

Feeding Practice and Nutritional Status of Children of South Asia: A Systematic Review

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Abstract:

Background: Nutritional status can be defined as the state of a person's health in terms of the nutrients in his or her diet. In 2021, an estimated 45 million children under the age of 5 were suffering from wasting, the deadliest form of malnutrition, which increases children's risk of death by up to 12 times. There are also 149 million children under the age of five who were stunted because of a chronic lack of essential nutrients in their diets, while 39 million are overweight. Prevalence of wasting is the highest in South Asia among all other sub-regions in the world. The aim of the paper is to review the feeding practice and nutritional status of children (age range 0-18 years) of South Asia and different factors behind food and nutritional intake.

Method: The study area is South Asian Countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka). The paper is entirely a review paper and all of the data was gathered from secondary sources. The search was conducted using several search engines and websites: Google scholar and PubMed. Various published publications from various journals aided in the gathering of data for this article. Total 7 paper were included in the review paper.

Result: There were a number of factors that affected the malnutrition situation in a significant way and several direct, indirect, and modifier factors were found. According to the selected studies, the following direct factors impact malnutrition in South Asia: Poor infant and young child feeding (IYCF) practices, LBW and pLBW (Pre-term Low Birth Weight), Climate change, Child's age, Mother's age at childbirth. South Asian children's interaction with the IYCF practice is greatly influenced by a variety of factors including parental education level, wealth status, place of residence, too early introduction of complementary feeding (ISSSF, MDD, MMF, MAD, EIBF, EBF, CBF and CRIF), low frequency of prenatal visits, lack of media exposure, country and regional differences. A child's socioeconomic status (place of residence) and cast/tribe variation also contribute to malnutrition. There was also a significant change in result across South Asian countries. It was found that, South Asia is experiencing a nutritional deficiency in terms of nutrition intake.

Conclusion: In recent years, health literacy has been attracting attention. The effectiveness of implementing food literacy has been suggested. As parental education and exposure to media has an important influence on child nutrition, it can be suggested that, for improved nutritional and dietary knowledge, parents must be educated and well informed at all levels. It is also important to educate everyone about the risk of early childbirth, as the mother's age at childbirth plays a significant role in malnutrition. Improving sanitation, including infrastructure development to minimize the effects of climate change, is a common challenge for South Asian countries.

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Background

One of the most significant elements impacting individuals' quality of life is nutrition. Nutritional status can be defined as the state of a person's health in terms of the nutrients in his or her diet [1]. Better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), and longevity [2]. On the other hand, an unhealthy diet leads to malnutrition. According to WHO, malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients [3]. The term malnutrition covers 2 broad groups of conditions- 'undernutrition' and 'overweight, obesity and diet-related non-communicable diseases.' [4].

The outbreak and spread of COVID-19 has created new hazards and challenges to global nutrition. According to 2022 UN report, as many as 828 million people were affected by hunger in 2021, which is 46 million people more from a year earlier and 150 million more from 2019 [5]. An estimated 45 million children under the age of 5 were suffering from wasting, the deadliest form of malnutrition, which increases children's risk of death by up to 12 times. There are also 149 million children under the age of five who were stunted because of a chronic lack of essential nutrients in their diets, while 39 million are overweight [5]. Prevalence of wasting is the highest in South Asia among all other sub-regions in the world. Approximately 516.5 million malnourished individuals living in the Asia and Pacific region and about 239 million malnourished living in Sub-Saharan Africa [6].

Almost all wasted children in the region live in five countries: India, Pakistan, Bangladesh, Afghanistan and Nepal [7]. According to Global Nutrition report, 2021, Pakistan has made some progress toward meeting the stunting objective, but 37.6% of children under the age of five are still stunted, which is more than the Asia region's average (21.8%) [8]. Also, it has made some progress in meeting the wasting objective, but 7.1 percent of children under the age of five are still affected, which is lower than the Asia region's average (8.9%). Pakistan has made only modest progress on its diet-related non-communicable disease (NCD) goals [8]. Similarly, India is on track to fulfill the stunting target, although 34.7 percent of children under the age of five are still stunted. In spite of India's efforts, 17.3 percent of children under the age of five are suffering from wasting [9]. In Nepal 31.5% of children under 5 years of age are still stunted and it has made no progress towards achieving the target for wasting, with 12.0% of children under 5 years of age affected [10]. In Bhutan, prevalence of stunting, wasting and overweight were 33.5%, 5.9%, and 7.6%, respectively [11].

Among the South Asian countries (SACs) Bangladesh is still off track to meet all targets for maternal, infant and young child nutrition [12]. According to a report on The Daily Star, in the 2021 Global Hunger Index report, Bangladesh ranked 76th out of the 116 countries with a score of 19.1 which indicates that Bangladesh has a level of hunger that is moderate [13]. According to Global Nutrition Report (2021), It has made some progress towards achieving the target for stunting and wasting but 28.0% and 9.8% of children under 5 years of age are still stunted and wasted, respectively [12].

As mentioned before, the lack of right amount of nutrients in diet leads to malnutrition. In other words, malnutrition is related to food intake. As various sociodemographic factors interplay with food intake and nutritional status of rural and urban children, this paper will focus on reviewing the feeding practices and malnutrition scenario among children of South Asian countries and reviewing the identified different factors that affect the food and nutrition intake of children.

Objective

The specific objectives of the study are:

1. To review the feeding practice of children of South Asia.
2. To review the nutritional status of children of South Asia.
3. To review different identified factors of food and nutritional intake of children of South Asia.

Methodology

The study review covered the studies conducted in South Asia region, which consists of the countries of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The population of South Asia is about 1.891 billion or about one-fourth of the world's population. Overall, it accounts for about 39.49% of Asia's population.

