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Review article

Determinants of malnutrition among children: A systematic review

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ABSTRACT

Objectives: Child undernutrition is a major public health problem. Globally in 2020, 149 million children <5 y of age were estimated to be stunted (*too short for age*), 45 million to be wasted (*too thin for height*), and 38.9 million were overweight. The aim of this review was to examine previous studies to determine the factors associated with malnutrition and contribute to the existing body of evidence needed for the formulation of effective interventions.

Methods: This systematic review was conducted using the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines. The Google Scholar database was used to search the studies conducted between 2012 and 2021. The included studies were searched by using some combinations of keywords and saved in Mendeley Desktop for review and referencing.

Results: Of 2150 articles retrieved from the Google Scholar databases, 37 met our inclusion criteria. Of the 37 studies reviewed; 13 were conducted in India, 5 in Ethiopia, 3 in Bangladesh, 2 in Ghana, 2 in Nepal, 2 in developing countries, and 1 each in Bolira, Benin, Netherland, Columbia, Pakistan, Malaysia, Africa, Egypt, Ecuadorian, and Indonesia.

Conclusion: The most consistent factors associated with child malnutrition were maternal education, household income, maternal nutritional status, age of the child, availability of sanitation facility at home, size of family, birth order in the family, and child's birth weight. Breastfeeding and caring practices, cooking area and the fuel used, sex, and socioeconomic status of the children also contribute toward child malnutrition.

Introduction

Malnutrition, especially undernutrition, among under-5 children is very high and a major health problem affecting the development of the children in many countries worldwide [1–3]. As per reports from the World Health Organization (WHO), in 2020 globally, 149 million children <5 y of age were estimated to be stunted (*too short for age*), 45 million were estimated to be wasted (*too thin for height*), and 38.9 million were overweight. The report further revealed that around 45% of deaths among children <5 y of age are linked to undernutrition, which occur in low- and middle-income countries [4]. Undernutrition continues to be the principal cause of ill health and premature mortality and morbidity among children in developing countries [5]. Estimates made by United Nations Children's Fund (UNICEF), WHO, and the World Bank indicate that in 1990, the prevalence of stunting and underweight were 39.6% and 25%, respectively, which dropped to 32.7% and 20.1% in 2000. In 2015, it was estimated that 23.2% of children <5 y were stunted, 7.4% wasted, and 13.9% underweight, thus posing a serious threat to human development [6].

Malnutrition among children is also a major public health problem in India [7]. Analysis from the third and fourth rounds of the National Family Health Survey data (NFHS-3, NFHS-4) show that the prevalence of underweight (*low weight for age*) among children <5 y decreased from 42.5% in NFHS-3 (2009–2010) to 35.1% in NFHS-4 (2015–2016). Stunting (*low height for age*) also registered a decline from 48% in NFHS-3 to 38.4% in NFHS-4. Wasting (*low weight for height*) increased from 19.8% to 21% for the same period [8] .

There are various factors that directly or indirectly affect the nutritional status of children. Birth size [9], maternal education [1,10], maternal nutrition [11–14], maternal low body mass index (BMI) (<18.5 kg/m^2), maternal anemia (hemoglobin <12 g/dL) [15] child's birth order and birth weight [10,16], maternal age, residence [17], antenatal care (ANC), child's sex and size at birth, toilet facility [1,18], stool disposal system [14], short period of breastfeeding [41] and household income level [19] are the main determinants of anthropometric failures (stunting, wasting, and

Abbreviations: ANC, Antenatal Care; BMI, Body Mass Index; Hb, Hemoglobin; MUAC, Mid Upper Arm Circumference; NFHS, National Family Health Survey; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; UNICEF, United Nations Children's Fund; WHO, World Health Organisation

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underweight) among the children. Despite considerable progress, there remain challenges in addressing the problem of undernourishment [20] particularly among school-age children [21]. The nutritional status of school-age children is of paramount importance because it lays the foundation for their lifetime health, strength, and intellectual capabilities. This is a dynamic period for determining their lifetime physical, mental, and financial health [22] and any future serious health problems [23]. These determinants may act singly or in combination. For example, if the child's household is poor, the family is likely food insecure, resulting in detrimental effects on the child's nutrition [24].

