Scientific Research Publishing

Food and Nutrition Sciences, 2023, 14, 908-927
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Prevalence and Predictors of Double Burden of Malnutrition within Households in Africa: A Systematic Review

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How to cite this paper: Santos, R., Jerome, C.S., Azandjeme, C., Mizehoun-Adissoda, C. and Metonnou, C. (2023) Prevalence and Predictors of Double Burden of Malnutrition within Households in Africa: A Systematic Review. *Food and Nutrition Sciences*, **14**, 908-927.
https://doi.org/10.4236/fns.2023.1410058

Received: September 3, 2023
Accepted: October 27, 2023
Published: October 30, 2023

Abstract

In recent years, there has been growing interest in the emergence of double burden of malnutrition (DBM) in Africa. In this study, we reviewed the literature on double burden of malnutrition in households, reviewing previous studies investigating the prevalence of DBM in Africa and the factors associated with it. To identify relevant studies, we consulted the PubMed and Cochrane electronic databases, using specific search terms. A total of seventeen articles met the eligibility criteria. These articles were published between 2012 and 2022, and their data were collected between 2000 and 2019. Twelve of these studies used secondary data, including demographic and health surveys. The age of children and adults varied from study to study. All studies used Body Mass Index as a nutritional indicator for adults. For children, the height-for-age Z-score was most commonly used, while weight-for-age, weight-for-height and Body Mass Index-for-age were less commonly used. The national prevalence of double nutritional burden in households ranged from 1.71% to 38.7%, depending on the country and the year. However, direct comparisons between studies were limited due to differences in combinations of undernutrition, overweight or obesity. Among the factors associated with double nutritional burden within households, the most frequently cited in the selected articles were urban/rural residence, income or socioeconomic status, age of child and mother, household size and mother's level of education. However, no study assessed physical activity, and very few examined the diet of household members. It is essential to take these different parameters into account when designing and implementing interventions to prevent the DBM in Africa. Community and societal factors will also need to be studied and taken into account in these interventions.

Keywords

Double Burden of Malnutrition, Household, Prevalence, Associated Factors, Africa

1. Introduction

The world's population is increasingly facing the double burden of malnutrition (DBM), which is characterized by the simultaneous coexistence of malnutrition due to deficiency and malnutrition due to excess, including overweight, obesity and nutrition-related chronic diseases [1]. According to the most recent estimates, around one in five children under the age of 5 is stunted, *i.e.* 149.2 million children. In addition, 45.4 million children (6.7%) are wasted, while 38.9 million (5.7%) are overweight [1]. This problem is no exception among adults. Some 2.2 billion adults are overweight or obese, representing 40.8% of women and 40.4% of men. In the 15 - 49 age group, 570.8 million girls and women of childbearing age are affected by anemia, representing 29.9% of this population. Diabetes affects 538.7 million people, or 8.9% of women and 10.5% of men [1]. In addition, hypertension affects 1.2 billion people, *i.e.* 19.9% of women and 24% of men [1].

Obesity leads to numerous complications, with somatic, psychological and social consequences, and an impact on the quality of life of those concerned [2]. Indeed, obesity is a risk factor for the main non-communicable diseases (NCDs) (cardiovascular disease, diabetes, certain cancers and chronic respiratory disease) [3]. These diseases not only result in a reduced quality of life due to their chronic nature, but also lead to serious complications and premature death [3] [4]. Obesity has also been reported to be positively associated with osteoarthritis, infertility, apnea and sleep quality, and can be a major risk for the development of resistance to certain drug treatments [4] [5] [6] [7]. Nutritional deficiencies have many adverse consequences on health: in addition to fatigue, they weaken the body and reduce resistance to infection. Folate (vitamin B9) deficiency in pregnant women can cause fetal malformations [8].

The DBM can be observed at different scales, including country, household and individual. At country level, the study by Irache *et al*. covered 49 low- and middle-income countries, including 29 in the African region, two in the Eastern Mediterranean, six in the European region, six in the American region, five in South-East Asia and one in the Western Pacific. This study revealed a prevalence of DBM in 17.2% of households included in the sample [9].

Double burden of malnutrition can also occur in households, where an overweight or obese mother often coexists with one or more stunted or underweight children. At the individual level, DBM is most often manifested by the association of overweight or obesity with micronutrient deficiencies in the same person [10]. Early studies exploring this health phenomenon revealed several factors

contributing to this health crisis, many of which are linked to the nutritional transition phase. This phase is characterized by decreased physical activity and increased access to less healthy, highly processed foods and beverages [11]-[14].