Search Strategies

The search was conducted using several search engines and websites: Google scholar and PubMed using these following search terms:

Google scholar: allintitle: "South Asia" (child OR children OR infant OR adolescent) (nutrition OR nutrient OR nutritional OR nourishment OR diet OR food OR feeding OR alimentation)

PubMed: "South Asia"[Title] (child[Title] OR children[Title] OR infant[Title] OR adolescent[Title]) (nutrition[Title] OR nutrient[Title] OR nutritional[Title] OR nourishment[Title] OR diet[Title] OR food[Title] OR feeding[Title] OR alimentation[Title])

The literature search was limited to observational studies, intervention study published in English between January 2002 and June 2022. Review articles were excluded. Two anthropometric indicators were selected: stunting and wasting. Stunting is the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation. Children are defined as stunted if their height-for-age is less than -2 SD below the WHO Child Growth Standards median [14]. Wasting (weight-for-height) measures body mass to height and describes current nutritional status.

Eligibility and Data extraction

Title and abstract screening was used to eliminate duplicated from the 80 articles retrieved. Double screening was conducted using the inclusion and exclusion criteria as shown in table 1.

The following data were extracted from the selected papers: basic bibliographic information, population, study design, results and findings. It was decided that, the paper should be an original article, reports, short reports, research materials (data), thesis papers etc. After screening by title and abstract, the full text was obtained and read thoroughly. As a result, 7 papers were selected that describe dietary diversity and nutritional intake (micronutrient and macro-nutrient) of children, infant feeding, malnutrition (stunting, wasting), micronutrient deficiency and study that discussed environmental factors affecting nutrition, food diversity and infant feeding.

Table 1: Inclusion and exclusion criteria

Topic	Inclusion	Exclusion
Subjects	Child (age range 0-18 years)	
Research context	<ul style="list-style-type: none"> • Dietary diversity and nutritional intake (micronutrient and macro-nutrient) • Infant feeding • Malnutrition (stunting, wasting, underweight, obesity/overweight) • Micronutrient deficiency • Study that discussed environmental factors affecting nutrition, food diversity and infant feeding. • Study that deals with other medical conditions of children, mental health, psychological factors, biological factors 	Study only deals with maternal health and food intake
Research design	<ul style="list-style-type: none"> • Observational studies • Intervention study • Nutritional outcomes measured quantitatively, included anthropometry, CIAF (Composite Index of Anthropometric Failure) 	
Region	South Asia (Bangladesh, India, Nepal, Sri Lanka, Bhutan, Pakistan, Afghanistan, Maldives)	
Type of paper	Original articles, reports, short reports, research materials (data), thesis papers	Systematic and scoping Review articles, conference proceedings, overview, working paper

Results and Discussion

Summary of screening process

In the first step, 80 studies were retrieved from the Google Scholar and PubMed databases. After excluding 17 duplicates, 63 studies were retained for screening. A screening of the titles resulted in the exclusion of 44 studies not South Asian, review and overview article, conference paper, only citation, working and other paper, not available etc. The abstracts of the remaining 18 studies were reviewed and screened, which resulted in the exclusion of another 11 studies review and overview, summary and policy paper, not available, duplication. The full text of the remaining 7 studies were reviewed (Figure 1).