Bello and Ijaiya found that shortage of food intake due to a decrease in production and poor distribution channels, poverty, illness, and ignorance were the main causes of malnutrition in developing countries. The study further revealed that the consequences of malnutrition in school-age children include mental damage, which impairs their capacity and performance in school, poor growth with long-term effects of reduced production after school, reduction in individual income, and the country's gross domestic product [25]. According to a study conducted by UNICEF, it is estimated that 22% of income is lost per annum by an adult affected by malnutrition [26].

Therefore, it has been noted that the causes of undernutrition are multifaceted, including economic, social, and political factors. For example, according to NFHS-3 (2009-10), girls and boys were about equally undernourished. Undernutrition was generally lower for first births than for subsequent births and consistently rose with increasing birth order for all measures of nutrition. It was further found that undernutrition had a strong negative relationship with maternal education. Children belonging to Scheduled Castes, Scheduled Tribes, and Other Backward Classes had relatively high levels of undernutrition according to all three measures stunting, wasting, and underweight). The data further revealed that children who do not live with either parent have slightly better nutritional status than those who live with both or only one parent.

Material and methods

Malnutrition/Undernutrition

For the present systematic review, four anthropometric indicators were selected: stunting, wasting, underweight, and overweight. 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. Wasting (weight-for-height) measures body mass to height and describes current nutritional status. Underweight (weight-for-age) reflects body weight relative to the child's age on a given day. This indicator is used to assess whether a child is underweight or severely underweight. This systematic review focuses on children with a Z-score below −2 SD and above +2 SD from the median of the WHO reference population.

Search strategy

This systematic review study was conducted using the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [27]. A list of combinations of keywords was prepared for searching the studies on the Google Scholar database. The keywords included for search are as follows:

- Determinants - OR - factors associated with malnutrition,
- Determinants - OR - factors associated with undernutrition,
- Determinants - OR - factors associated with stunting,
- Determinants - OR - factors associated with wasting,
- Determinants - OR - factors associated with underweight and overweight.

The search covered research conducted between 2012 and 2021 and available on the Google Scholar database.

Inclusion criteria

Studies were included in the systematic review if they were conducted with children <14 y; focused on factors associated with child malnutrition/undernutrition (i.e., stunting, wasting, underweight, and overweight); were published in a peer-reviewed journal between 2012 and 2021; and were written in English only.

Exclusion criteria

All case studies, books, policy briefs, thesis/dissertations and non−peer-reviewed articles were excluded for the current systematic review.

Data extraction

Only the studies identified by the search on Google Scholar were added into the Mendeley Desktop library and duplicates were removed before screening in the first phase. In the second phase, all the studies were screened by reading the titles and those studies not reporting malnutrition/undernutrition were excluded. In the third phase, records were excluded after reading the abstract and finding that the study did not report the determinants of malnutrition or undernutrition. The fourth phase consisted of full-length text review and inclusion of peer-reviewed articles published in the journals only and exclusion of non−peer-reviewed articles, reports, case studies, theses/dissertations, books and policy briefs, etc. for the systematic review. In the fifth phase, summaries of the selected studies were recorded. These included author [Ref.] & year, country/location, sample size (n), type and age of the sample, and factors associated with malnutrition.

Results and discussion

We retrieved 2150 studies from the Google Scholar database. After excluding 755 duplicates, 1395 studies were retained for screening. A screening of the titles resulted in the exclusion of 1205 studies not reporting malnutrition, undernutrition, stunting, wasting, undernutrition, and overnutrition. The abstracts of the remaining 190 studies were reviewed and screened, which resulted in the exclusion of another 110 studies not reporting the determinants or factors associated with malnutrition/undernutrition. The full text of the remaining 80 studies were reviewed and 43 studies that include reports, case studies, books, policy briefs, theses/dissertations, and non−peer-reviewed articles were further excluded. Thirty-seven articles, which published in peer-reviewed journals, met the inclusion criteria for the systematic review Figure 1.