In Africa, deficiency malnutrition persists, while nutrition-related chronic diseases are emerging. The region is currently undergoing a nutritional transition, marked by an increase in cases of overweight, obesity and diet-related non-communicable diseases [15]. In West Africa, the situation is particularly worrying among women of childbearing age, 50% of whom are anemic. What's more, 38% of these women are overweight and 15% obese. In sub-Saharan Africa as a whole, 40% of children are stunted, indicating chronic undernutrition, while 7.5% of adults are obese [8]. The Paradox is striking in sub-Saharan Africa, where despite the progress made, the number of undernourished people rose from 181 million in 2010 to almost 222 million in 2016 [1]. This increase testifies to a complex reality and underlines the persistent challenges associated with food security in the region. [16]. This increase reveals a resurgence of food insecurity, resulting in an unbalanced diet that cannot provide sufficient energy and nutrients to support normal growth and development. However, studies have shown that food-insecure populations are more likely to be obese than food-secure ones [17]. Food insecurity can therefore give rise to a situation of "undernutrition" or "overnutrition", where the coexistence of these two problems at the level of the individual, the household or even a nation, defines the DBM [18]. This complex situation highlights the multiple nutrition challenges facing the region, and the need for holistic approaches to tackling these public health issues.

Africa's rapid urbanization largely explains this nutritional transition. This population increase stems from natural growth in urban centers and immigration from rural areas. With urbanization comes changes in the quality and quantity of food consumed, with food choices often influenced by the cost of food. This leads to an increasing prevalence of consumption of highly processed and less expensive foods, high in fat, sugar and salt, contributing to the rise in obesity and nutrition-related diseases [17]. Rising incomes, lack of time to prepare meals and individual preferences play a role in increasing demand for and consumption of energy-dense processed foods and fast food, which can be eaten inside or outside the home [13]. At the same time, there has been rapid growth in the number of fast-food chains, supermarkets and transnational food companies, as well as an increase in food imports [19]. The rise of new technologies has also contributed to a decline in physical activity. More and more children travel to school by car rather than on foot or by bike [20]. Based on a meta-analysis of fifteen studies published between 1966 and 2007, Abubakari *et al*. estimated that 13% of West African adults were physically inactive [21].

In recent years, attention has focused on the emergence of DBM within households, *i.e*. the coexistence of overweight and undernutrition among members of the same family. However, studies published in scientific journals have

done little to address the prevalence of this form of DBM in Africa and the factors associated with it. Most studies on DBM have focused on the national and individual levels. There is a lack of in-depth assessment of the prevalence and predictive factors of DBM at household level in different African countries. The present study is therefore a systematic review of the current literature on DBM in African households.

2. Methods

2.1. Search Strategy

The PRISMA guidelines were used to draft the entire systematic review [22]. A literature search was carried out in March and April 2023 using the PubMed/Medline and Cochrane databases. The search equation used is presented in **Table 1**.

Table 1. Search equations used in each database.

Database	Search equation
Pubmed	(double burden of malnutrition OR dual forms of malnutrition OR dual burden of malnutrition) AND household AND (Africa OR Algeria OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR Cameroon OR "Cape Verde" OR "Central African Republic" OR Comoros OR Congo OR "Ivory Coast" OR Djibouti OR Egypt OR Eritrea OR Eswatini OR Ethiopia OR Gabon OR Gabon OR Gambia OR Ghana OR Guinea OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Morocco OR Mauritius OR Mauritania OR Mozam bique OR Namibia OR Niger OR Nigeria OR Uganda OR Rwanda OR "São Tomé and Principe" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR Sudan OR Tanzania OR Chad OR Togo OR Tunisia OR Zambia OR Zimbabwe)
Cochrane	(double burden of malnutrition OR dual forms of malnutrition OR dual burden of malnutrition) AND household AND (Africa OR Algeria OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR Cameroon OR "Cape Verde" OR "Central African Republic" OR Comoros OR Congo OR "Ivory Coast" OR Djibouti OR Egypt OR Eritrea OR Eswatini OR Ethiopia OR Gabon OR Gabon OR Gambia OR Ghana OR Guinea OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Morocco OR Mauritius OR Mauritania OR Mozam bique OR Namibia OR Niger OR Nigeria OR Uganda OR Rwanda OR "São Tomé and Principe" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR Sudan OR Tanzania OR Chad OR Togo OR Tunisia OR Zambia OR Zimbabwe)

2.2. Item Selection

The articles selected are those published between 2012 and 2022. These are original articles using secondary data or based on an original survey. These studies must have reported the prevalence of DBM in a household or in mother-child pairs. After selecting records from the search results based on titles and abstracts, the authors reviewed the full-text versions of all identified articles to determine their eligibility (Figure 1).

