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Prevalence and Determinants of the Double Burden of Malnutrition at Household Level

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Abstract

The persistent problem of undernutrition and the emerging prevalence of overnutrition hints at a new term for the double burden of malnutrition among children globally. This study aims to provide a review of the published studies concerning the prevalence of double burden of malnutrition at the household level and the associated factors. Articles were identified from the electronic databases of PubMed, Nature, SAGE, Scopus, and SpringerLink, using the same search terms for all. A total of fourteen articles were eligible and sixteen sets of prevalence values were obtained. Most articles were published in 2018 – 2020. Fourteen articles used secondary data from the Demographic and Health Survey. Most articles studied under five children and mothers 15-49 years. Mother's nutritional status was identified using BMI, while for children height for age z-score was commonly used. The reported prevalence of double burden at the household level varied from 1.0 to 28.0% by country. Frequently assessed factors observed that older children and older mothers were likely to develop a household double burden of malnutrition. A negative association was found when households possessed access to mass media. Overall, the media should have been channels for health promotion. Intervention concerning the nutrition of mothers and children at the household level is required to be intensified through nutrition-specific and nutrition-sensitive programs.

Introduction

In 2020, WHO estimated that global malnutrition among under five years children affected 149 million with stunting, 45 million for wasting, and 38.9 million for overweight/obese. Stunting has plummeted steadily to 22%, while being overweight has slightly increased to 5.7%, and wasting remains at an alarming rate of 6.7%. Regionally, most malnourished children live in Asia and Africa, whereas 53% and 41% are stunted, 70% and 27% are wasted, and 48% and 27% are overweight, respectively (UNICEF, WHO & World Bank, 2021). This coexistence of overnutrition along with undernutrition is referred to as the double burden of malnutrition (DBM) (Blankenship *et al*., 2020a).

Undernutrition, especially among children, has been associated directly with a lack of dietary intake and infectious disease. Further, caring capacity, household food security, and access to health services are also distal factors of malnutrition (UNICEF, 2021). As for overnutrition, the imbalance of energy intake and energy expenditure are the main causes (Williams & Greene, 2018). As consequences of childhood malnutrition are health problems such as non-communicable diseases and infectious diseases, and non-health related consequences such as lower cognitive ability and rate of wages later in adulthood (Shaban *et al*., 2022).

WHO suggested that DBM may occur at community, household, and individual levels as a result of nutrition transition. Nutrition

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transition is described as the changes in diet, physical activity, and body composition as the result of urbanization and modernization (Popkin, 2004). In many developing countries the transition occurs at a great speed (Roemling & Qaim, 2012). The changes in dietary patterns can be highlighted by the shift of traditional food that is rich in grains, vegetables, and fruits, which are locally available to diet high in sugar, fat, salt, and processed food (Adair & Popkin, 2005; Popkin *et al*., 2017). As for the physical activity spectrum, there is a limited study that has been observing the global trends of physical activity changes among children. However, studies have associated insufficient physical activity with the increase in television viewing, changes in the mode of transportation, and the emergence of modern technologies (Alotaibi *et al*., 2020; García-Soidán *et al*., 2020; Wachira *et al*., 2022). Each transition leads to changes in body composition. A global map developed by Barry M. Popkin depicted the increased prevalence of overweight and obesity from the 1990s to the 2010s (Popkin & Ng, 2022).

Over the years, the problem of overnutrition has escalated globally (Rachmi *et al*., 2017), while the number of undernutrition cases remains a public health problem (Barkley *et al*., 2015; Beal *et al*., 2018). The emergence of the double burden of malnutrition has been investigated extensively among scholars, however, there is a limited review article published on this topic. The double burden of malnutrition at the household level occurred when undernutrition coexisted with overnutrition within a household, mainly involving children and mothers. This current systematic review aims to provide an overview of the prevalence and associated factors of the double burden of malnutrition at the household level from the published articles.