Summary of studies reviewed

Table 1 Shows a country-wide summary of the studies included in this review on determinants of malnutrition among children [10−12,14−19,21,28−40,42−53]. Of the 37 studies reviewed, 13 were in India, 5 in Ethiopia, 3 in Bangladesh, 2 in Ghana, 2 in developing countries, 2 in Nepal, and 1 each in Bolira, Benin, Netherland, Columbia, Pakistan, Malaysia, Africa, Egypt, Ecuadorian, and Indonesia. The sample size of these studies ranged from 100 to 798961 children Table 1.

The summary of the studies reviewed to ascertain the determinants of child malnutrition are presented in Figure 2.

Maternal education is an important factor when providing adequate care to children. About 51.4% of the studies (highest in this review) reported maternal education as the most significant factor associated with child malnutrition Figure 2. A study conducted in Mozambique [54] found that attending some years of primary school is fundamental for mothers aiming to improve their children's long- and short-term anthropometric status. The study further found that on average, 1 y of a mother's formal education increases their children's height-for-age and weight-for-age Z-scores by nearly 0.025 and 0.015, respectively. Thus, a mother's education affects her child's nutritional status because educated mothers are more likely to know about child nutrition and

Table 1
Summary of selected studies reviewed

Sr. No	Author (y) [Ref]	Country/Location	Sample size (n)	Type and age of sample	Factors associated with malnutrition
1	Katoch & Sharma (2016) [19]	India/J&K	100	School-age children (5–14 y)	Mother's education, birth order in family, family system, social and economic categories, nature of sanitation, cooking area and type of fuel used
2	Stiller et al. (2020) [15]	India/West Bengal	307	Tribal mothers and their children of (6–39 mo) (survey data)	Low maternal BMI (<18.5 kg/m^2), maternal anemia (Hb <12 g/dL), Breastfeeding and caring practices
3	Ahmadi et al. (2018) [28]	Ethiopia	1261	Women of reproductive age (15–49 y) and children <5 y	Child's sex, age, region, open defecation, and maternal MUAC
4	Frost et al. (2005) [29]	Bolivia	5562	Used data from 1998 Bolivia Demographic and Health Survey, which includes mothers (15–49 y) and children between 0 and 60 mo	Maternal education, utilization of modern health care, improving health care knowledge and reproductive behavior
5	Alom et al. (2009 [30]	Bangladesh	1547	Children <5 y whose father's occupation was agriculture	Child's age, birth order, maternal education, paternal education, family wealth index, sanitation facility, place of delivery, and place of residence
6	Amare et al. (2019) [12]	Ethiopia	9419	Used data from 2016 Ethiopia Demographic and Health Survey (EDHS) for children between 0 and 59 mo	Child's age, sex, perceived birth weight, maternal educational status, BMI, maternal stature, region, wealth quintile, type of toilet facility, and type of cooking fuel
7	Reed et al. (1996) [31]	Benin/Ouidah District	435	Children 13–36 mo	Level of mother's education and low socioenvironment
8	Katoch & Sharma (2016) [19]	India/J&K	360	School-age children between 6 and 14 y (survey data)	Low household income (poverty), mother's education, birth order in the family, family system, social and economic categories, nature of sanitation, cooking area and fuel used
9	Dani et al. (2015) [32]	India/Maharashtra	2926	Tribal children between 0 and 60 mo	Lack of basic facilities in tribal child population
10	Woldeamanuel et al. (2019) [11]	Ethiopia	337	Pregnant women who gave birth during the study period (18–37 y)	Maternal factors: pregnant mother's diet, Hb level, pre-pregnancy BMI, weight gain during pregnancy
11	Adedokun & Yaya (2021) [14]	Sub-Saharan Africa	189195	Used data from the Demographic and Health Surveys (DHS) of 31 countries	Maternal age, education, household wealth, residence, media exposure, antenatal care attendance, child's sex, child's size at birth, toilet facility, and child's stool disposal system
12	Atsu et al. (2017) [16]	Ghana (West Africa)	7550	Used data from round 4 of the Ghana Multiple Indicator Cluster Survey (MICS4) (0–5 y)	Breastfeeding status, religion, geographic region, and wealth index quintile
13	Striessnig & Bora [33]	India	259627	Used data from India's National Family Health Survey (NFHS-4) conducted in 2015–2016 (children between 0 and 5 y)	Low maternal BMI, household poverty levels, high fertility, mothers' age at birth <20 y and lack of immunization
14	Katoch et al. (2017) [21]	India/J&K	182	School-age children between 5 and 14 y (survey data)	Child's age, religion, castes, parental education, maternal diet during pregnancy, economic status of the family, nature of house, availability of drinking water and toilet facilities in the home
15	Singh et al. (2020) [10]	India	15241 (NFHS-3) and 53483 (NFHS-4)	Used data from India's NFHS-3 (2005–2006) and NFHS-4 (2015–2016) (children<5 y)	Maternal factors: mother's education, environmental factors– open defecation, and health-seeking factors
16	van Bokhorst et al. (2013) [34]	Netherlands	448	448 consecutive patients in hospital between October 2005 and March 2010	Multimorbidity, poor functional status, depressive symptoms and smoking, somatic, psychological, social, or functional problems
17	Fakir & Khan 2015) [35]	Bangladesh	174	Children <5 y living in slums	Per capita income, maternal education, child health precautions, health-seeking practices and medical cost knowledge
18	Aheto et al. (2015) [17]	Ghana	2083	Used data from 2008 GDHS for children <5 y	Age, breastfeeding duration, multiple births, experience of diarrheal episodes, small size at birth, absence of toilet facilities in households, poor households, mothers who are not covered by national health insurance, maternal education and BMI

