined as "not pLBW." In summary, we calculated both LBW and pLBW for this sample while clearly acknowledging the limitations to each variable.

2.5 | IYCF practices

Seven IYCF indicators were derived from maternal recall questions regarding breastfeeding initiation, prelacteal feeding, breastfeeding continuation, and the provision and frequency of complementary foods by food groups. DHS IYCF questionnaires are designed in such a way to build these variables. The WHO definitions of these seven IYCF practices and indicators are (a) initiating breastfeeding with the first hour after birth, (b) breastfeeding exclusively for the first 6 months post-partum, (c) continuing to provide breast milk for at least 2 years post-partum, (d) introducing complementary foods at about 6 months, (e) meeting the minimum meal frequency (MMF) of receiving solid, semi-solid, or soft foods per day in children aged 6 to 23 months, and (f) meeting the MDD of consuming four or more of the seven food groups per day in children aged 6 to 23 months, and (g) meeting the MAD, an indicator that combines meeting the MDD and MMF among children aged 6 to 23 months (WHO et al., 2008, 2010). Provision of prelacteal feeds was defined as prelacteals given within the first 3 days of birth. In Afghanistan, provision of prelacteal feeds was modified to *provision of prelacteals given before breast milk* based on availability of data; furthermore, adequate data were not available to determine MDD and MAD in Afghanistan because specific foods to build food group variables were not available.

2.6 | Maternal variables

Age of mother in years was available in most datasets, but was only collected for a subsample of women in Afghanistan. Typically, a woman was asked if she was married, currently working outside the home, currently pregnant, number of times given birth, level of formal education completed, and literacy level. Due to inconsistencies across surveys in measuring educational attainment, literacy level was used as an indicator for all countries except Maldives where "no formal education" was used as a proxy for illiteracy. Height and weight were measured, and body mass index (BMI) was calculated and categorized into underweight, normal, and overweight according to the international classifications. Short stature was defined as height ≤ 145 cm.

2.7 | Household variables

A wealth index for each household was generated based on a number of assets and other variables using principal component analysis. This process was done by country; thus, the wealth quintiles for each household are relative to wealth conditions in each setting. The variable was available in the DHS datasets, and we derived wealth index and quintiles in Afghanistan using the methods of the corresponding final report. Each country has unique distinction for subregions: 34 provinces in Afghanistan, seven divisions in Bangladesh, 29 states in India, six geographic regions in Maldives, three ecological zones in Nepal, and six provinces and regions in Pakistan. Each household sampled was from one of these subregions.

2.8 | Analytic sample

Children under 5 years of age in the aforementioned surveys were included in the analysis if they had a plausible value for WHZ (i.e.,

WHZ ranging from −5 to 5). Because maternal BMI was an important risk factor in this study, children of pregnant women were excluded as pregnancy influences maternal BMI.

The overall sample size was limited to cases with reported birthweights or perceived birth size in the evaluation of LBW as factors associated with wasting, severe wasting, and the co-occurrence of being wasted and stunted. In evaluating different IYCF practices as factors associated with wasting, severe wasting, and the co-occurrence of wasting and stunting, the analytic sample was limited to the relevant age groups for each IYCF practice.

2.9 | Analysis

We considered three primary outcomes: prevalence of wasting (WHZ < −2), severe wasting (WHZ < −3), and the co-occurrence of wasting (WHZ < −2) and stunting (HAZ < −2) in the same child. To test the association of LBW with each outcome of interest, we used multivariate mixed logistic regression, adjusting for child's age, sex, and preceding birth interval, as well as maternal age, education, BMI and stature, household wealth, urban/rural residence and country, and accounting for the random effect of survey clusters. The impacts of child's age and sex, maternal education, household wealth, urban/rural residence, and country on these relationships were tested using an interaction term between each potential effect modifier and LBW while still accounting for the above listed covariates. If an interaction was found to be significant, the model was stratified by the interaction term, and results of the stratified models presented. The process was repeated using the variable derived for pLBW.

Similar analyses were conducted to evaluate the association between each IYCF indicator and each of the three outcomes of interest. Maternal parity was also adjusted for in these models, and currently, breastfeeding was adjusted for in the models for MMF, MDD, and MAD. LBW and multiple birth pregnancies can influence these relationships. However, given the large amount of missing data on these variables (e.g., all of Afghanistan), we ran these analyses to include pLBW in the models and excluding children that were not from singleton births from the analyses.

2.10 | Ethical considerations

Informed consent was obtained from all study participants, and each survey's ethical procedures have been published in the respective survey reports. Datasets from the surveys that were used for this analysis did not include any variables identifying individuals.

3 | RESULTS

The sample included 62,509 children aged 0 to 59 months from six South Asian countries (Table 1). Across the pooled sample, approximately 16% were wasted, 5% were severely wasted, and 6% were both wasted and stunted. The majority of the children came from rural households (69%), about a quarter (26%) of the children had an underweight (BMI < 18.5 kg/m^2) mother, and 9% had a mother with short stature (less than 145 cm tall).

The prevalence of undernutrition varied by child's age: The prevalence of wasting and severe wasting was highest among children less than 6 months old, and this decreased with age. By contrast, the prevalence of stunting and the co-occurrence of wasting and stunting increased with age (Figure 1).

Specific age subgroups were included in the analysis for the various IYCF practices. Table 2 summarizes the sample for each LBW and IYCF practice exposure, including the prevalence of wasting, severe wasting, and the co-occurrence of wasting and stunting among each exposed and unexposed group. Approximately 19% of children were LBW, and 19% were perceived as having LBW. Less than half (40%) were breastfed within the first hour after birth, and almost half (47%) received prelacteal feeds within the first 3 days. Half (50%) of the children aged 0 to 5 months were exclusively breastfed at the time of the interview, and the majority (84%) of children aged 6 to 23 months were being breastfed at the time of the survey. Approximately 59% of children 6 to 23 months old had been fed a minimum number of times (MMF) during the previous day, whereas only 23% and 16% met the MDD and MAD criteria, respectively.