Method

Several inclusion criteria were employed to identify eligible articles: (1) articles published in the year 2016-2021; (2) full-text articles written in English; (3) derived from original analysis of primary survey or secondary data analysis, excluded reviews, meta-analysis, and qualitative study; (3) measured the outcome of DBM prevalence at the household level. Articles were searched using the electronic databases in Nature, PubMed, SAGE, Scopus, and SpringerLink. The following MeSH terms were used to search the literature using Boolean Logic 'Double burden of malnutrition' OR 'dual burden of malnutrition' OR 'obesity' OR overweight OR overnutrition OR 'undernutrition' AND 'children' AND 'prevalence' AND 'risk factors' OR 'determinants'. Furthermore, the identified articles were checked for duplicates using Mendeley and went through title and abstract review using the PICOS formula. Then, selected articles were critically appraised using the Centre for Evidence-Based Medicine (CEBM) for a cross-sectional study. This selection process is depicted in a flow diagram together with the number of articles in each step in Fig 1.

Data were extracted from the final eligible articles using extraction form for several information such as publication data: name of the journal, year of publication, volume and issue number, and page number. Methods information obtained such as country, type of data collection, study design, year of

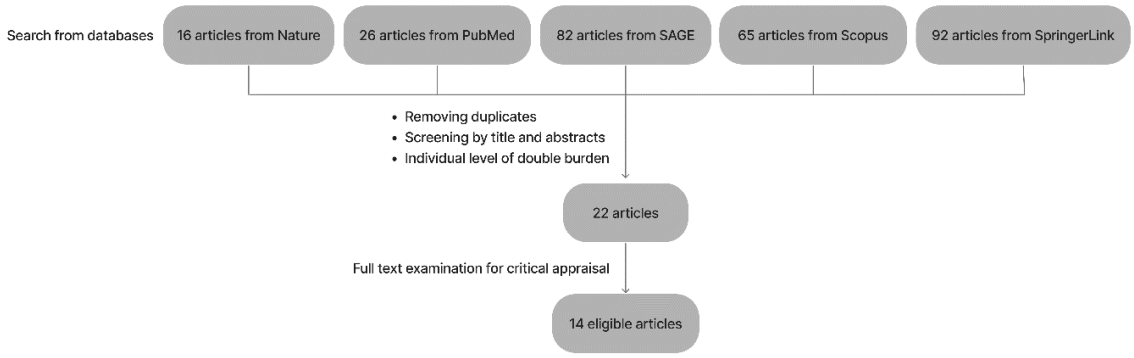

Figure 1. Diagram Process of Study Selection

data source, number of households analyzed, scope of data collection, sampling method, age range of the mother and children, nutritional indicators used to determine undernutrition and overnutrition among adults and children. Results information that was extracted: prevalence of households with double burden of malnutrition and the associated factors.

Several articles reported the prevalence of double burden with distinguished coexistence. All articles presented DBM with overnutrition from the maternal side, however, the children's undernutrition came in different forms, such as stunting, being underweight, wasting, and anemia. Some articles showed the prevalence values with 'any' children malnutrition, meaning all types of malnutrition were mixed and considered. For associated factors, we retrieved data only from statistically significant results.

Result and Discussion

Eventually, fourteen articles were identified as eligible for inclusion in the present review. Fig. 1 depicts a flow diagram of the selection process and the number of articles in each step. After removing duplicates, screening by titles and abstracts, and excluding the individual scope, twenty-two articles remained for the full-text examination. Reasons for exclusion during the full-text examination included: malnutrition prevalence not combined as DBM (four articles), different study design (two articles), and different scope (two studies, e.g. association between maternal stature and wasted newborn). Using the data extraction form, sixteen prevalence values were obtained from fourteen articles.

The characteristics of the included articles are shown in Table 1. Most of the articles are derived from the year 2018 – 2020. Of the fourteen articles, nine used secondary data from the Demographic and Health Survey. All articles analyzed the data using a cross-sectional design. In total, sixteen countries were identified in the extracted data, of which two were in Africa, eleven were in Asia, two were in America, and one from the Central Pacific Ocean. Several articles specified the settings within the country, such as the population at refugee camps in the Gaza Strip (El Kishawi *et al*., 2016) and urban areas (Mahmudiono *et al*., 2018). The year of data collection ranged from 2006 to 2017.