(*continued on next page*)

Table 1 (*Continued*)

Sr. No	Author (y) [Ref]	Country/Location	Sample size (n)	Type and age of sample	Factors associated with malnutrition
19	Ijarotimi (2013) [36]	Developing countries		Review from developing countries	Poor dietary intake, care by caregivers, health environment and services and poverty,
20	Demissie & Worku (2013) [37]	Ethiopia/Somali region	541	Children between 6 and 59 mo	sex and age of child, maternal education, monthly household's income, decision making, having of livestock, total number of children ever born, health status during pregnancy, prelactation practice, mode of feeding, access to clean water and type of housing
21	Vargas & Hernández (2020) [38]	Colombia	Review of existing studies	Review in Colombia	Poverty, lack of resources, restricted access to health care, rising prices of essential foods, political conflicts leading forced displacement, drought, the absence of an equity-based policy approach, poor environmental sanitation
22	Ahmed et al. (2012) [18]	Bangladesh	8885	Used data from National Nutrition Program baseline survey conducted in 2004 for children <2 y	Sex, not having measles vaccination, age, height, less educated mother, not hygienic toilet, lowest quintile of asset index
23	Seedhom et al. (2014) [39]	Egypt/ Minia	700	Data collected from children 6–24 mo	Low birth weight, short stature of the mothers (≤160 cm, no/lower education of mothers, less knowledge of mothers on nutrition
24	Imran & Gandhi (2021) [40]	India/Bengalore	245	Children 2–6 y	Age, mothers' educational status, fathers' educational status, socioeconomic status, prelacteal feeds
25	Singh et al. (2020) [10]	India/Madhya Pradesh.	294	Tribal children from Madhya Pradesh	Short period of breastfeeding, delayed initiation of supplementary nutrition, and poor activities under the Integrated Child Development Services
26	Singh et al. (2012) [42]	India/Uttar Pradesh	406	Children (1–6 y) from rural area of Meerut	Age, family type, low standard of living index, maternal illiteracy, poor housing and sanitation
27	Biswas et al. (2020) [43]	Bangladesh, India, Nepal, et al.	798961	Used data from the Demographic and Health Survey, conducted between 2007 and 2017	Older age of the mother, mothers with a lower education, and households with >4 members
28	Ortiz et al. (2014) [44]	Ecuadorian highlands	703	Infants from Cuenca 476 (urban area) and 227 infants from Nabon (rural area)	Rural determinant—male sex, preterm, maternal education, facility-based delivery, maternal, diarrhea prevalence, socioeconomic status, child's age Urban determinants— maternal BMI, cough prevalence, facility-based delivery
29	Tasnim (2018) [45]	Developing countries	Review study	Children <5 y	Parental education, drinking water sources, toilet facilities, and income
30	Corsi, Mejía-Guevara, and Subramanian (2016) [46]	India	26842 (stunting) 27483 (underweight)	Used data from NFHS-3, children between 6 and 59 mo	Maternal stature and education, household wealth, dietary diversity, and maternal BMI
31	Wong et al. (2014) [47]	Malaysia	274	Children <5 y	Food insecurity at child level, low birth weight, frequent infection, inadequate nutrients intake, and large number of children in the family
32	Ansuya et al. (2018) [48]	India/Karnataka	570	Children 3–6 y	Parental education, childhood illness, short birth interval, open defecation, type of weaning and complimentary food given to children
33	Khan et al. (2016) [49]	Pakistan/Sindh	3964	Children <5 y	Sex, age and wealth quintiles and diarrhea
34	Aiga et al. (2019) [50]	Africa/Madagascar	393	School-age children between 5 and 14 y	Age of child, number of members in the household, adequate food availability and dietary diversity over a sufficient period
35	Abera et al. (2017) [51]	Ethiopia	398	Children <5 y	Sex (male), children with shorter birth interval, children who had sickness sometimes for past 2 wk, children whose mothers attended ANC, children whose mother's main occupation was non-farm, presence of diarrhea in children
36	Ghimire et al. (2020) [52]	Nepal	398	Children <5 y	Household size, household food access, and the child's age
37	Katoch (2021) [53]	India		Children <5 y	Maternal health— BMI, anaemia level in mothers and maternal education