Children with LBW were more likely to be wasted (adjusted odds ratio [95% CI]: 1.60 [1.45, 1.76]) and severely wasted (1.57 [1.34, 1.83]) compared with children who were not reported LBW, in models adjusted for the covariates previously described (Table 3). LBW children were also more likely to be both wasted and stunted compared with children who were not LBW, though this relationship was modified by age, and when the model was stratified by age, was strongest among infants 0 to 5 months old (3.33 [1.46, 7.62]) and infants 6 to 12 months old (3.94 [2.45, 6.33]). The relationship between LBW and the co-occurrence of being wasted and stunted was also modified by wealth quintiles. This relationship attenuated as wealth decreased, and LBW was not significantly associated with being wasted and stunted among children in the poorest households (1.16 [0.75, 1.80]).

Similarly, children who were pLBW were more likely to be wasted (1.41 [1.29, 1.53]), severely wasted (1.42 [1.30, 1.56]), or wasted and stunted (2.40 [1.66, 3.47]) compared with children who were not pLBW (Table 3). Although the likelihood of being wasted or being wasted and stunted given pLBW was higher among all children, the relationship was stronger among children with more educated mothers compared with children of mothers with less education. Overall, in urban settings, the odds of being both wasted and stunted was 2.08 times greater among pLBW children compared with children not pLBW. Similarly, the odds of stunting and wasting was 1.57 times greater among rural pLBW children compared with rural children who were not pLBW, with significant intercountry variations.

A number of IYCF practices were associated with each of the suboptimal nutrition outcomes of concern (Table 4). Not initiating breastfeeding within the first hour of birth increased a child's likelihood of being wasted (1.09 [1.01, 1.18]) in the pooled sample and of being both wasted and stunted in India (1.23 [1.06, 1.43]). Similarly, the provision of prelacteal feeds increased a child's likelihood of being wasted (1.10 [1.02, 1.18]) and severely wasted (1.13 [1.01, 1.27]) in the pooled sample.

When stratified by maternal education, not exclusively breastfeeding (EBF) was associated with wasting among children of mothers with a secondary education (1.35 [1.04, 1.75]), and stratified by country, EBF reduced the likelihood of severe wasting in India (1.37

TABLE 1 Characteristics of the study population by country and in the pooled sample

	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan	Pooled (unweighted)
Source	NNS 2013	DHS 2014	NFH 2005–2006	DHS 2009	DHS 2011	DHS 2012–2013	2005–2014
n	10,958	6,632	37,881	2,226	2,188	2,624	62,509
Outcomes (%)							
Wasted	9.54	14.34	19.78	10.59	10.54	10.89	15.66
Severely wasted	3.92	3.11	6.47	2.29	2.38	3.38	5.16
Stunted	38.39	35.28	46.92	17.87	39.74	44.53	40.72
Wasted and stunted	3.14	5.2	8.4	2.31	3.89	4.99	6.00
Covariates							
Children							
Age (%)							
0–5 months	15.42	8.54	9.19	9.78	9.89	11.21	9.98
6–11 months	13.58	11.93	10.89	12.87	10.87	10.28	11.43
12–23 months	19.76	21.74	19.34	21.04	19.52	18.04	19.61
24–59 months	51.24	57.80	60.58	56.31	59.71	60.47	58.99
Female (%)	48.13	47.68	47.09	49.89	48.92	48.81	47.89
Preceding birth interval (months)	—[c]	58.97	36.40	60.76	43.10	33.75	40.73
(*n* = 35,134)[a]		(33.02)	(20.59)	(36.31)	(26.66)	(23.04)	(25.47)
Mother							
Age (year)[a]	28.62 (6.82)	25.61 (5.86)	26.45 (5.40)	29.40 (5.68)	26.96 (6.12)	29.38 (6.10)	27.27 (5.85)
BMI (kg/m^2)[a]	23.03 (3.94)	21.58 (3.92)	19.76 (3.25)	24.49 (4.57)	20.93 (2.93)	23.37 (5.15)	21.16 (3.88)
Short stature (%)[b]	2.85	12.88	11.85	8.84	12.03	4.55	9.43
Literate (%)	19.38	76.7	47.82	—[c]	58.33	45.83	51.45
Household							
Rural (%)	76.7	74.29	74.88	69.02	91.21	68.98	68.64

Note. Pooled estimates are not weighted, whereas estimates by country are weighted based on study design. NNS: national nutrition survey; DHS: demographic and health survey; NFH: national family health survey; BMI: body mass index.

[a]Mean (*SD*).

[b]Height < 145 cm.

[c]Data were not collected.

[1.10, 1.69]) and Afghanistan (2.78 [1.33, 5.56]). Children 0 to 5 months and 6 to 11 months who were not being breastfed at the time of the interview had a higher likelihood of being both wasted and stunted compared with children who were not breastfed (0 to 5 months: 4.35 [1.85, 10.00]; 6 to 11 months: 1.69 [1.12, 2.56]).

MMF was not significantly associated with wasting, severe wasting, or the co-occurrence of wasting and stunting. Children who did not met the MDD in India were more likely to be wasted (1.22 [1.08, 1.39]) or wasted and stunted (1.61 [1.32, 2.00]) compared with children who meet the MDD. Children without the MAD in India were also more likely to be wasted and stunted (1.45 [1.12, 1.85]), and Indian girls who did not met the MAD criteria were significantly more likely to be wasted and stunted compared with girls who did meet the MAD (1.61 [1.15, 2.22]).

4 | DISCUSSION

This analysis demonstrates that key determinants of child stunting are also significant determinants of child wasting in South Asia. This

supports the view that these two manifestations of undernutrition should not be separated conceptually or programmatically (Bergeron & Castleman, 2012; Khara et al., 2017). Both forms of undernutrition are the result of multifaceted and overlapping processes by which children face physiological and developmental insults at individual, maternal, family, and societal levels. Therefore, there is a need for governments and their development partners to address nutrition concerns in a more coherent manner that pays attention to all forms of malnutrition throughout the life cycle.