All of the articles focused on the DBM definition of pairs of undernourished children and overweight/obese mothers. The age ranges of the children and adults varied among articles; most of the articles included children aged under five years and only one article categorized 5 to 10-year-old individuals as children, while nine articles included adults aged 15-49 years. The most used indicator for the nutritional status of adults was BMI, with fourteen articles using a cut-off point > 25 kg/m^2 for overweight and > 30 kg/m^2 for obese adults, while two articles used BMI classification for the Asian population 23 – 27.4 kg/m2 for overweight and ≥ 27.5 kg/m2 for obese (Barba *et al*., 2004). Indicators for children's nutritional status differed between articles, most of the articles used height-for-age *z-score* (HAZ), however weight-for-age *z-score* (WAZ), weight-for-length *z-score* (WLZ), BMI-for-age *z-score* (BAZ) and anemia status were also used in several articles. The WHO Child Growth Standard was used to identify undernourishment among children (World Health Organization (WHO), 2006). The numbers of household samples varied between articles, with > 2356-fold (339 (Shinsugi *et al*., 2019) and 798,961(Biswas *et al*., 2021).

Table 2 provides the prevalence of double burden of malnutrition by countries in different years. The prevalence values were derived from children's undernutrition (stunting/wasting/underweight/anemia) paired with mothers overweight/obese. Overall prevalence values vary from 1.0 to 28.0%, ranging by the nutritional status indicators, countries, and years. Of the sixteen prevalence values, nine were national prevalence rates for the double burden of malnutrition. Among them, high prevalence values are from Pakistan, Indonesia, and the Republic of the Marshall Island. Geographically, Asian countries show a lower prevalence value than Africa and America. Only Nepal in 2019 and Brazil in 2006 had prevalence values less than 3%. Most countries had a prevalence of less than 10% (Republic of Benin, India, Sri Lanka, Myanmar, Pakistan 2019, and Bangladesh). However, Pakistan's 2017 data reported a higher

prevalence of 28%. A high prevalence of DBM is also reported in several countries, such as Indonesia (24.7%), the Republic of the Marshall Islands (25.2%) and Palestine (2.5-15.7%).

The prevalence distribution of DBM in the current systematic review is consistent with that of a systematic review in 2017 (Kosaka *et al*., 2018). It has also been found that low-income countries tended to have a lower prevalence of DBM than middle-income countries. Also, a low prevalence was more seen in Asian countries than in African countries by geographical area. In the current review, the prevalence of DBM varied from 1.0 to 28.0%. This wide range reflects differences in age ranges, nutritional indicators, and cut-off points used, as well as the involvement of different countries, years, and data sources (Kosaka & Umezaki, 2017). Age classification varied among the studies; for example, one study included 5-10 years old among children whereas the other studies included under 5 years old among children.

Among several factors frequently assessed in terms of association to double burden of malnutrition was access to mass media, family socioeconomic status, and age of children and mother. Mix finding was observed between maternal education and double burden of malnutrition Table 2 summarizes the association results. Most articles reported a negative association between possessing access to mass media and DBM, inversely, wealthier families were positively associated with DBM. Older mothers and older children were found to be positively associated with DBM.

Five articles reported a negative association between possessing access to mass media and a double burden of malnutrition. The studies explained that children who did not have access to mass media were more likely to suffer malnutrition (Brennan *et al*., 2004; Rahman, 2016). Most of the countries applied media as a platform for distributing nutrition information to tackle malnutrition to reduce the consumption of unhealthy food (oily and sugar-sweetened beverages). Therefore, it was considered that media access is one of the protective factors of the double burden of malnutrition. On the other hand, a study in Bangladesh found that women (Hossain *et al*., 2023) who did not have access to media were less likely to suffer from the double burden of malnutrition because media use can increase sedentary behavior and decreased physical activity although media campaign can improve nutritional knowledge (Fox *et al*., 2019; Matusitz & McCormick, 2012).