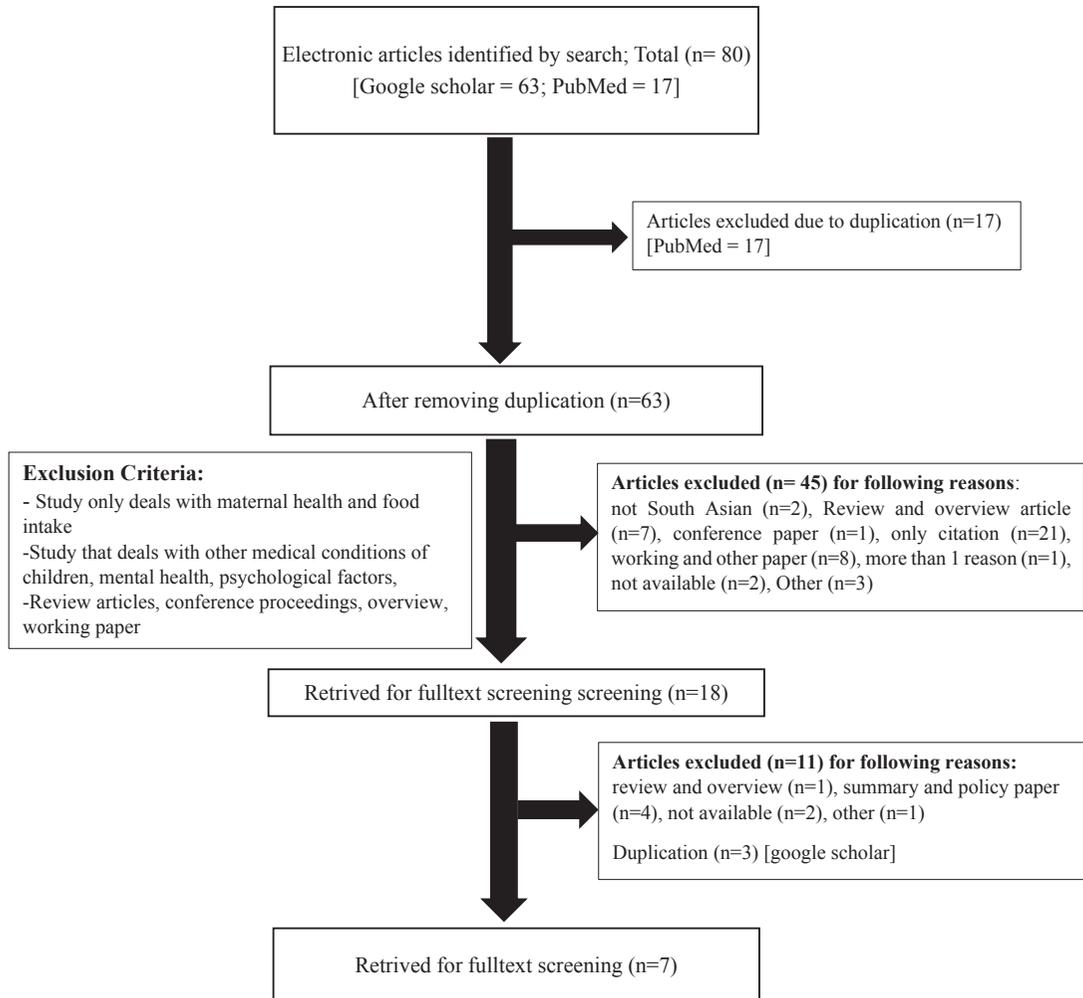


Figure 1: PRISMA diagram of the review process

Summary of the study included in the review

The characteristics of studies that met inclusion criteria for assessing South Asian children's feeding practices and nutritional status are shown in Table 2. Quantitative approach was used in all the studies. The 8 studies reviewed included 6 analytical epidemiology (1 was cohort study and 5 cross-sectional studies) and 1 intervention study (Randomized Controlled Trial). The majority of the studies used Demographic and Health Surveys (DHS) as their data source (5 studies). Other sources were Indian National Family Health Survey (2 studies), Afghanistan National Nutrition Survey (1 study), Regional food composition database (1 study), Malnutrition and Enteric Disease (MAL-ED) data (1 study), Primary data (1 study), Climate Research Unit's Time-Series (CRU-TS) (1 study), Climate Hazards Group Infrared Temperature & Precipitation with Stations (CHIRPS & CHIRTS) Datasets (1 study). It should be noted that three of the studies have multiple data sources. According to the subject matter of the studies, 3 of them dealt with IYCF practice, 2 of them dealt with the source and intake of nutrition, and 2 of them focused mainly on the external factors that influence malnutrition levels.

Table 2: Characteristics of studies for assessment of Feeding Practice and Nutritional Status of Children of South Asia (n = 7 studies)

	No. of studies
Methods in Epidemiological Studies	
Analytical epidemiology	
Cohort study	1
Cross-sectional study (analytical)	5
Intervention study	1
*Data source	
Demographic and Health Surveys	5
Indian National Family Health Survey	2
Afghanistan National Nutrition Survey	1
Regional food composition database	1
Malnutrition and Enteric Disease (MAL-ED) data	1
Primary data	1
Climate Research Unit's Time-Series (CRU-TS)	1
Climate Hazards Group Infrared Temperature & Precipitation with Stations (CHIRPS & CHIRTS) Datasets.	1
US Department of Agriculture (USDA)	1
Food Data Central (FDC)	1
South and Southeast Asian countries' food composition tables (FCTs)	1
Subject matter	
Infant and Young Child Feeding (IYCF) Practice	3
Nutrition intake	2
External factors that influence malnutrition levels	2

*Some studies may have multiple sources

The following table gives an overview of the studies included in this review (Table 3). The sample size of these studies ranged from 1463 to 222572 children and 6150 to 120830 mother-child dyads.