LBW and pLBW were both highly prevalent in this sample (19% of children), and both were strong predictors of wasting and severe wasting. This is consistent with Christian et al.'s report that the odds of wasting was higher among children with LBW in Southern and Eastern Asia compared with those not with LBW (OR [95% CI]: 2.42 [2.03, 2.88]; Christian et al., 2013), though the increased odds reported in the current study is substantially smaller at 1.60 [1.45, 1.76]. This is not surprising given the difference in population, covariates adjusted for, and data collection methods for LBW. Specifically, LBW was based on birthweight measures within 72 hr of delivery in the Christian et al.'s report, whereas our definition included mother's recall
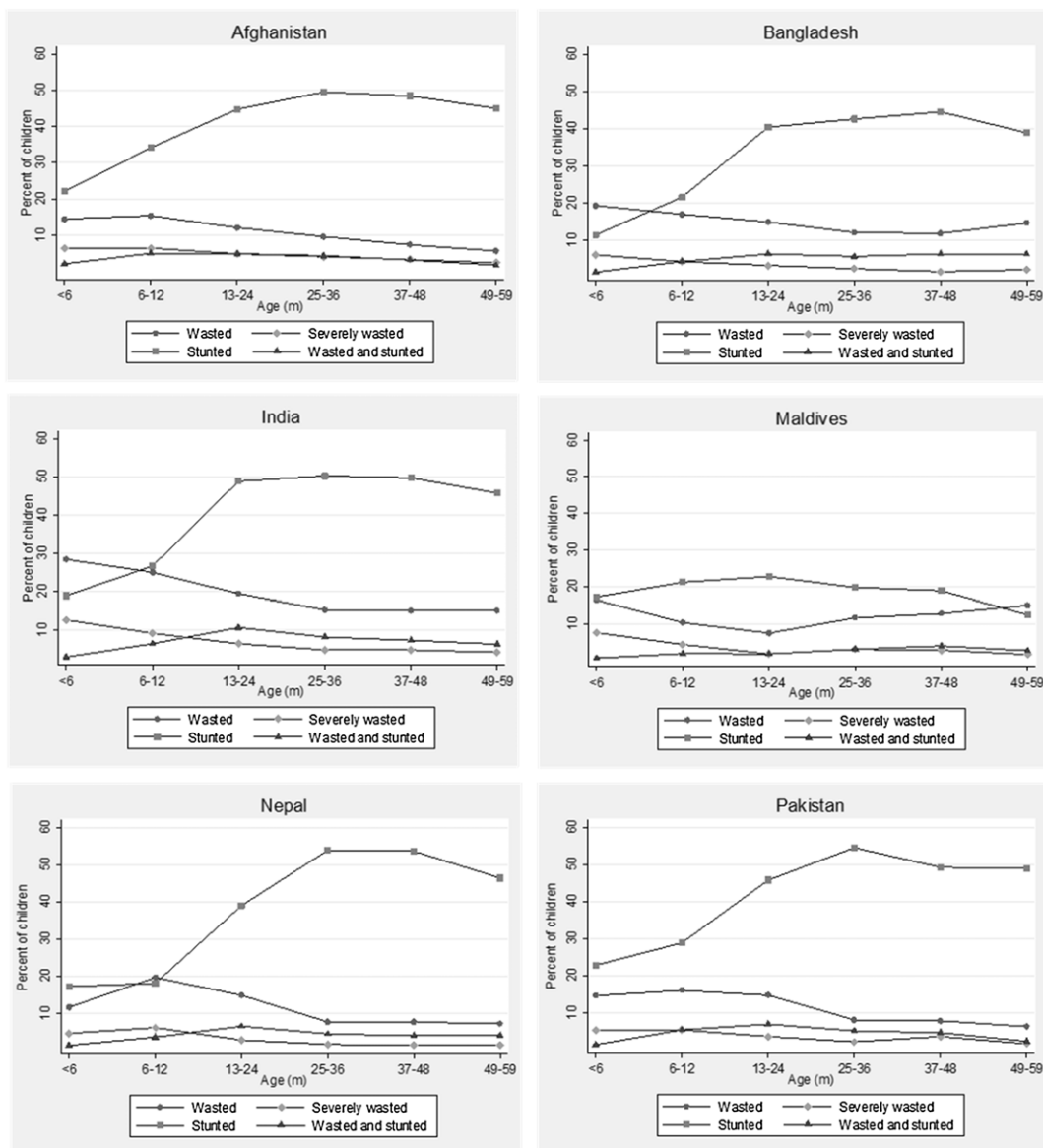
FIGURE 1 Percent of children wasted, stunted, severely wasted, and both wasted and stunted across age categories, by country

TABLE 2 Summary of child anthropometry outcomes among children exposed and not exposed to each factor of interest including low birthweight and infant and young child feeding practices

	Sample			Among exposed (%)			Among nonexposed (%)		
	Age category (months)	N	Exposed (%)	Wasted	Severely wasted	Wasted and stunted	Wasted	Severely wasted	Wasted and stunted
Exposure									
Low birthweight (<2,500 g)	0–59	20,847	18.52	21.14	7.05	9.20	13.40	4.30	3.54
Perceived low birthweight	0–59	52,622	19.37	22.77	7.49	10.37	15.40	4.92	5.78
Not early breastfeeding initiation	0–23	26,309	59.9	21.2	7.7	6.9	17.1	6.2	4.8
Provision of prelacteal feeds	0–23	25,188	46.6	21.1	7.8	6.9	18.5	6.4	5.5
Not exclusively breastfeeding	0–5	6,342	49.7	23.9	10.6	2.5	20.4	8.4	2.1
Never breastfed	0–23	27,033	15.6	15.3	5.5	6.6	20.2	7.4	6.1
Not meeting minimum meal frequency	6–23	18,372	40.9	21.6	7.6	8.7	16.9	5.3	6.6
Not meeting minimum diet diversity	6–23	17,034	77.0	21.5	7.2	8.9	14.0	4.3	4.6
Not meeting minimum acceptable diet	6–23	16,895	84.2	20.9	7.0	8.5	14.1	4.0	4.7