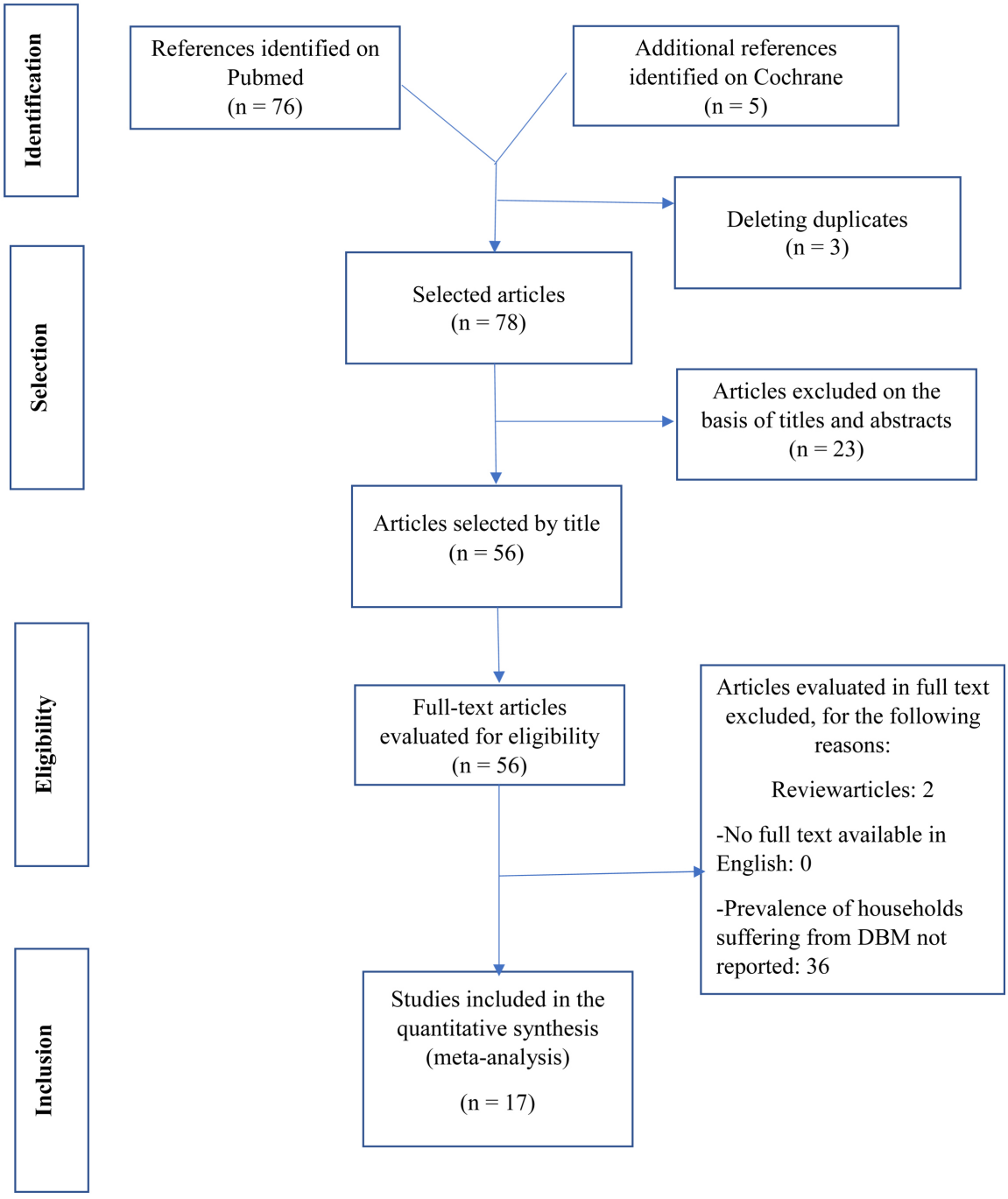

Figure 1. Selection process and number of articles included in the journal.