Table 3: List of literature included in the review

Author (Publication year)	Title	Country	Population studies	background settings	Method	Result	Main findings
Tariqujman et al., 2022-a	Association between Mother's Education and Infant and Young Child Feeding Practices in South Asia	Afghanistan, Bangladesh, India, Maldives, Nepal, and Pakistan	youngest children, aged 0–23 months, and their mothers, aged 15–49 years. (120,830 mother-child (youngest) dyads)	Cross-country, Demographic and Health Survey (DHS) [Afghanistan (2015), Bangladesh (2017–2018), India (2016), Maldives (2017), Nepal (2016), and Pakistan (2018)]	Multistage cluster sampling technique Survey contents: Infant and Young Child Feeding (IYCF), early initiation of breastfeeding (EIBF), exclusive breastfeeding under 6 months (EBF), Continuing breastfeeding at 1 year (CBF), the introduction of solid, semisolid or soft foods (ISSSF), minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD), and consumption of iron-rich or iron-fortified foods (CIRF)	Was found significantly higher odds (adjusted odds ratio, AOR, 1.13 to 1.47) among mothers who completed secondary or higher education than among mothers with education levels below secondary for the seven IYCF indicators. Country-specific analyses revealed significantly higher odds in EIBF (AOR 1.14; 95% CI: 1.11, 1.18) and EBF (AOR 1.27; 95% CI: 1.19, 1.34) among mothers with secondary or higher education levels in India. In contrast, the odds were lower for EIBF in Bangladesh and for EBF in Pakistan among mothers with secondary or higher education levels. For country-specific analyses for complementary feeding indicators such as ISSSF, MDD, MMF, MAD, and CIRF, significantly higher odds (AOR, 1.15 to 2.34) were also observed among mothers with secondary or higher education levels.	Overall findings indicated that mother's education has a significantly and consistently positive association with IYCF practices in South Asia. The findings of the pooled results indicated that mothers with secondary or higher education levels had significantly higher odds of practicing all of the WHO's IYCF core indicators except for continued breastfeeding at one year. In the country-specific analyses, it was also found a similar, significant positive association between mother's education and IYCF indicators, but a significant negative association between EIBF and mother's education in Bangladesh and between EBF and mother's education in Pakistan was found.
Tariqujman et al., 2022-b	Between and Within-Country Variations in Infant and Young Child Feeding Practices in South Asia	Afghanistan, Bangladesh, India, Maldives, Nepal, and Pakistan	Youngest children under two years of age and their mothers aged 15 to 49 years old. (120,830 mother-child dyads)	Nationally, Demographic and Health Survey (DHS) [Afghanistan (2015), Bangladesh (2017–2018), India (2015–2016), Maldives (2017–2018), Nepal (2016), and Pakistan (2017–2018)]	Stratified multistage cluster sampling Survey contents: Infant and Young Child Feeding (IYCF), early initiation of breastfeeding (EIBF), exclusive breastfeeding under 6 months (EBF), the introduction of solid, semisolid or soft foods (ISSSF), minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD), and consumption of iron-rich or iron-fortified foods (CIRF), continuing breastfeeding at 1 year (CBF)	Among all SACs, the early initiation of breastfeeding (EIBF) practice was 45.4% with the highest prevalence in the Maldives (68.2%) and the lowest prevalence in Pakistan (20.8%). Exclusive breastfeeding (EBF) practice was 53.9% with the highest prevalence in Nepal (67%) and the lowest prevalence in Afghanistan (42%). Only 13% of children had a minimum acceptable diet (MAD), with the highest prevalence in the Maldives (52%) and the lowest prevalence in India (11%). Higher IYCF practices among the mothers with secondary or higher levels of education (EIBF: 47.0% vs. 43.6%; EBF: 55.5% vs. 52.0%; MAD: 15.3% vs. 10.0%), urban mothers (MAD: 15.6% vs. 11.8%), and mothers from the richest households (MAD: 17.6% vs. 8.6%) was found compared to the mothers with no formal education or below secondary level education, rural mothers and mothers from the poorest households, respectively. Mothers from the poorest households had better EIBF, EBF, and continued breastfeeding at 1-year (CBF) practices compared to the mothers from the richest households (EIBF: 44.2% vs. 40.7%; EBF: 54.8% vs. 53.0%; CBF: 86.3% vs. 77.8%). Poor IYCF practices were most prevalent in Afghanistan, Pakistan, and India.	This study concludes that the prevalence of IYCF practices varied substantially between and within countries, with IYCF practices were suboptimal in Afghanistan, Pakistan, and India. The complimentary feeding-related indicators were suboptimal among the poorest, rural, and mothers with no formal or below secondary level education. Large gaps in IYCF practices were observed in the poorest vs. richest, urban vs. rural, and less than secondary vs. secondary or higher maternal education groups. There are several reasons for the variations in complementary feeding (ISSSF, MDD, MMF, MAD, and CIRF) practices in SACs. Higher breastfeeding practices among rural mothers (EBF, CBF), mothers from the poorest households, and mothers with secondary or higher education (EIBF, EBF) was found.
Harding K.L. et al., 2018	Birthweight and feeding practices are associated with child growth outcomes in South Asia	Bangladesh, India, Nepal, Pakistan, Maldives, Afghanistan	aged 0 to 59 months (62,509 children)	National level, 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 data.	multistage cluster sampling Survey contents: Low Birth Weight (LBW), Infant and Young Child Feeding (IYCF), Minimum dietary diversity (MDD), Minimum acceptable diet (MAD), Pre-term delivery of low-birth weight (pLBW)	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 postpartum, 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 prevalence of undernutrition varied by child's age also. 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.	This analysis demonstrates that key determinants of child stunting are also significant determinants of child wasting in South Asia. LBW and pLBW were both highly prevalent and both were strong predictors of wasting and severe wasting. 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 than in rural households. In general, poor IYCF practices within the first 6 months, such as 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.
Maciel B.L.L. et al., 2021	Higher Energy and Zinc Intakes from Complementary Feeding Are Associated with Decreased Risk of Undernutrition in Children from South America, Africa, and Asia	Brazil, Peru, South Africa, Tanzania, Bangladesh, India, and Nepal	9–24 months of age infants (1463 children and 22,282 food recalls)	MAL-ED data from enrollment to 24 months were used. Data were collected from 2010 to 2014.	24h food recall Survey contents: Haydom, Tanzania (TZH); Dhaka, Bangladesh (BGD); Vellore, India (INV); Bhaktapur, Nepal (NEB); Fortaleza; Brazil (BRF); Loreto, Iquitos, Peru (PEL); Venda, South Africa (SAV). Enteropathogen burdens were used in the present analysis as adjustment variables	Children with malnutrition presented significantly lower intakes of energy and zinc at 12, 18, and 24 months of age, ranging from -16.4% to -25.9% for energy and -2.3% to -48.8% for zinc. Higher energy intakes decreased the risk of underweight at 12 [adjusted odds ratio (AOR): 0.90; 95% CI: 0.84, 0.96] and 24 months (AOR: 0.91; 95% CI: 0.86, 0.96), and wasting at 18 (AOR: 0.91; 95% CI: 0.83, 0.99) and 24 months (AOR: 0.83; 95% CI: 0.74, 0.92). Higher zinc intakes decreased the risk of underweight (AOR: 0.12; 95% CI: 0.03, 0.55) and wasting (AOR: 0.19; 95% CI: 0.04, 0.92) at 12 months, and wasting (AOR: 0.05; 95% CI: 0.00, 0.76) at 24 mo.	The study was able to associate energy and nutrient intakes from complementary feeding to nutritional outcomes. Findings show that in the sites where undernutrition was more prevalent—in the Eastern African site (TZH) and South Asian sites (BGD, INV, and NEB)—zinc intakes from complementary feeding were lower and in the South Asian sites (BGV, INV, and NEB) these intakes tended to not increase over time. Also, in the South Asian sites, where energy intakes from complementary feeding were lower from 9 to 24 months of age than at the other studied sites, undernutrition was more prevalent. In summary, higher intakes of energy and zinc in complementary feeding were associated with decreased risk of undernutrition in the studied children.