TABLE 3 Odds of being wasted, severely wasted, and both wasted and stunted among children with low birthweight (LBW) or perceived LBW (pLBW) compared with those without

	Wasted		Severely wasted		Wasted and stunted	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
LBW	1.60	1.45, 1.76	1.57	1.34, 1.83	1.80	0.74, 4.38
Not LBW	Ref		Ref		Ref	
By child's age (months)						
<6					3.33	1.46, 7.62
6–12					3.94	2.45, 6.33
13–24					2.37	1.81, 3.12
25–36					2.42	1.80, 3.26
37–48					1.63	1.15, 2.32
49–59					2.11	1.50, 2.96
By wealth index						
Poorest					1.16	0.75, 1.80
Poorer					1.88	1.34, 2.66
Middle					2.61	1.94, 3.50
Richer					2.87	2.20, 3.75
Richest					2.71	1.97, 3.73
pLBW	1.41	1.29, 1.53	1.42	1.30, 1.56	2.40	1.66, 3.47
Not pLBW	Ref		Ref		Ref	
By maternal education						
No education	1.37	1.26, 1.49			1.48	1.33, 1.66
Primary	1.45	1.27, 1.65			1.72	1.43, 2.07
Secondary	1.63	1.48, 1.80			2.03	1.74, 2.37
Higher	1.58	1.22, 2.05			2.80	1.72, 4.57
By urban/rural						
Urban					2.08	1.77, 2.43
Rural					1.57	1.43, 1.72
By country						
Bangladesh					2.33	1.70, 3.18
India					1.65	1.51, 1.80
Maldives					2.67	1.39, 5.13
Nepal					1.88	1.19, 2.97
Pakistan					1.24	0.78, 1.97

Note. All models were adjusted for covariates including child's age, sex and preceding birth interval, maternal age, education, body mass index and stature, household wealth, country and urban or rural residence, and the clustered survey designs. Each row and column represent a different model. Rows under the exposure of interest represent the model stratified by effect modifiers that were significant in the final model. Adjusted odds ratio (AOR) and 95% confidence interval (CI) are for the primary exposure of interest.

and birthweights record on a health card. Beyond the relationship between LBW and wasting, Christian et al. conclude that the odds of both stunting and underweight among children is also higher among those with LBW (Christian et al., 2013). In the current analysis, LBW was also a predictor of being simultaneously wasted and stunted among children in all age groups considered and applied to all wealth quintiles except the poorest quintile. The association between pLBW and being both wasted and stunted was statistically significant.

As maternal education increased, so did the strength of the negative correlation between pLBW and wasting and between pLBW and being both wasted and stunted. Similarly, the increased likelihood of being both wasted and stunted among LBW children increased with wealth. The odds of being both wasted and stunted given pLBW was greater among children in urban households than in rural households. These patterns suggest that reducing LBW

would have substantial impacts on reducing child wasting, severe wasting, and decreasing the odds of being both wasted and stunted across. Of course, additional determinants of wasting and stunting must also be addressed, particularly among the most vulnerable groups.

IYCF practices are generally poor across South Asia, with fewer than 60% of children meeting any one indicator other than "any breastfeeding." We found that in general, poor IYCF practices within the first 6 months, such as not initiating breastfeeding within the first hour post-partum, provision of prelacteal feeds and not EBF in the first 6 months were significantly associated with wasting in this pooled South Asia sample, whereas indicators of poor complementary feeding such as not meeting the MDD or MAD criteria were associated with being wasted and both wasted and stunted in India.

TABLE 4 Odds of being wasted, severely wasted, and both wasted and stunted among children exposed to specific infant and young child feeding practices

	Wasted		Severely wasted		Wasted and stunted	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Early breastfeeding initiation[a]	0.92	0.85, 0.99	1.43	0.97, 2.10	1.27	0.88, 1.84
No early initiation	Ref		Ref		Ref	
By country						
Afghanistan			1.00	0.70, 1.42	1.03	0.71, 1.50
Bangladesh			1.41	0.97, 2.06	1.27	0.88, 1.80
India			0.90	0.79, 1.03	0.81	0.70, 0.94
Maldives			1.99	0.84, 4.69	1.26	0.38, 4.16
Nepal			1.32	0.68, 2.57	0.67	0.28, 1.61
Pakistan			0.53	0.21, 1.36	0.81	0.42, 1.58
Provision of prelacteal feeds[a]	1.10	1.02, 1.18	1.13	1.01, 1.27	1.08	0.96, 1.22
No provision of prelacteals	Ref		Ref		Ref	
Exclusively breastfeeding[b]	0.75	0.60, 0.94	1.64	0.74, 3.63	0.82	0.54, 1.25
Not exclusively breastfeeding	Ref		Ref		Ref	
By maternal education						
No education	0.81	0.65, 1.00				
Primary	1.10	0.77, 1.57				
Secondary	0.74	0.57, 0.96				
Higher	1.17	0.65, 2.12				
By country						
Afghanistan			0.36	0.18, 0.75		
Bangladesh			1.15	0.47, 2.82		
India			0.73	0.59, 0.91		
Maldives			1.02	0.32, 3.24		
Nepal			1.85	0.52, 6.50		
Pakistan			0.55	0.14, 2.19		
Currently breastfeeding[a]	1.01	0.90, 1.12	0.92	0.78, 1.09	0.25	0.12, 0.51
Not currently breastfeeding	Ref		Ref		Ref	
By age (months)						
0–5					0.23	0.10, 0.54
6–11					0.59	0.39, 0.89
12–23					0.99	0.84, 1.17
By maternal education						
No education					1.00	0.81, 1.24
Primary					0.77	0.52, 1.13
Secondary					0.81	0.60, 1.10
Higher					0.43	0.16, 1.14
MMF[c]	0.92	0.70, 1.20	0.87	0.72, 1.06	0.91	0.81, 1.04
Not meeting MMF	Ref		Ref		Ref	
By sex						
Female	0.80	0.63, 1.01				
Male	1.05	0.85, 1.30				
By country						
Afghanistan	0.84	0.54, 1.31				
Bangladesh	2.12	0.69, 6.55				
India	0.89	0.74, 1.08				
Maldives	1.42	0.23, 8.94				
Nepal	0.59	0.24, 1.49				
Pakistan	1.01	0.51, 1.98				
By maternal education						