Seven articles show a positive association between higher socioeconomic status and a double burden of malnutrition. The wealthier family has a higher risk of having malnourished children. This is related to a global nutrition transition that included urbanization, lifestyle factors as well as limited nutrition education and behaviors. A study in Africa showed countries characterized by higher socioeconomic status (SES) tend to exhibit a greater degree of urbanization and a higher prevalence of obesity compared to countries with lower SES (Mbogori *et al*., 2020). Research conducted in Indonesia found that children from affluent families residing in urban areas are still susceptible to stunting. Additionally, the study identified seven factors associated with the risk of stunting among children from wealthy families: the age of the mother, marital status of the mother, level of maternal education, employment status of the mother, age of the children, gender of the children, and early initiation of breastfeeding (Latifah *et al*., 2023).

Seven articles observed a positive association between the age of the mother and the double burden of malnutrition. Advanced maternal age increases the likelihood of having malnourished children due to various reasons. As women grow older, their reproductive capabilities may diminish, resulting in reduced nutrient absorption and utilization that can adversely affect the nutritional well-being of their offspring. The research indicated that children born to mothers aged over 34 at the time of birth had a lower likelihood of experiencing childhood underweight in comparison to those born to mothers under the age of 34 (Seidu *et al*., 2023). Older mothers have a higher prevalence of underlying health issues or chronic diseases that can impact their nutritional status as well as the health of their children (Galang *et al*., 2021).

Table 1. Characteristics of Selected Studies (in Chronological Order of Publication)

Year of Publication	Country	Data	Analysis	Year of Data Source	Number of HH Sample	Adult		Children		Notes	Article ref.
						Age Range	Indicator	Age Range	Indicator		
2016	30 countries in Sub-Saharan Africa	S	CS	2006-2012	154,789 women, 114,552 children	15-49	BMI & anemia	12-59 months	HAZ	National representative survey (DHS)	(Jones et al., 2016)
2016	Palestine	P	CS	2012	357	18-50	BMI	2-5 years	WAZ	3 regions in the Gaza Strip (urban, rural, refugee camp), systematic sampling	(El Kishawi et al., 2016)
2017	Brazil	S	CS	2006	4299	15-49	BAZ, BMI	< 5 years	HAZ	National representative survey (DHS)	(Gubert et al., 2017)
2018	Bangladesh	S	CS	2014	5687	15-49	BMI	0-59 months	HAZ	National representative survey (DHS)	(Hauqe et al., 2019)
2018	Indonesia	P	CS	2015	685	Not available	BMI	0-59 months	HAZ	Surabaya (urban), systematic cluster sampling	(Mahmudiono et al., 2018)
2018	Bolivia	S	CS	2015	3946	15-49	BMI & anemia	0-59 months	HAZ, WAZ	2 regions in Bolivia (city and satellite city), stratified sampling	(Jones et al., 2018)
2019	Bangladesh	S	CS	2014	5951	15-49	BMI	< 5 years	HAZ, WLZ, WAZ	National representative survey (DHS)	(Das et al., 2019)
2019	Bangladesh, Nepal, Pakistan, Myanmar	S	CS	2012-2016	Varied	15-49	BMI	0-59 months	HAZ	National representative survey (DHS)	(Anik et al., 2019)
2019	Sri Lanka	P	CS	2017	339	20-59	BMI	5–10 years	BAZ	1 district of Gampaha (urban), stratified random sampling	(Shinsugi et al., 2019)
2019	Republic of Benin, West Africa	P	CS	2014	426	15-49	BMI	6-59 months	WAZ, HAZ	Solar Market Garden Project in Kalale district, random sampling	(Alaofè & Asaolu, 2019)
2020	8 countries	S	CS	2007-2016	798,961	15-49	BMI	< 5 years	HAZ, WAZ, WHZ	National representative survey (DHS)	(Biswas et al., 2021)