2.3. Data Collection

Information was extracted from eligible studies using a data extraction form. The information sought through the extraction forms is as follows:

- Publication details: name of journal, year of publication, volume and page numbers;
- Data: country, region, data source, year of data collection, subject characteristics (e.g., slum dwellers, refugees) and number of subjects analyzed;
- Methods: targeted combination of undernourished and over-nourished people (e.g. an overweight mother and an undernourished child), age range of adults and children, and nutritional indicators used to identify undernutrition and over-nourishment in adults and children;
- Results: number and prevalence of households/pairs with DBM, and associated factors.

For purposes of comparison, crude prevalence rates were preferably sought if available, as some studies report only crude (unadjusted) values. For studies analyzing multiple data sets (multiple countries and/or years) or using multiple indicators, available data were extracted.

3. Results

3.1. Study Selection and Data Collection

Finally, seventeen articles were identified as suitable for inclusion in the present study. Figure 1 shows a flow chart of the selection process and the number of records in each phase. After elimination of duplicates and selection of titles and abstracts, fifty articles remained for review. Reasons for exclusion from full-text review were: narrative reviews without analysis of original data (2); unreported prevalence of households or mother-child pairs with DBM (36). Using the data extraction form, 156 prevalence values were obtained from seventeen articles.

3.2. Study Characteristics

The characteristics of the included studies are presented in Table 2. Twelve of the studies used secondary data such as demographic and health surveys. One study looked at the situation of DBM at household level in refugee camps in Western Sahara Africa. Others studied DBM in rural and urban areas. The data collection year ranged from 2000 to 2019.

Data analysis methods varied from study to study. Of the seventeen studies, eleven looked at the pair of overweight or obese mother with an undernourished child (stunted growth, wasting, underweight, anemia). The age range of children and adults varied from study to study. For adults, the following age groups were used: over 16; over 18; 15 - 49; 20 - 49. For children and adolescents, the following age groups were used: children aged 06 to 59 months, children aged 12 to 59 months, children aged 5 to 10 years, children aged under 10 years, children aged 10 to 17 years, children aged 15 to 19 years. Body Mass Index (BMI) was a

Table 2. Characteristics of included studies (in order of publication).

Year of Publication	Country	Data	Analysis	Years of data collection	Number of households/ pairs sampled	DBM Type	Children and Teens		Adults		Database or sample population	References
							Age range (years)	Indicator	Age range (years)	Indicator		
2012	Cape Verde	Secondary	Transversal	2001-2002	2063	One person in the household is overweight and one is underweight	<10 10 à 17.9	P/T BMI for age	≥18	BMI	Survey of household expenditures and income (IDRF 2001/02)	[24]
2012	Algeria	Primary	Transversal	2010	2005	At least one undernourished and one overweight individual in the household	<5	P/T and/or presence of edema T/A P/A	15 - 49 years	T/A BMI Waist circumference	Western Sahara refugee camp in protracted emergency situation	[33]
2014	28 sub-Saharan African countries	Secondary	Transversal	2000-2010	Not available	Obese mother with an undernourished child (defined as stunted, underweight or wasted)	<5	P/T T/A P/A	15 - 49 years	BMI	WHO databases	[34]
2016	30 sub-Saharan African countries	Secondary	Transversal	2006-2012	154,789	Overweight mothers and stunted children in the household Maternal overweight and anemia	1 - 5	T/A	15 - 49 years	BMI Anemia	Demographic and health surveys	[29]
2018	Benin	Primary	Transversal	2015	357	Overweight/obese mother and stunted child	<5	T/A	<25 25 - 34 35 - 49	BMI	Households in the commune of Comè, Benin	[25]
2019	Benin	Secondary	Transversal	2014	426	Overweight/obese mother and underweight/stunted child in the same household.	<5	M/S T/A P/T	15 - 49 years	BMI	Solar-powered drip irrigation project (Solar Market Garden [SMG])	[30]
2019	Kenya	Primary	Transversal	2016	173	Overweight/obese adult and underweight, stunted, wasted or micronutrient-deficient child	<5	T/A M/S BMI/A	>16 years	BMI Vitamin A, iron and zinc intake	Rural households in the Nyanza region, western Kenya	[35]
2019	Tunisia	Primary	Transversal	2009 -2010	437	Anemic child and overweight or obese mother; overweight or obese child and anemic mother; stunted child and overweight or obese mother; and wasted child and overweight or obese mother.	<5	P/T T/A BMI/A Anemia	20 to 49 years old	BMI Anemia	ObeMaghreb research project	[32]
2020	15 sub-Saharan African countries	Secondary	Transversales	2012-2016	69,082	Co-occurrence of an overweight woman of childbearing age and a stunted preschooler in the same household	<5	T/A P/T	15 - 49 years	BMI	Demographic and health surveys data on global forest change	[36]
2020	Kenya	Secondary	Transversal	2014	7830	Overweight or obese mother with a stunted, underweight or wasted child.	<5	M/S T/A P/T	15 - 49 years	BMI	Demographic and health surveys	[26]
2021	Ethiopia	Primary	Transversal	2018-2019	1454	At least one overweight adult and one wasted or stunted child, at least one underweight adult and one overweight child, two overweight adults and one wasted or stunted child, and two underweight adults and one overweight child.	<5	T/A P/T	18 - 49 years	BMI	Data from two cross-sectional studies conducted in urban areas—the capital Addis Ababa, and in rural areas—the district of Kersa	[27]