TABLE 4 (Continued)

	Wasted		Severely wasted		Wasted and stunted	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
No education			1.01	0.79, 1.29		
Primary			0.89	0.58, 1.35		
Secondary			0.82	0.61, 1.10		
Higher			0.66	0.35, 1.26		
MDD[c]	0.87	0.65, 1.15	0.90	0.75, 1.09	1.03	0.67, 1.59
Not meeting MDD	Ref		Ref		Ref	
By country						
Bangladesh	0.84	0.63, 1.13			1.08	0.70, 1.68
India	0.82	0.72, 0.93			0.62	0.50, 0.76
Maldives	1.55	0.84, 2.85			0.84	0.24, 3.01
Nepal	1.01	0.59, 1.72			0.43	0.15, 1.27
Pakistan	1.07	0.68, 1.70			0.55	0.25, 1.23
MAD[c]	0.93	0.81, 1.06	0.89	0.71, 1.11	1.68	1.05, 2.70
Not meeting MAD	Ref		Ref		Ref	
By sex						
Female					0.62	0.45, 0.87
Male					0.89	0.69, 1.16
By country						
Bangladesh					1.33	0.84, 2.09
India					0.69	0.54, 0.89
Maldives					0.62	0.16, 2.46
Nepal					0.57	0.19, 1.64
Pakistan					0.59	0.25, 1.41

Note. All models were adjusted for covariates including child's age, sex and preceding birth interval, maternal age, education, parity, body mass index and stature, household wealth, country and urban or rural residence, and the clustered survey designs. Models with minimum meal frequency (MMF), minimum diet diversity (MDD), or minimum acceptable diet (MAD) as the main predictor were also adjusted for currently breastfeeding. Each row and column represent a different model. Rows under the exposure of interest represent the model stratified by effect modifiers that were significant in the final model. Adjusted odds ratio (AOR) and 95% confidence interval (CI) are for the primary exposure of interest.

[a]Among 0- to 23-month-old children.

[b]Among 0- to 5-month-old children.

[c]Among 6- to 23-month-old children.

It is not surprising that poor IYCF practices in the first 6 months were significantly associated with wasting and severe wasting, given that the prevalence of wasting is greatest in the first 6 months of life and tends to decline with age, whereas the prevalence of stunting increases with age (Victora, de Onis, Hallal, Blossner, & Shrimpton, 2010). In the current study sample, the prevalence of being both wasted and stunted increases with age through 12 to 23 months of age, after which there is a slight decline.

That said, not all IYCF indicators were consistently associated with wasting, severe wasting, or with the co-occurrence of wasting and stunting in the pooled study sample. This is consistent with findings from a review of associations between the WHO-UNICEF IYCF indicators and child anthropometry that concluded that additional IYCF indicators may be needed to better assess the relationship between IYCF practices and child growth (Jones et al., 2014).

Nevertheless, we did find important associations between breastfeeding practices in the first 6 months of life and wasting and severe wasting. In the India sample, there were also significant associations between complementary feeding practices and wasting and the co-occurrence of wasting and stunting. Similar findings have been reported in Bhutan, where poor IYCF indicators were shown to be associated with wasting, severe wasting, stunting, and also with severe stunting (Aguayo et al., 2017; Aguayo et al., 2015).

The benefits of initiating breastfeeding within 1 hr of birth and exclusive breastfeeding in the first 6 months are indisputable, particularly in the context of reducing the risk of infant mortality (Group, 2016; Victora et al., 2016). Appropriate complementary feeding practices can also prevent morbidity among children during the vulnerable period of 6 to 23 months old (Black et al., 2008) and improve child growth and development (Frongillo et al., 2017; Nguyen et al., 2017). It is therefore of concern that this analysis identified several important deficiencies in breastfeeding and complementary feeding practices across this sample. Two of the most concerning problems are that only half of children aged 0 to 5 months were exclusively breastfed and only 23% of children aged 6 to 23 months met the MDD criteria.

A recent review of IYCF in South Asia concluded that poor complementary feeding practices are widespread (Aguayo, 2017). Analysis by the South Asia Infant Feeding Research Network concluded that higher maternal education and household wealth were

the most consistent determinants of adequate complementary feeding practices (Senarath et al., 2012; Senarath & Dibley, 2012). This same group identified that provision of prelacteal feeds was a common barrier to achieving exclusive breastfeeding in South Asia, a practice that can be targeted with context-appropriate communication strategies to improve behaviours and practices (Dibley et al., 2010). These analyses identified a number of additional factors associated with IYCF behaviours; for example, antenatal contact with a health care provider was associated with timely initiation of breastfeeding and timely complementary feeding in Bangladesh and India (Dibley et al., 2010).

The concern with poor complementary feeding in South Asia is not new. It was recently highlighted in a supplement in Maternal and Child Nutrition by UNICEF documenting the main drivers of stunting and poor child growth and development: inadequate complementary feeding practices, poor maternal nutrition, and poor hygiene and sanitation practices were identified as key drivers of the burden of poor growth in South Asian children (Aguayo & Menon, 2016). Similarly, a 2012 supplement in Maternal and Child Nutrition highlighted IYCF priorities for the region, including (a) policy commitments to IYCF, (b) evidence-based interventions at scale aimed at improving complementary feeding, and (c) effective delivery platforms to maintain these interventions (Menon, 2012).

4.1 | Study limitations

This analysis is limited by the cross-sectional nature of our data, which does not allow us to assess causality. With regard to the sample used in the analysis evaluating LBW as a predictor, the sample was subject to selection bias because not all women had information on their child's birthweight. Regarding the sample use in the analysis evaluating pLBW as a predictor, some level of reporting and recall bias is to be expected as women were asked to recall the size of their children at birth and compare that size to a "normal" birth size. In all models, we excluded cases with any missing data.