Year of Publication	Country	Data	Analysis	Year of Data Source	Number of HH Sample	Adult		Children		Notes	Article ref.
						Age Range	Indicator	Age Range	Indicator		
2020	Nepal	S	CS	2016	2261	15-49	BMI	< 5 years	HAZ, WHZ, WAZ, Anemia	National representative survey (DHS)	(Sunuwar et al., 2020)
2020	Republic of the Marshall Islands	S	CS	2017	464	Not available	BMI	0-59 months	HAZ, WAZ	National representative survey (DHS)	(Blankenship et al., 2020b)
2021	India	S	CS	2015-2016	168,784	15-35	BMI	0-59 months	HAZ, WHZ, WAZ, anemia	National Family Health Survey	(Kumar et al., 2021)

HH: Household; CS: cross-sectional; BAZ: BMI for age z-score; BMI: Body Mass Index; HAZ: height for age z-score; WAZ: weight for age z-score; WLZ: weight for length z-score; WHZ: weight for height z-score; P: primary data; S: secondary data

Table 2. Prevalence of Double Burden of Malnutrition at the Household Level and Its Association with Various Factors

Countries	Year of Data	Prevalence (%)	Associated Factors
Nepal	2006	5[e]	Rural residence (n), wealthier family (p), older mother (p), non-working mother (p), exposure to mass media (n), middle education attainment (p)
Pakistan	2017	24.0[a] 14.0[b] 15.0[c] 28.0[e]	Rural residence (n), wealthier family (p), older mother (p), non-working mother (p), exposure to mass media (n)
Brazil	2006	2.6[a]	Boy (p), HH severe food insecure (p), lower educational level head of HH (p)
SSA	2006-2012	3.3 – 9.2[a] 1.0-22[d]	Urban (p)
Bangladesh	2014	4.7[a] 1.7[b] 3.8[c]	No exposure to media (p), cesarean section delivery (p), having more than one kid in a household (p), mother's age at first birth being 21-25 years (p)
Nepal	2016	6.6[e]	Rural residence (n), wealthier family (p), older mother (p), non-working mother (p), exposure to mass media (n)
Bangladesh	2019	4.10[a]	Breastfeeding not given (p), older mother (p), wealthier family (p)
Nepal	2019	1.54[a]	Older mother (p), girl (n), access to media (n)
Pakistan	2019	3.93[a]	older children (p), wealthier family (p), girl (n), mother higher education (n)
Myanmar	2019	5.54[a]	Breastfeeding not given (p), older mother (p), older children (p)
Surabaya, Indonesia	2018	24.7[a]	HH food insecurity (p)
Republic of the Marshall Islands	2017	25.2[a]	Older children (p), older maternal age at birth (p), higher maternal education (p), lower maternal height (p), larger household size (p), open defecation (p)
Gaza Strip - Palestine	2012	2.5-15.7[c]	Childbirth order (p), lower paternal education (p), higher maternal nutrition knowledge (p), lower monthly income (n)
Sri Lanka	2017	2.1-5.3[b]	Mother lower education (p)
India	2015 to 2016	4.2[a] 2.0[b] 3.3[c] 7.8[d]	Older mother (p), mother lower education attainment (p), not exclusively breastfed (n), cesarean section delivery (p), older children (p), smaller birth size (p), wealthier family (p), rural (n)
Republic of Benin	2014	6.1[Δ]	Older children (p), wealthier families (p), educated mothers (n),

OBM: overweight/obese mother; aOBM/STC; bOBM/WSC; cOBM/UWC; dOBM/AC; eOBM/ANY; ΔOBM/STC-UWC