Senarath U. and Dibley M. J., 2012	Complementary feeding practices in South Asia: analyses of recent national survey data by the South Asia Infant Feeding Research Network	Bangladesh, India, Nepal, Pakistan and Sri Lanka	youngest child aged 6-23 months in the household, living with the respondent (ever married women of 15-49 years)	Demographic and Health Surveys for Bangladesh, Nepal, Pakistan and Sri Lanka, and the National Family Health Survey of India	Stratified multi-stage cluster design Survey contents: the introduction of complementary foods, minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD).	In Bangladesh, introduction of complementary food at 6-8 months of age was 71%, and for minimum meal frequency 82%, the rates of minimum dietary diversity 42% and minimum acceptable diet for the breastfed 40% in infants 6-23 months. In India 55% of the children aged between 6-8 months were introduced to solid foods. The rate of minimum meal frequency was 42%, minimum dietary diversity was 15% and minimum acceptable diet for the breastfed were 9% in children 6-23 months. In Nepal, introduction of complementary food during 6-8 months was 70% and meal frequency 82%, the rates of minimum dietary diversity was 42% and minimum acceptable diet for the breastfed was 40% in infants 6-23 months. In Pakistan, the rate of introduction of complementary food among 6-8-month-old infants was 39%. Among infants aged 3-5 months, 11% already received solids, semisolid or soft foods. In Sri Lanka, the introduction of complementary food at 6-8 months of age was 84%, the rate of minimum dietary diversity 71%, and the minimum meal frequency 88% and minimal acceptable diet for the breastfed 68%. Other determinants of not receiving a diverse or acceptable diet were lower maternal education, lower wealth index, lack of post-natal visits, unsatisfactory exposure to media and acute respiratory infections.	The result showed that the most consistent determinants of inappropriate complementary feeding practices across all countries were the lack of maternal education and lower household wealth. In Bangladesh, the analysis showed several factors that were consistently associated with poor complementary feeding indicators, including low household wealth, low levels of parental education especially fathers' education and selected geographic areas in the country. The factors significantly associated with inappropriate feeding indicators in India were poverty, low level of maternal education, lower frequency of antenatal visits and no exposure to media. Consistent with Bangladesh and India, the children from the poor households and illiterate mothers were found to have poor complementary feeding practices in Nepal. In Pakistan too early introduction of complementary feeding was found in this population. In Sri Lanka, where the indicators of complementary feeding practices were higher than in all other South Asian countries, children who lived in tea estate sector had a lower dietary diversity and minimum acceptable diet than children in urban and rural areas.
Saville M.N. et al., 2018	Impact on birth weight and child growth of Participatory Learning and Action women's groups with and without transfers of food or cash during pregnancy: Findings of the low birth weight South Asia cluster-randomized controlled trial (LBWSAT) in Nepal	Nepal	married women aged 10-49 years (average population/cluster= 6150)	plains districts of Dhanusha and Mahottari	Non-blinded cluster-randomized controlled trial. Survey contents: PLA (Participatory Learning and Action), PLA alone, PLA plus a food supplement, PLA plus a cash transfer, weight-for-age z-scores, Length-for-age z-score	In PLA plus food/cash arms, 94-97% of pregnant women attended groups and received a mean of four transfers over their pregnancies. In the PLA only arm, 49% of pregnant women attended groups. Due to unrest, the response rate for birthweight was low at 22% (n = 2087), but response rate for midline nutritional and dietary measures exceeded 83% (n = 9242). Compared to the control arm (n = 464), mean birthweight was significantly higher in the PLA plus food arm by 78.0 g (95% CI 13.9, 142.0; n = 626) and not significantly higher in PLA only and PLA plus cash arms by 28.9 g (95% CI -37.7, 95.4; n = 488) and 50.5 g (95% CI -15.0, 116.1; n = 509) respectively. Mean weight-for-age z-scores of children aged 0-16 months (average age 9 months) sampled cross-sectionally at endpoint, were not significantly different from those in the control arm (n = 2091). Differences in weight for-age z-score were as follows: PLA only -0.026 (95% CI -0.117, 0.065; n = 2095); PLA plus cash -0.045 (95% CI -0.133, 0.044; n = 2545); PLA plus food -0.033 (95% CI -0.121, 0.056; n = 2507). Amongst many secondary outcomes tested, compared with control, more institutional deliveries (OR: 1.46 95% CI 1.03, 2.06; n = 2651) and less colostrum discarding (OR:0.71 95% CI 0.54, 0.93; n = 2548) were found in the PLA plus food arm but not in PLA alone or in PLA plus cash arms.	Trial of the effects of PLA women's groups, with and without transfers of cash or food to pregnant women, suggests an increase in birthweight in the PLA plus food arm. However, better nutritional status soon after birth did not persist into early childhood, reflected by only small differences between arms in child anthropometry at 0-16 months. In the PLA plus food arm the prevalence of colostrum discarding was lower and the number of institutional deliveries was higher. It was concluded that adding a fortified balanced energy protein supplement to a Participatory Learning and Action behaviour change intervention is likely to increase birthweight. However, in environments with very poor sanitation and hygiene, where infant and young child feeding behaviors are inadequate, gains in weight resulting from pregnancy interventions are not sustained. In summary, food supplements in pregnancy with PLA women's groups increased birthweight more than PLA plus cash or PLA alone but differences were not sustained.
McMahon K., 2021	Climate change, social vulnerability and child nutrition in South Asia	Bangladesh, India, Nepal, and Pakistan	children ages 24-59 months (222,572 children)	Nationally, Demographic and Health Survey Program (DHS) data, temperature and precipitation data from the Climate - anomalies Research Unit's Time-Series (CRU-TS) and the Climate Hazards Group Infrared Temperature & Precipitation with Stations (CHIRPS & CHIRTS) Datasets.	Stratified, multi-stage sampling Survey contents: low height-for-age z-score (HAZ), Stunted, Mother's age at child's birth, Mother's education level, Improved toilet, rural, Climate - anomalies (Prenatal precipitation and temperature, 1st year precipitation and temperature, 2nd year precipitation and temperature, Prenatal precipitation and temperature anomaly, 1st year precipitation and temperature anomaly, 2nd year precipitation and temperature anomaly), Climate - extreme days (dry, hot and cold days, 1st year wet, dry, hot and cold days, 2nd year wet, dry, hot and cold days)	The extreme days' specification reveals that child heights are more reactive to precipitation shocks than to temperature extremes. Joint significance tests reveal that each of the four key socio-demographic variables (household toilet quality, mother's education level, country of residence, and caste/tribe among Indian children) significantly modifies the impacts of climate on child nutrition. The magnitude of the temperature effect increases with the age of exposure. Precipitation anomalies during the first and second years of life increase stunting among children with unimproved toilets by 4.2% (p=0.000) and 4% (p=0.018). Stronger significance in the relationship between prenatal precipitation anomalies and reduced stunting (p=0.008). It was revealed that climate's effects on child stunting are most pronounced in India and Pakistan. Exposure to heat in any developmental period has a much stronger detrimental health effect in Pakistan than those living in any other country. First and second year heat exposure actually reduces the odds of stunting for children in India and Nepal, respectively. Finally, the interaction between climate anomalies and caste/tribe in India reveals that children of mothers belonging to scheduled castes and scheduled tribes tend to be more vulnerable to the detrimental effects of extreme precipitation during the first and second years of life, while those whose mothers do not belong to these groups tend to benefit more from anomalous heat.	It was found that the temperature and precipitation extremes in the first year of life significantly increase the likelihood of stunting for the majority of South Asian children. The detrimental effects of extreme precipitation are especially concentrated in under-resourced households, while anomalous heat is particularly harmful for children in Pakistan. These results indicate that nutritional status in South Asia is highly responsive to climate exposures. It was also found that the impacts of first year precipitation shocks are most pronounced in children who live in India and have low socioeconomic status (whose mothers have no education, or who do not have access to an adequate toilet). Temperature anomalies appear to have a weaker effect than precipitation in the sample, but evidence was found that both temperature extremes in the first year of life threaten to undermine child nutritional health. Temperature's impacts on nutrition also vary significantly by country. Multiple social factors (toilet access, maternal education status, country, and caste/tribe) significantly modify climate's effects on stunting.