Despite these limitations, our study identifies significant factors predicting wasting, severe wasting, and the co-occurrence of being wasted and stunted in South Asia. Models were adjusted for covariates that are known to or could plausibly impact the relationships being studied, and a number of individual, maternal, and household characteristics were tested for their impact on these relationships under examination. Importantly, this analysis focuses on South Asia, home to the largest number of wasted and stunted children globally, and included tests to determine whether country modified these relationships.

5 | CONCLUSIONS

The findings from this study support the need for policy and programme action both prenatally and post-natally to prevent child wasting *alongside* stunting in South Asia. Wasting has tended to be regarded as an acute condition requiring urgent treatment via services often dependent on short-term humanitarian funding or medical facility capacity. By contrast, stunting is generally understood as a chronic condition that needs to be prevented via longer-term developmental

investments in quality health, education, and water and sanitation, as well as improved knowledge and behaviours at the household level. Because of the long-standing conceptual divide, nutrition actions have long been designed for one or the other manifestation with less attention to shared risk factors (Khara & Dolan, 2014; Saaka & Galaa, 2016).

Martorell and Young (2012) noted that although many questions remain regarding the causal pathways for stunting and wasting, causal factors for both conditions overlap in many contexts (Black et al., 2013; Martorell & Young, 2012). The findings presented here support the case for a rethinking by policymakers across the region on the focus of investments for nutrition. We do not challenge the established importance of preventing stunting, which has taken on its own momentum through the First 1,000 Days agenda (Branca, Piwoz, Schultink, & Sullivan, 2015; Wrottesley, Lamper, & Pisa, 2016). However, preventing as well as treating wasting is of equal policy priority. Because many of the underlying causes of both conditions are the same, the region's policies and programmes must be less siloed in both design and implementation. Malnutrition has many manifestations that overlap in time, space, and even in the same individual. The underlying commonalities must therefore be tackled more explicitly, which requires moving beyond one-nutrient-at-a time approaches (as with some supplementation initiatives) and also beyond one-type-of-malnutrition-at-a-time. The policy agenda has to be realigned towards tackling all forms of malnutrition through the life cycle and striving for optimal nutrition in all its forms rather than making incremental inroads on one front versus another.

The Lancet series of 2013 on maternal and child nutrition promoted a conceptual diagram of the linkages among risk factors, interventions, and mortality risk that was used to guide modelling with the Lives Saved tool (LiST; Black et al., 2013). That conceptual framing has direct lines linking birth risks, birth outcomes, and various IYCF interventions to stunting, but those lines do not also link to wasting. In that model, stunting and wasting were separately determined for modelling purposes, but the concept framing of that separation is hugely important both to our thinking about these outcomes and to the resulting actions taken to address them.

Specifically, effective interventions that reduce the incidence of LBW and increase the likelihood of optimal IYCF practices should be urgently scaled up. The potential for including these in public media messaging as well as systematically in targeted health services should be urgently examined. LBW has significant consequences for the infant, including increased mortality and morbidity, as well as higher likelihood of stunting (Belizan et al., 2012; Ramakrishnan, 2004). Maternal nutrition and cigarette smoking are the most important determinants of LBW in low- and middle-income countries (Kramer, 1987); therefore, interventions are needed to promote adequate nutrition among adolescent girls as well as women of child-bearing age. Similarly, actions are needed to dramatically curtail smoking and tobacco use before and during pregnancy among women. Social and behaviour change messaging on the importance of good nutrition and health in pregnancy and effective IYCF practices for infants should be embedded in national plans of action and in multisector interventions aimed at promoting improved nutrition. Actions required to reduce LBW include the provision of quality antenatal care, balanced energy-protein supplements for malnourished women, iron

and folic acid or multiple micronutrient supplements to prevent and treat anaemia, calcium supplements, and counselling on dietary improvement and birth spacing (Imdad & Bhutta, 2013; Morris, Oliver, Malin, Khan, & Meads, 2013).

At the same time, the promotion of optimal IYCF requires major investments in policies that support appropriate breastfeeding and complementary feeding, women's education, and ensuring that nutritious complementary foods are available, affordable, and used (Bhutta et al., 2013; Kattula et al., 2014).

More broadly, the findings of this analysis call for a prioritization of actions to address malnutrition in all its forms in South Asia. Just as the SDGs are interlinked and mutually reinforcing, comprehensive actions are needed to address the various elements of the world's nutrition agenda.

Prevention of stunting is essential across South Asia as is action against wasting. Because LBW and poor IYCF are significantly associated with wasting, severe wasting, and the co-occurrence of wasting and stunting in South Asia, policymakers should seek to link the prevention of child wasting with interventions for the prevention of LBW, poor IYCF, and stunting in early childhood while ensuring early detection and care for children with severe wasting.

ACKNOWLEDGMENTS

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

KLH, PW, and VMA designed the research. KLH wrote the first draft of the paper, and all authors edited and approved the final paper.

ORCID

Kassandra L. Harding http://orcid.org/0000-0002-8095-3471
Víctor M. Aguayo http://orcid.org/0000-0003-1825-4108
Patrick Webb http://orcid.org/0000-0002-9857-3354

REFERENCES

Aguayo, V. M. (2017). Complementary feeding practices for infants and young children in South Asia. A review of evidence for action post-2015. Maternal & Child Nutrition, 13(Suppl 2), e12439. https://doi.org/10.1111/mcn.12439

Aguayo, V. M., Badgaiyan, N., & Dzed, L. (2017). Determinants of child wasting in Bhutan. Insights from nationally representative data. Public Health Nutrition, 20(2), 315–324. https://doi.org/10.1017/S1368980016002111

Aguayo, V. M., Badgaiyan, N., & Paintal, K. (2015). Determinants of child stunting in the Royal Kingdom of Bhutan: An in-depth analysis of nationally representative data. Maternal & Child Nutrition, 11(3), 333–345. https://doi.org/10.1111/mcn.12168

Aguayo, V. M., & Menon, P. (2016). Stop stunting: Improving child feeding, women's nutrition and household sanitation in South Asia. Maternal & Child Nutrition, 12(Suppl 1), 3–11. https://doi.org/10.1111/mcn.12283

Angood, C., Khara, T., Dolan, C., Berkley, J. A., & WaSt Technical Interest, G (2016). Research priorities on the relationship between wasting and stunting. PLoS One, 11(5), e0153221. https://doi.org/10.1371/journal.pone.0153221

Barker, D. J. (2004). The developmental origins of chronic adult disease. Acta Paediatrica. Supplement, 93(446), 26–33.