Four articles reported a positive association between mothers' higher education and the double burden of malnutrition. Two other articles showed a negative association between educated mothers and the double burden of malnutrition. A possible explanation for these findings is study proposed that the relationship between education and overweight/obesity is intricate and varies across different countries (Monteiro *et al*., 2001). The conflicting findings might be because having a higher level of education doesn't necessarily guarantee the adoption of healthy lifestyle behaviors. In cases where mothers have poor health and nutritional knowledge, they may be less attentive to their child's nutritional status or less responsive to health and nutrition concerns, such as food choices and barriers

like food cost, accessibility, and lack of cooking skills (Sunuwar *et al*., 2020). A study by Kumar *et al*. (2021) shows women with higher degrees of education typically have higher wealth status than women with lower levels of education. Mothers who had completed at least secondary education were found to be at a higher risk of facing a double burden of malnutrition (Sunuwar *et al*., 2020). Study shows women with primary/secondary education are more prone to overweight or obesity (Rai *et al*., 2019).

Five articles reported a positive association between the age of the children and the double burden of malnutrition. Older children were more likely to suffer from malnutrition. The explanation for this finding is as children get older, their malnutrition rates rise, which is related to their increased TBM (Kumar *et al*., 2021). Previous research has shown that children's growth faltering is more common later in life (Headey *et al*., 2019). It is conceivable to have greater rates of DBMHL among children 24-59 months when nursing has a limited impact on a child's dietary adequacy and is less commonly practiced by mothers because breastfeeding has a preventive effect on both stunting in children and overweight in mothers. Recent studies have investigated the fact that, in addition to Pakistan, other Asian nations are facing malnutrition among older children as a result of eschewing continued nursing traditions, and these investigations have corroborated this conclusion (Anik *et al.,* 2019). Another study observed the elevated risk of TBM among children at later ages is most likely caused by a higher prevalence of stunting, wasting, and underweight. The significant risk of TBM among children in the high age group is confirmed by the fact that in addition to undernutrition, anemia is also more common among children in the high age group than among children of lower age.

Two articles explored a positive association between household food insecurity and the double burden of malnutrition. Research conducted in Brazil shows a strong association between household food insecurity and the occurrence of the double burden of malnutrition. Even after considering factors related to DBM, severe HFI remains a significant factor associated with DBM (Gubert *et al*., 2017). Although previous studies have indicated a relationship between economic factors and the presence of DBM (Lee *et al*., 2017). Research in Indonesia also indicates a relationship between household food insecurity and DBM. In Indonesia, research also demonstrates a relationship between household food insecurity and the occurrence of double-burden malnutrition. This study reveals that HFI is a contributing factor to the development of DBM, even after considering other related factors. The results of this study provide new insights into the impact of food insecurity on nutritional balance in the Indonesian population (Mahmudiono *et al*., 2018; Septiani *et al*., 2021).

Household food insecurity can indeed contribute to the occurrence of double-burden malnutrition, which refers to the simultaneous presence of undernutrition and overnutrition within the same population, household, or individual. When a household experiences food insecurity, it means they have limited or uncertain access to sufficient and nutritious food. This can result in a lack of dietary diversity and poor food quality. In many cases, food-insecure households may rely on inexpensive but nutrient-poor foods that are high in energy. This can contribute to the development of overweight and obesity. Household food insecurity can also lead to undernutrition and deficiencies in micronutrients. Inadequate access to nutritious foods can result in an insufficient intake of essential nutrients, including proteins, vitamins, and minerals. This can hinder growth and development, leading to stunting, wasting, and deficiencies in important nutrients such as iron, vitamin A, and zinc (Gao *et al*., 2020).

Limitations in the present study are the heterogenicity in the sample size and the scale setting of the study, which prevented from performing meta-analysis. However, for such a new field in nutrition, reporting the published article qualitatively through a systematic literature review has been a cornerstone for impending research.

Conclusion

Overall, the prevalence of double burden of malnutrition at the household

level was < 30% with a lower prevalence in Asian countries. However, with the emerging cases of overnutrition, the increasing trend of double burden was projected in Asia. Among the factors that had been associated with the double burden of malnutrition was access to media. Media should have been channels for health promotion. Intervention concerning the nutrition of mothers and children at the household level is required to be intensified through nutrition-specific and nutrition-sensitive programs.

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