Continued

2022	23 Sub-Saharan African countries	Secondary	Transversal	2008 -2017	145,020	Cooccurrence of undernutrition and overweight/obesity in a child and/or a woman	<5	T/A P/T	15 - 49 years	BMI Anemia	Demographic and health surveys	[23]
2022	Tanzania	Secondary	Transversal	2015-2016	8083	Cooccurrence of undernutrition and overweight/obesity in a child and/or a woman	<5	T/A P/T M/S	15 - 49 years	BMI	Demographic and health surveys	[28]
2022	South Africa	Secondary	Transversal	2008	3720	Coexistence of overnutrition (overweight and obesity) among adults and undernutrition (stunted growth) among children in the same household	0 - 4 5 - 9 10 - 17	P/T BMI/A T/A	≥18	BMI	South African National Income Dynamics Survey (NIDS)	[37]
2022	49 low- and middle-income countries, including 29 African countries	Secondary	Transversal	2000-2019	311,604	Overweight/obese mother and at least one anaemic child, or anaemic mother and at least one overweight/obese child.	<5 15 - 19	BMI/A	20 - 49	BMI Anemia	Demographic and health surveys	[9]
2022	Ethiopia	Secondary	Transversales	2005-2016	13,107	Maternal overweight/obesity and infant growth retardation Maternal overweight/obesity and infant anemia Maternal overweight/obesity and anemia and/or infant growth retardation	<5 15 - 19	T/A Anemia BMI/A	20 - 49	BMI	Demographic and health surveys	[38]
2022	Ethiopia	Secondary	Transversales	2016	7624	Maternal overweight/obesity and child growth retardation Maternal overweight/obesity and child wasting Overweight/obese mother and underweight child Maternal overweight/obesity and child anemia	<5	T/A M/S P/T Anemia	15 - 49	BMI	Demographic and health surveys	[31]

T/A: Z-score Height-for-age; W/A: Z-score Weight-for-age; W/T: Z-score Weight-for-height; BMI/A: Body Mass Index-for-age.

commonly used indicator of nutritional status in adults. Indicators of children's nutritional status differed somewhat from one study to another. Although the height-for-age Z-score (T/A) was the most commonly used, the weight-for-age Z-score (W/A), the weight-for-height Z-score (W/H) and the BMI-for-age Z-score were also used in several studies. The WHO reference for children under 5 and the 2007 reference for children aged 5 to 19 were most often used for the Z-score. To measure anemia in mothers and children, hemoglobin concentration levels were sought in all studies using this indicator. One study did not report the actual number of households or pairs in its sample. Seventeen studies reported the prevalence of DBM within the household, and twelve reported the associated factors. Factors frequently assessed were maternal age and education, urban/rural residence, household size and income/wealth.