Belizan, J. M., McClure, E. M., Goudar, S. S., Pasha, O., Esamai, F., Patel, A., ... Goldenberg, R. L. (2012). Neonatal death in low- to middle-income countries: A global network study. American Journal of Perinatology, 29(8), 649–656. https://doi.org/10.1055/s-0032-1314885

Bergeron, G., & Castleman, T. (2012). Program responses to acute and chronic malnutrition: Divergences and convergences. Advances in Nutrition, 3(2), 242–249. https://doi.org/10.3945/an.111.001263

Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., ... Maternal Child Nutrition Study Group (2013). Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? Lancet, 382(9890), 452–477. https://doi.org/10.1016/S0140-6736 (13)60996-4

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., de Onis, M., Ezzati, M., ... Child Undernutrition Study, G (2008). Maternal and child undernutrition: Global and regional exposures and health consequences. Lancet, 371(9608), 243–260. https://doi.org/10.1016/S0140-6736 (07)61690-0

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., ... Child Nutrition Study, G (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet, 382(9890), 427–451. https://doi.org/10.1016/S0140-6736 (13)60937-X

Branca, F., Piwoz, E., Schultink, W., & Sullivan, L. M. (2015). Nutrition and health in women, children, and adolescent girls. BMJ, 351, h4173. https://doi.org/10.1136/bmj. h4173

Briend, A., Khara, T., & Dolan, C. (2015). Wasting and stunting—Similarities and differences: Policy and programmatic implications. Food and Nutrition Bulletin, 36(1 Suppl), S15–S23.

Christian, P., Lee, S. E., Donahue Angel, M., Adair, L. S., Arifeen, S. E., Ashorn, P., ... Black, R. E. (2013). Risk of childhood undernutrition related to small-for-gestational age and preterm birth in low- and middle-income countries. International Journal of Epidemiology, 42(5), 1340–1355. https://doi.org/10.1093/ije/dyt109

Dewey, K. G., Hawck, M. G., Brown, K. H., Lartey, A., Cohen, R. J., & Peerson, J. M. (2005). Infant weight-for-length is positively associated with subsequent linear growth across four different populations. Maternal & Child Nutrition, 1(1), 11–20. https://doi.org/10.1111/j.1740-8709.2004.00004.x

Dibley, M. J., Roy, S. K., Senarath, U., Patel, A., Tiwari, K., Agho, K. E., ... South Asia Infant Feeding Research, N (2010). Across-country comparisons of selected infant and young child feeding indicators and associated factors in four South Asian countries. Food and Nutrition Bulletin, 31(2), 366–375.

Frongillo, E. A., Nguyen, P. H., Saha, K. K., Sanghvi, T., Afsana, K., Haque, R., ... Menon, P. (2017). Large-scale behavior-change initiative for infant and young child feeding advanced language and motor development in a cluster-randomized program evaluation in Bangladesh. The Journal of Nutrition, 147(2), 256–263. https://doi.org/10.3945/jn.116.240861

Group, N. S. (2016). Timing of initiation, patterns of breastfeeding, and infant survival: Prospective analysis of pooled data from three randomised trials. The Lancet Global Health, 4(4), e266–e275. https://doi.org/10.1016/S2214-109X (16)00040-1

Imdad, A., & Bhutta, Z. A. (2013). Nutritional management of the low birth weight/preterm infant in community settings: A perspective from the developing world. The Journal of Pediatrics, 162(3 Suppl), S107–S114. https://doi.org/10.1016/j.jpeds.2012.11.060

International Institute for Population Sciences (IIPS), & Macro International. (2007). National Family Health Survey (NFHS-3), 2005–06: India: Volume I. Retrieved from Mumbai, India:

Jones, A. D., Ickes, S. B., Smith, L. E., Mbuya, M. N., Chasekwa, B., Heidkamp, R. A., ... Stoltzfus, R. J. (2014). World Health Organization infant and young child feeding indicators and their associations with child anthropometry: A synthesis of recent findings. *Maternal & Child Nutrition*, 10(1), 1–17. https://doi.org/10.1111/mcn.12070

Kattula, D., Sarkar, R., Sivarathinaswamy, P., Velusamy, V., Venugopal, S., Naumova, E. N., ... Kang, G. (2014). The first 1000 days of life: Prenatal and postnatal risk factors for morbidity and growth in a birth cohort in southern India. *BMJ Open*, 4(7), e005404. https://doi.org/10.1136/bmjopen-2014-005404

Khara, T., & Dolan, C. (2014). Technical briefing paper: Associations between wasting and stunting, policy, programming and research implications. Retrieved from

Khara, T., Mwangome, M., Ngari, M., & Dolan, C. (2017). Children concurrently wasted and stunted: A meta-analysis of prevalence data of children 6–59 months from 84 countries. *Maternal & Child Nutrition*, 14, e12516. https://doi.org/10.1111/mcn.12516

Kinyoki, D. K., Kandala, N. B., Manda, S. O., Krainski, E. T., Fuglstad, G. A., Moloney, G. M., ... Noor, A. M. (2016). Assessing comorbidity and correlates of wasting and stunting among children in Somalia using cross-sectional household surveys: 2007 to 2010. *BMJ Open*, 6(3), e009854. https://doi.org/10.1136/bmjopen-2015-009854

Kramer, M. S. (1987). Determinants of low birth weight: Methodological assessment and meta-analysis. *Bulletin of the World Health Organization*, 65(5), 663–737.