Malnutrition scenario of South Asia

Study selection indicated that malnutrition is a serious problem in almost every country of South Asia. There were a number of factors that affected the malnutrition situation in a significant way and several direct, indirect, and modifier factors were found. Infant and children aged 0-5 years of age are affected by the disease most. According to the selected studies, the following direct factors impact malnutrition in South Asia: Poor infant and young child feeding (IYCF) practices, LBW (Low Birth Weight) and pLBW (Pre-term Low Birth Weight), Climate change, Child's age, Mother's age at childbirth.

Low birth weight (LBW) is directly related to malnutrition, as was mentioned earlier. A study analysis of Harding et.al. (2018) demonstrated that LBW and pLBW were both highly prevalent and both were strong predictors of wasting and severe wasting. The study also found that, children with reported LBW

had significantly higher odds of being wasted or severely wasted, compared with non-LBW children. However, the likelihood of malnutrition, varies according to parental education, financial condition, and place of residence. In other words, 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. Also, the odds of being both wasted and stunted given pLBW was greater among children in urban than in rural households [15]. This implies that parental education levels, financial backgrounds, as well as the location of their residence can be included as modifier factors of malnutrition.

Moreover, Harding et. al. (2018) observed in his study that the age of the children affected the prevalence of undernutrition as well. It was also noted that children less than 6 months of age were most likely to experience wasting and severe wasting, which decreased with age in the South Asian population [15]. By contrast, the prevalence of stunting and the co-occurrence of wasting and stunting increased with age [15].

McMahon's (2021) study results also indicated that climate change affects malnutrition. In other words, nutritional status in South Asia is highly responsive to climate exposures. Additionally, that study found that for most South Asian children, extreme temperature and precipitation in the first year of life significantly increase the likelihood of stunting and the magnitude of the temperature effect increases with the age of exposure. Socio-demographic factors also play an important role in modifying climate change's effect on child nutrition, for instance, in India, the interaction between climate inconsistencies and caste/tribe. The study found that children from scheduled castes and scheduled tribes are more susceptible to the negative effects of rainfall patterns in the first and second years of their lives, whereas those whose mothers do not belong to these groups are more likely to benefit from anomalous heat patterns. Additionally, extreme precipitation has a negative impact particularly on households with low resources, such as those without women's education. Also, climate has a different effect on child stunting depending on the country. The effect was most pronounced in India and Pakistan. In Pakistan, exposure to heat at any developmental stage is much more detrimental to health than in any other country. First and second year heat exposure actually reduces the odds of stunting for children in India and Nepal [16].

McMahon (2021) [16] also identified mother's age at childbirth as another factor. With each additional year of a mother's age at childbirth, her child is 8.9% less likely to be stunted when they are 2-5 years old ($p=0.000$). This factor impact significantly as early child birth is common in Bangladesh, Nepal, India and Pakistan with large subnational variation in most countries [17]. Because, South Asia has the highest rates of child marriage in the world and almost half (45%) of all women aged 20-24 years reported being married before the age of 18 [18]. So, it can be argued that early childbirth is associated with low birth weight (LBW) or premature LBW children, which is a direct factor contributing to the malnutrition of children.

One of the papers selected was an intervention study of Saville et.al. (2018) and in that study it was observed that food supplements in pregnancy with PLA (Participatory Learning and Action) women's groups increased birthweight more than PLA plus cash or PLA alone but differences were not sustained. It was concluded that adding a fortified balanced energy protein supplement to a Participatory Learning and Action behaviour change intervention is likely to increase birthweight. However, in environments with very poor sanitation and hygiene, where infant and young child feeding behaviors are inadequate, gains in weight resulting from pregnancy interventions are not sustained [19].

From the discussion, I might be able to propose the following causal model: climate, mother's age at childbirth, parent's educational status, breastfeeding status, nutritional intake during infancy, regional characteristics, economic power, etc. For example, it can be considered that, "Low wealth status \Rightarrow Poor sanitation (indirect cause) \Rightarrow LBW children (direct cause) \Rightarrow malnutrition (outcome)". Taking a more comprehensive view it can be expressed as: "poor socio-economic condition (indirect effect) \Rightarrow unable to provide sufficient nutritional intake (direct effect) \Rightarrow malnutrition of children (outcome)" (Figure 2).

So, the results of these studies were summarized in a causal model 1 (Figure 2).

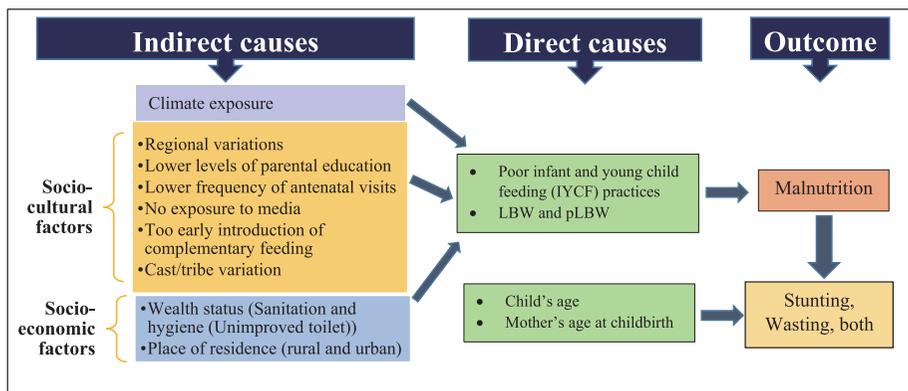


Figure 2: Simplified causality model based on the factors associated with each literature

Feeding practice of children of South Asia

Poor infant and young child feeding (IYCF) practice is one of the factors that impact malnutrition directly. According to WHO, IYCF has 8 core indicators, which are: early initiation of breastfeeding (EIBF), exclusive breastfeeding under 6 months (EBF), continuing breastfeeding at 1 year (CBF), the introduction of solid, semi-solid or soft foods (ISSSF), minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD), and consumption of iron-rich or iron-fortified foods (CIRF) [20].