3.3. Prevalence of Double Burden of Malnutrition in Households

The most recent country-level prevalences of DBM within households in Africa are reported through two studies. Table 3 summarizes the national prevalence of co-occurrence of undernutrition and overweight/obesity in a child and/or a woman within households in 23 African countries reported by Christian and Dake. Reported prevalence figures ranged from 1.71% to 17.12%. The lowest prevalence was reported in Madagascar, and the highest in South Africa. Four countries had a household prevalence of DBM below 5%, fifteen countries had a household prevalence of DBM between 5% and 10% and four countries had a household prevalence of DBM above 10%. The overall household prevalence of DBM in this study was 8%. The study reported that the most common malnutrition condition at household level was anemia: nearly seven out of ten households participating in the study had a child or woman with anemia. Anemia was the

Table 3. Most recent national prevalence of co-occurrence of undernutrition and overweight/obesity in a child and/or a woman within households by country [23].

Country	Year of data	Prevalence
Burkina Faso	2010	3.74
Burundi	2016	3.72
Cameroon	2011	8.80
Democratic Republic of Congo	2013	7.33
Benin	2011	13.99
Ethiopia	2016	3.18
Ghana	2014	5.78
Guinea	2012	5.68
Ivory Coast	2011	6.03
Kenya	2014	6.56
Lesotho	2014	13.81
Madagascar	2008	1.71
Malawi	2016	7.69
Mali	2012	6.69
Mozambique	2011	8.37
Namibia	2013	7.02
Niger	2012	8.56
Nigeria	2013	10.10
Rwanda	2014	9.72
South Africa	2016	17.12
Zimbabwe	2015	9.60
Tanzania	2015	8.61
Zambia	2013	9.61

most frequent deficiency malnutrition condition observed in studies conducted in Burkina Faso (88.19%), Mali (84.53%), Côte d'Ivoire (82.19%) and Guinea (81.86%). It was relatively less frequent in Rwanda (42.60%). The frequency of overweight/obesity malnutrition was high in South Africa, where around seven out of ten households had an overweight or obese woman or child. DBM prevalences were highest in South Africa (17.12%), Benin (13.99%) and Lesotho (13.81%), and lowest in Madagascar (1.71%) [23].

More recent national prevalence data are available in the Irache al study (**Table 4**). This study presents the prevalence of overweight/obesity and anaemia

Table 4. National co-occurrence prevalence of overweight/obesity and anaemia among mothers and their children under five in households by country [9].

Country	Year of data	Prevalence (%)
Benin	2017-2018	18.3
Burkina Faso	2010	8.8
Burundi	2016	4.8
Cameroon	2011	21.3
Congo	2011-2012	17.8
Ivory Coast	2011	17.4
Democratic Republic of Congo	2013	11.5
Eswatini	2006-2007	25.4
Ethiopia	2016	4.1
Gabon	2012	31.6
Gambia	2013	16.5
Ghana	2014	23.9
Guinea	2018	21.7
Lesotho	2014	21.9
Malawi	2015-2016	11.7
Mali	2018	22.6
Mozambique	2011	11.5
Namibia	2013	15.3
Niger	2012	15.3
Nigeria	2018	20.1
Rwanda	2014-2015	10.3
Sao Tome and Principe	2008-2009	28.6
Senegal	2010-2011	18.8
Sierra Leone	2013	16.7
South Africa	2016	38.7
Tanzania	2015-2016	15.7
Togo	2013-2014	20
Uganda	2016	13.4
Zimbabwe	2015	13.7

among mothers and their children under five in households. At this level, the reported prevalence figures ranged from 4.1% to 38.7%. In this case, the lowest prevalence was reported in Ethiopia and the highest in South Africa. The overall prevalence of DBM in this study was 17.2%. Of the 29 countries included, 26 had a DBM prevalence above 10% [9]. Household prevalences of DBM reported by Irach *et al*. were higher than those reported by Christian and Dake. Indeed, Christian and Dake's study focused on the national prevalence of co-occurrence of undernutrition and overweight/obesity in a child and/or woman within households. Irach *et al*., on the other hand, looked at the prevalence of overweight/obesity and anaemia among mothers and their children under the age of five within households.

3.4. Factors Associated with Double Burden of Malnutrition in Households

Urban/rural residence, income, age of child and mother, household size and mother's level of education were frequently assessed for their impact on health. Factors associated with DBM are summarized in **Table 5**.