Leroy, J. (2011). zscore06: Stata command for the calculation of anthropometric z-scores using the 2006 WHO child growth standards. Retrieved from http://www.ifpri.org/staffprofile/jef-leroy:

Martorell, R., & Young, M. F. (2012). Patterns of stunting and wasting: Potential explanatory factors. *Advances in Nutrition*, 3(2), 227–233. https://doi.org/10.3945/an.111.001107

McDonald, C. M., Olofin, I., Flaxman, S., Fawzi, W. W., Spiegelman, D., Caulfield, L. E., ... Nutrition Impact Model, S. (2013). The effect of multiple anthropometric deficits on child mortality: Meta-analysis of individual data in 10 prospective studies from developing countries. *The American Journal of Clinical Nutrition*, 97(4), 896–901. https://doi.org/10.3945/ajcn.112.047639

Menon, P. (2012). The crisis of poor complementary feeding in South Asia: Where next? *Maternal & Child Nutrition*, 8(Suppl 1), 1–4. https://doi.org/10.1111/j.1740-8709.2011.00394.x

Ministry of Health and Population, New ERA, & ICF International. (2012). Nepal Demographic and Health Survey 2011. Retrieved from Kathmandu, Nepal and Calverton, Maryland, USA:

Ministry of Public Health, UNICEF, & Aga Khan University. (2014). National Nutrition Survey Afghanistan 2013. Retrieved from

Morris, R. K., Oliver, E. A., Malin, G., Khan, K. S., & Meads, C. (2013). Effectiveness of interventions for the prevention of small-for-gestational age fetuses and perinatal mortality: A review of systematic reviews. *Acta Obstetricia et Gynecologica Scandinavica*, 92(2), 143–151. https://doi.org/10.1111/aogs.12029

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International. (2016). Bangladesh Demographic and Health Survey 2014. Retrieved from Dhaka, Bangladesh and Rockville, Maryland, USA:

National Institute of Population Studies (NIPS) [Pakistan], & ICF International. (2013). Pakistan Demographic and Health Survey 2012–13. Retrieved from Islamabad, Pakistan, and Calverton, Maryland, USA: NIPS and ICF International.:

Nguyen, P. H., Headey, D., Frongillo, E. A., Tran, L. M., Rawat, R., Ruel, M. T., & Menon, P. (2017). Changes in underlying determinants explain rapid increases in child linear growth in alive & thrive study areas

between 2010 and 2014 in Bangladesh and Vietnam. *The Journal of Nutrition*, jn243949. https://doi.org/10.3945/jn.116.243949

Rahman, M. S., Howlader, T., Masud, M. S., & Rahman, M. L. (2016). Association of low-birth weight with malnutrition in children under five years in Bangladesh: Do mother's education, socio-economic status, and birth interval matter? *PLoS One*, 11(6), e0157814. https://doi.org/10.1371/journal.pone.0157814

Ramakrishnan, U. (2004). Nutrition and low birth weight: From research to practice. *The American Journal of Clinical Nutrition*, 79(1), 17–21.

Richards, S. A., Black, R. E., Gilman, R. H., Guerrant, R. L., Kang, G., Lanata, C. F., ... Network, C. I. a. M. (2012). Wasting is associated with stunting in early childhood. *The Journal of Nutrition*, 142, 1291–1296.

Saaka, M., & Galaa, S. Z. (2016). Relationships between wasting and stunting and their concurrent occurrence in Ghanaian preschool children. *Journal of Nutrition and Metabolism*, 2016, 1–11.

Senarath, U., Agho, K. E., Akram, D. E., Godakandage, S. S., Hazir, T., Jayawickrama, H., ... Dibley, M. J. (2012). Comparisons of complementary feeding indicators and associated factors in children aged 6–23 months across five South Asian countries. *Maternal & Child Nutrition*, 8(Suppl 1), 89–106. https://doi.org/10.1111/j.1740-8709.2011.00370.x

Senarath, U., & Dibley, M. J. (2012). Complementary feeding practices in South Asia: Analyses of recent national survey data by the South Asia Infant Feeding Research Network. *Maternal & Child Nutrition*, 8(Suppl 1), 5–10. https://doi.org/10.1111/j.1740-8709.2011.00371.x

UNICEF. (2016). The state of the world's children 2016. Retrieved from New York, NY:

UNICEF, WHO, & World Bank. (2017). Joint child malnutrition estimates database

Victora, C. G., Bahl, R., Barros, A. J., Franca, G. V., Horton, S., Krasevec, J., ... Lancet Breastfeeding Series, G (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *Lancet*, 387(10017), 475–490. https://doi.org/10.1016/S0140-6736 (15)01024-7

Victora, C. G., de Onis, M., Hallal, P. C., Blossner, M., & Shrimpton, R. (2010). Worldwide timing of growth faltering: Revisiting implications for interventions. *Pediatrics*, 125(3), e473–e480. https://doi.org/10.1542/peds.2009-1519

WHO (2014). *Global nutrition targets 2025: Policy brief series (WHO/NMH/NHD/14.2)*. Geneva: World Health Organization.

WHO Multicentre Growth Reference Study Group. (2006). WHO child growth standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Retrieved from Geneva, Switzerland:

WHO, UNICEF, USAID, AED, UCDAVIS, & IFPRI. (2008). Indicators for assessing infant and young child feeding practices Part I: Definitions. Retrieved from Geneva:

WHO, UNICEF, USAID, AED, UCDAVIS, & IFPRI. (2010). Indicators for assessing infant and young child feeding practices Part II: Measurement. Retrieved from Geneva:

Wrottesley, S. V., Lamper, C., & Pisa, P. T. (2016). Review of the importance of nutrition during the first 1000 days: Maternal nutritional status and its associations with fetal growth and birth, neonatal and infant outcomes among African women. *Journal of Developmental Origins of Health and Disease*, 7(2), 144–162. https://doi.org/10.1017/S2040174415001439