ANC, antenatal care; BMI, body mass index; GDHS, Ghana Demographic and Health Survey; NFHS, National Family Health Survey.

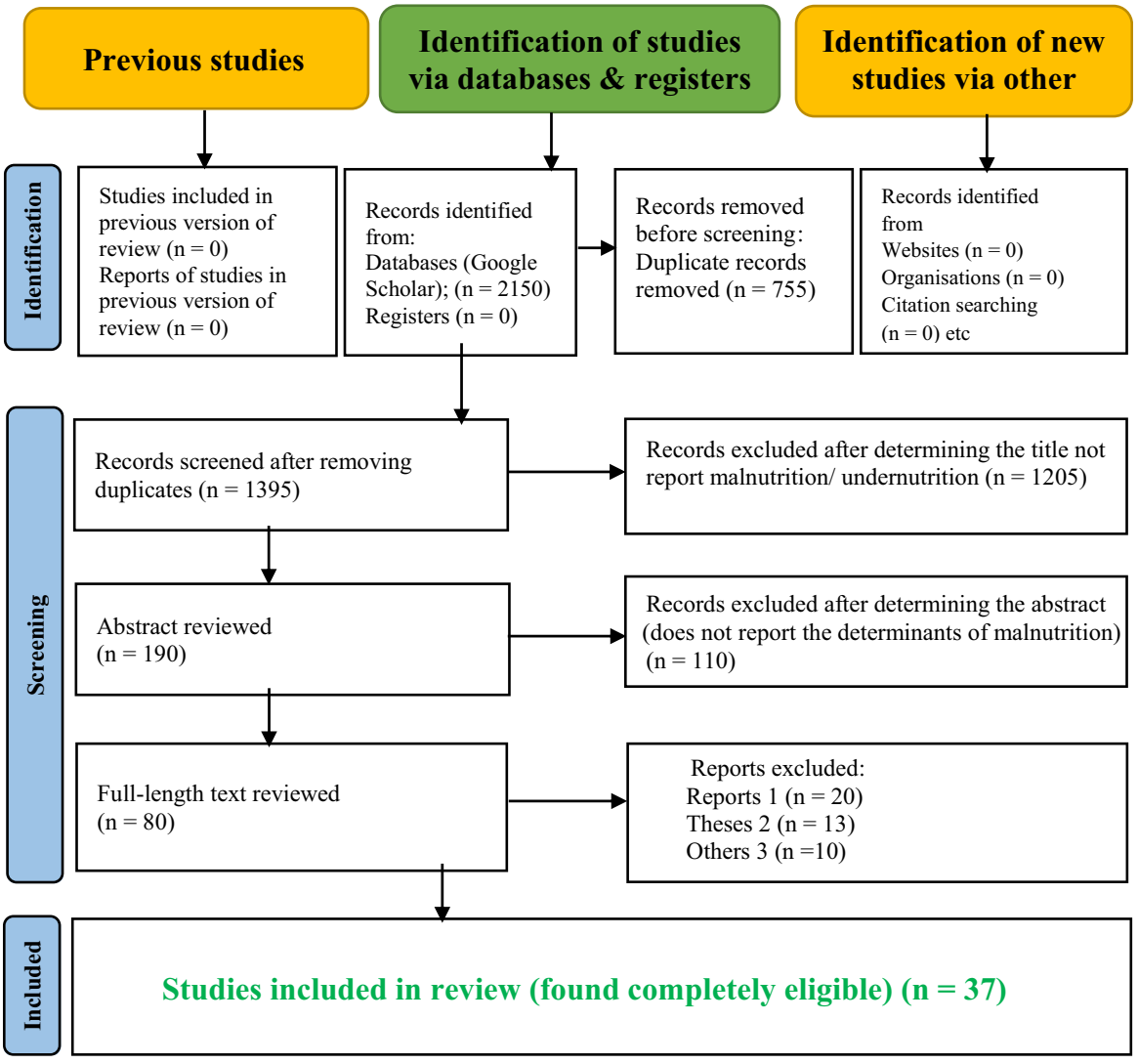

Fig. 1. Flowchart for the selection of studies based on PRISMA 2020 guidelines [27].

childcare practices, provide healthy environments for children, and have higher awareness of the utilization of child health care services [14,34]. Educated mothers are more inclined to be better employed, which supports household income, thus increasing the purchasing power for healthy food, better health services, and so on [21,55].

Slightly more than 35% of the studies reported household income as a determinant of child malnutrition. Household income contributes to malnutrition in children <14 y of age. It affects the household's ability to purchase food, to provide child health services, and to have the physical capital for improving hygiene standards [19,56]. Providing adequate food, such as an animal source of food, is important for proper child growth. Animal sources of food supply are not only high-quality and readily digested protein and energy, but also an efficient source of micronutrients [57,58]. Therefore, a low level of household income cannot meet such needs. Children in lower-income families are more likely to be malnourished than those in higher-income families. Poor families also tend to spend less money on health services, so mothers have low nutritional status during pregnancy, poor knowledge of child feeding practices, and a lack of immunizations and vitamins among children. Furthermore, low-income families cannot provide better quality housing, including inadequate clean water and appropriate sanitation facilities [32]. This condition also increases susceptibility to infection, impaired child development, and an increased mortality rate [59].

Age of the child is also considered as one of the determinants of malnutrition as investigated by 32.4% of the studies in this review. As the age of child increases, the risk for malnutrition also increases [12,37,60]. There are various studies that show that the prevalence of child undernutrition increases with the increase in the age of the child. For example, a study conducted in rural health block of North India (Jammu and Kashmir) using the WHO Z-score system, revealed that older children are at higher risk for stunting compared with younger ones [61]. Seven studies reported that the availability of sanitation facilities at home is an important factor of child malnutrition. The type of sanitation facility that the members of a household use is strongly related to malnutrition among children [19,32,38].

Birth order in the family is also an important factor in determining the nutritional status of the child. Of the studies in the review, 16% supported that the prevalence of malnutrition rises with the