Senarath and Dibley (2012) studied variations in complimentary feeding practices in South Asian countries and observed that, in Bangladesh, where in spite of reasonable rates for introduction of complementary food at 6–8 months of age (71%) and for minimum meal frequency (82%), the rates of minimum dietary diversity (42%) and minimum acceptable diet for the breastfed (40%) remained comparatively low in infants 6–23 months. In Nepal, where there were reasonable rates of introduction of complementary food during 6–8 months (70%) and meal frequency (82%), but the rates of minimum dietary diversity (42%) and minimum acceptable diet for the breastfed (40%) were low in infants 6–23 months. In India only half (55%) of the children aged between 6 and 8 months were introduced to solid foods. The rate of minimum meal frequency was 42%, but both minimum dietary diversity (15%) and minimum acceptable diet for the breastfed (9%) were alarmingly low in children 6–23 months [21].

Also, indicators of poor complementary feeding especially, not initiating breastfeeding within the first hour post-partum, provision of prelacteal feeds and not EBF (exclusive breastfeeding under 6 months) in the first 6 months were significantly associated with wasting in South Asia, whereas not meeting the MDD or MAD criteria were associated with being wasted and both wasted and stunted in India [15]. The study was also able to associate energy and nutrient intakes from complementary feeding to nutritional outcomes [22].

Nutritional status of children of South Asia

A review of three studies indicates that complementary feeding may affect energy and nutritional outcomes. According to Ortenzi and Beal (2021), introducing small quantities of priority micronutrient dense animal and plant source foods would contribute significantly to achieving micronutrient adequacy in complementary feeding diets in South Asia. The study also emphasized that top sources of priority micronutrients should be consumed together with a variety of other nutrient-dense foods, as part of a diverse and balanced diet. Foods presenting very high aggregate priority micronutrient density (top

sources) are the following: organs, including liver, spleen, kidney and heart from beef, goat/lamb, chicken, and pork; bivalves (clams, mussels, and oysters); crustaceans; fresh fish; goat and eggs [23]. But According to a study of Senarath and Dibley (2012), in Bangladesh, India and Nepal, the rates of minimum dietary diversity (MDD) and minimum acceptable diet (MAD) for the breastfed remained comparatively low in infants 6–23 months [21]. Consequently, it can be said that, South Asia is experiencing a nutritional deficiency in terms of nutrition intake. In another study Maciel et. al. (2021) also found that zinc intakes from complementary feeding were lower and did not increase over time in the South Asian sites where undernutrition was more prevalent (Bangladesh, India, Nepal) [22].

Additionally, undernutrition was also more prevalent in the South Asian sites where complementary feeding intakes were lower from 9 to 24 months of age. Children with malnutrition presented significantly lower intakes of energy and zinc at 12, 18, and 24 months of age (rang from -16.4% to -25.9% for energy and -2.3% to -48.8% for zinc). The study concluded that children with higher energy and zinc intake in complementary feeding were at a lower risk of undernutrition [22].

Different identified factors of food and nutritional intake of children of South Asia

From the studies, several factors were found which affected the food and nutritional intake of children significantly. Direct factors that affect IYCF practices were found in 3 studies among the selected 8 studies. South Asian children's interaction with the IYCF practice is greatly influenced by a variety of factors including parental education level, wealth status, place of residence, too early introduction of complementary feeding (ISSSF, MDD, MMF, MAD, EIBF, EBF, CBF and CRIF), low frequency of prenatal visits, lack of media exposure, country and regional differences.

Following figure shows a more detailed hypothetical causality model, which was proposed based on the factors associated with each literature showing the relationship among different factors including modifier factors (Figure 3).

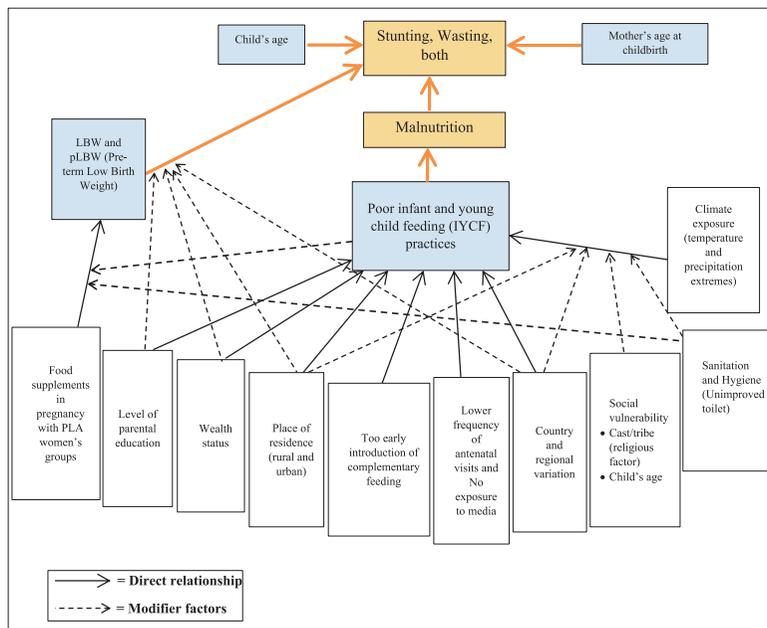


Figure 3: Conceptual framework of factors influencing childhood malnutrition, stunting, and wasting disease: hypothetical model

Parental education was one of the significant direct factors of IYCF practice of South Asian children. A total of 4 studies identified the importance of parental education. In one study, Tariqujjaman et. al. (2022-a) assessed the relationship between mother's education and infant and young child feeding practices in South Asia. The findings indicated that mother's education has a significantly and consistently positive association with IYCF practices in South Asia. The findings of the study also indicated that mothers with secondary or higher education levels had significantly higher odds (adjusted odds ratio, AOR, 1.13 to 1.47) of practicing all of the WHO's IYCF core indicators except for continued breastfeeding at one year than mothers with education levels below secondary [24]. Another study showed that, in Bangladesh, consistently associated with poor complementary feeding indicators was low levels of parental education especially fathers' education and in India and Nepal, it was low level of maternal education [21].