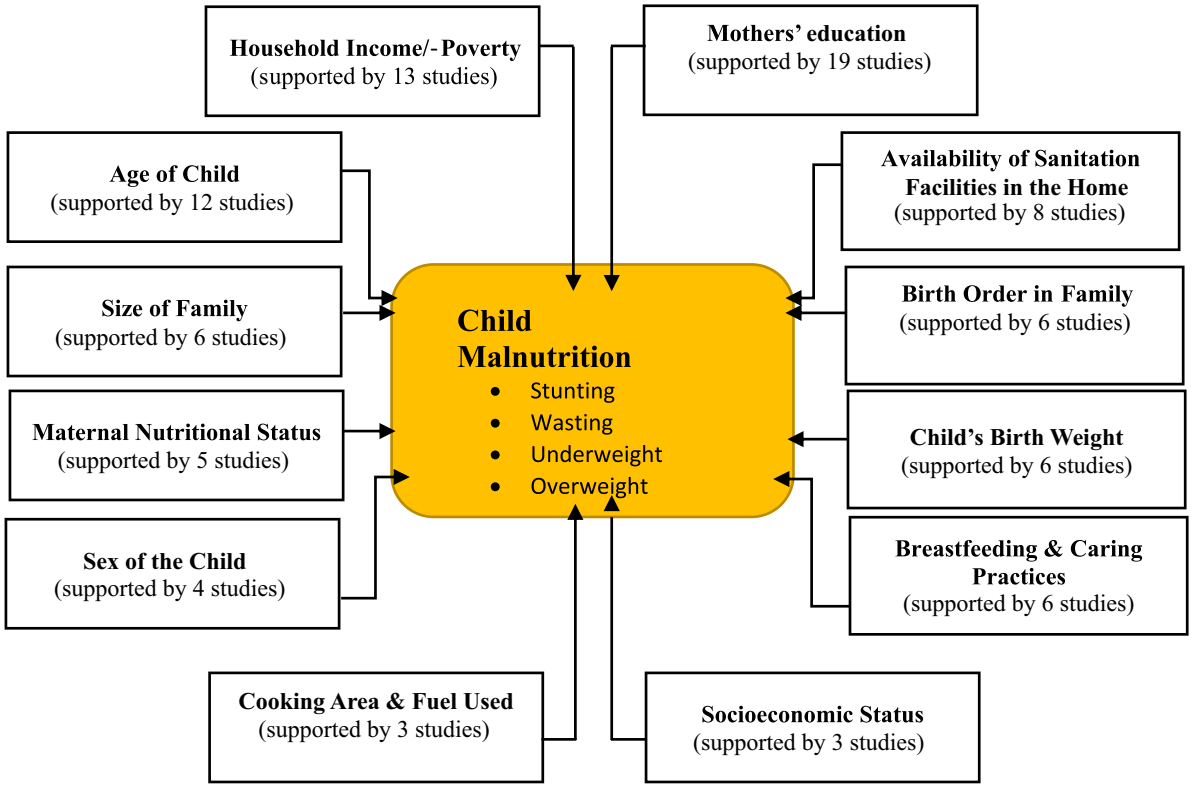

Fig. 2. Determinants of malnutrition sources.

increase in birth order in the family. A study by Katoch and Sharma [19] found that undernutrition rises with the increase of birth orders for all measures of child undernutrition. Six studies showed that there is growth retardation for all children due to malnutrition, which is due to large family size. Family size is an important factor in determining child nutritional status. Normal children had a small family size compared with those who were malnourished. As the size of the family increases, the chances of malnourishment also rise because in families with a larger number of children, less attention is paid to the fulfillment of child nutritional requirements [62].

There is a close link between maternal and child nutritional status, as 13.5% of studies in the review supported this association. Maternal nutrition refers to the nutritional needs of women during the antenatal and postnatal periods and to the period before conception. Undernourished pregnant women have higher reproductive risks, including death during or after childbirth. Many women have a combination of chronic deficiency, poor weight gain in pregnancy, anemia, and other micronutrient deficiencies, as well as infections such as HIV and malaria [63]. In this way, undernutrition in pregnant women is directly linked to intrauterine growth retardation, which results in low birth weight, premortality, and low nutrient stores in infants [64]. Maternal undernutrition also diminishes a woman's productivity, causing repercussions for herself, her family, her community, and society [65,66]. Breastfeeding [10,15,16,41] and caring practices, birth weight, cooking area and the type of fuel used, sex, and socioeconomic status of the children also contribute toward child malnutrition.

Conclusions and Policy Recommendations

After a systematic review of various studies, it was found that maternal education, household income, maternal nutritional status, age of the child, availability of sanitation facilities at home, size of family, birth order in the family, and child's birth weight are the most significant determinants of childhood malnutrition. Breastfeeding and caring practices, cooking area and fuel used, sex, and socioeconomic status of the children also contribute toward child malnutrition.

There is a need for policymakers to intervene to improve children's nutritional status by targeting in the following ways:

1. As maternal education is an important factor for determining child nutritional status, education must be provided to all females at all levels to improve nutritional and dietary knowledge.
2. It was found that household income and availability of sanitation in the home are also important factors responsible for contributing malnutrition. In this context, nutritional and affordable housing programs must be launched/strengthened to target the poor sections in the society.

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