Another significant factor that impact feeding practice of child was wealth status which was also identified by 4 studies. One of the study of Tariqujjaman et.al. (2022-b) assessed the Between and Within-Country Variations in Infant and Young Child Feeding Practices in South Asia and showed that, large gaps in IYCF practices were observed in the poorest vs. richest. The complimentary feeding-related indicators were suboptimal among the poorest. But, higher breastfeeding practices were seen among mothers from the poorest households [25]. Another study showed, in Bangladesh and India, low household wealth was a significant factor that was consistently associated with poor complementary feeding indicators. Consistent with Bangladesh and India, the children from the poor households were found to have poor complementary feeding practices in Nepal also [21].

The place of residence was another important factor. According to Tariqujjaman et.al. (2022-b) [25]. The complimentary feeding-related indicators were suboptimal among the rural. Large gaps in IYCF practices were observed in the urban vs. rural. Higher breastfeeding practices were seen among rural mothers (EBF, CBF). Indicators of complementary feeding practices were higher in Sri Lanka than in all other South Asian countries, where children who lived in tea estate sector had a lower MDD and MAD than children in urban and rural areas [21].

According to McMahon (2021), nutritional status in South Asia is highly responsive to climate exposures. Extreme weather can damage crop yields, increase heat stress and infectious disease, and destabilize the economy, all of which puts children's nutritional health at risk. A causal model could be presented in which extremes in temperature and precipitation promote lower crop yields and affect poor IYCF and child malnutrition [16].

From the mentioned result it can be seen that, country and regional variation is present among the factors. Country and regional variation affect IYCF directly. These variations were found in 3 studies. There was significant change in result of different countries and different areas. Tariqujjaman et.al. (2022-b) assessed the Between and Within-Country Variations in Infant and Young Child Feeding Practices in South Asia, one of the study concludes that the prevalence of IYCF practices varied substantially between and within countries, with IYCF practices were suboptimal in Afghanistan, Pakistan, and India. Among all SACs, the early initiation of breastfeeding (EIBF) practice was 45.4% with the highest prevalence in the Maldives (68.2%) and the lowest prevalence in Pakistan (20.8%). Exclusive breastfeeding (EBF) practice was 53.9% with the highest prevalence in Nepal (67%) and the lowest prevalence in Afghanistan (42%). Only 13% of children had a minimum acceptable diet (MAD), with the highest prevalence in the Maldives (52%) and the lowest prevalence in India (11%) [25]. In Bangladesh, the analysis showed that the factor that was consistently associated with poor complementary feeding indicators was selected geographic areas in the country [21].

Among other factors of IYCF, there were factors which was identifies by 1 study such as, lower frequency of antenatal visits and no exposure to media in India [21]. Which we can explain as: "Unsatisfactory exposure to media and clinics \Rightarrow lack of information on nutritional intake \Rightarrow malnutrition

of children". The study also found that in Pakistan too early introduction of complementary feeding was prevailing [21].

Conclusion

The aim of this systematic review was to assess the nutritional status and feeding practices of children in South Asia and identifying different factors that has impact on food and nutritional intake. From the discussion of papers, it can be said that, South Asia is experiencing a nutritional deficiency in terms of nutrition intake and country variation was also present. The reviewed studies also suggest that introducing small amounts of priority micronutrient dense animal and plant sources would contribute significantly to the achievement of micronutrient adequacy in complementary feeding diets in South Asia. On the basis of observation, this paper concluded that, malnutrition is acute in South Asian countries (SACs) especially stunting and wasting. Although, the countries are showing improvement in tackling malnutrition problem, prevalence of malnutrition is still concerning. Age of the child, poor infant and young child feeding (IYCF) practices, LBW and pLBW, mother's age at childbirth are the most significant determinants of child malnutrition. From the review of various studies, it was found that direct factors that affect IYCF practices includes parental education level, wealth status, place of residence, too early introduction of complementary feeding (ISSSF, MDD, MMF, MAD, EIBF, EBF, CBF and CRIF), low frequency of prenatal visits, lack of media exposure, country and regional differences.

It can be suggested that, for improved nutritional and dietary knowledge, parents must be educated and well informed at all levels, because parental education and exposure to media has an important influence on child nutrition. Lack of exposure to media leads to lack of information regarding healthy habit and complementary feeding practice which eventually leads to malnutrition of children. Also, poor socio-economic condition may unable parents to provide sufficient nutritional intake which leads to poor IYCF practice. Government messages about nutrition and health in pregnancy, importance of antenatal visit as well as ensuring optimal IYCF practices by educating mother's should be integrated into national action plans. A surveillance system should be placed to continuously monitor the progress and gaps in IYCF practices between and within countries [25].

In recent years, health literacy, which is used in the fields of health, medicine, and education to enable people to make healthy lifestyle choices, has been attracting attention. Health literacy represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health [26]. The effectiveness of implementing food literacy (wide range of skills needed for healthy and responsible nutrition behavior [27] education, which is health literacy related to nutrition intake, has been suggested [28].

It can also be suggested that, health literacy education for young people especially women who bear and raise children should be positioned as a priority issue in each South Asian Countries (SACs) that should be supported through national level policy, education at schools and other institutions, as it is considered a factor that influences the growth and development of children who will be born in the future. It is also important to educate everyone about the risk of early childbirth, as the mother's age at childbirth plays a significant role in malnutrition. Another important issue is to improve support for the media environment in order to obtain information beneficial to health. Improving sanitation, including infrastructure development to minimize the effects of climate change, is a common challenge for South Asian countries.

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