- **Urban/rural residence**

A total of seven studies have investigated the association between place of residence and DBM within households [9] [21] [24]-[28]. In six cases, there was a positive relationship between DBM and urban residence. These studies demonstrated that the urban environment was associated with higher odds of overweight and lower odds of anemia in households. The association between place of residence and the probability of stunting in children shows different trends. Children living in rural and semi-rural areas have higher probabilities of stunting than those living in urban areas. They also report higher probabilities of overweight in households in peri-urban and urban areas than in rural areas [29].

- **Socioeconomic level, household income or wealth**

Eight studies have reported the relationship between household wealth and DBM [9] [23]-[28] [30]. Results concerning household wealth status indicate that, on the one hand, increasing household wealth status is associated with a lower probability that a household is undernourished or anemic, but on the other hand, increasing household wealth is associated with a greater probability that the household is overweight/obese. Similarly, the likelihood of a household being subject to DBM increases with household wealth [23] [28] [29] [31].

- **Age of child, mother**

Seven studies have reported an association between age of child, mother and DBM [9] [23] [25] [29] [31]. The study by Dembélé *et al*. in Benin reported that overweight or obese mothers were more likely to have a stunted child under the age of five. The risk of stunted growth in children increased with the mother's age. Compared with mothers aged under 25, the risk was 1.750 (CI 95% = [1.300 - 2.355]) for mothers aged 25 - 34, and 2.617 (CI 95% = [1.888 - 3.626]) for those aged 35 - 49. This increased risk of growth retardation was therefore associated

Table 5. Factors associated with DBM in included studies.

Country	Associated factors	References
Cape Verde	Household size, gender of head of household, place of residence, level of education of head of household, level of household expenditure.	[24]
30 sub-Saharan African countries	Place of residence (urban or rural) mother's age, mother's occupation, household size, household access to water, household access to sanitation.	[29]
Benin	Child's age, level of education, mother's occupation, mother's age, household size, household socioeconomic level, household food security, means of transport, ethnicity, mother's height and social status.	[25]
Benin	Household size, lack of latrines, drinking water consumption, ethnicity, socio-economic status.	[30]
Tunisia	Child's age, mother's age, parity (mothers with three or more children), mother's total energy intake.	[32]
Kenya	Household wealth, urban residence, age of child, gender.	[26]
Ethiopia	Place of residence, religion, household size, housing quality, household wealth, sanitation.	[27]
23 Sub-Saharan African countries	Household size, availability of drinking water, availability of improved toilets, availability of improved sanitation facilities, household wealth, age of child, age of mother, marital status of head of household, level of education of mothers.	[23]
Tanzania	Mother's age, occupation of head of household, low birth weight, place of residence, household wealth.	[28]
49 low- and middle-income countries	Household wealth, mother's level of education, area of residence	[9]
Ethiopia	Maternal age, urban residence, household wealth, number of children under 5 in the household	[38]
Ethiopia	Average wealth index, birth weight, age of child	[31]

with the mother's advanced age [25]. Similar results were reported by Sassi *et al.* in a study in Tunisia. Pairs in which the mother was over 30 years of age were at greater risk of DBM than pairs in which the mother was under 30 years of age [32]. Christian and Dake report in their study that the risk of a household being undernourished decreases with women's age, from 20 to 49. Similar results were

observed for anemia, but were only statistically significant for women aged 25 to 49. The risk of a household being overweight/obese increased with the age of the women of childbearing age in the household. Again, the risk of a household being doubly affected by malnutrition increases with the age of women of childbearing age, 25 - 49 and 35 - 49, respectively, compared to a 15 - 19 year-old woman in the household [23].

- **Household size**

Five studies have reported an association between household size and DBM [23] [25] [27] [29] [30]. Dembélé *et al*. reported that a household size greater than or equal to five conferred a 34.6% increased risk of DBM (CI 95% = [1.025 - 1.694]) compared with households of smaller size [25]. Similarly, Alaofè and Asaolu reported that a large family was significantly associated with DBM [30]. Christian and Dake reported that increasing household size is associated with a higher probability of undernutrition and anemia, but a lower probability of overweight or obesity at the household level [23].

- **Mother's level of education**

Four studies have reported an association between maternal education and DBM [9] [23] [25] [29]. These studies reported that increasing the educational level of women of childbearing age in the household was associated with a lower probability that the household was undernourished or anemic, but increasing the educational level of wooverweight/obese [9] [23] [24] [29]. However, Christian and Dake report in their study that, when considering the educational level of women of childbearing age within the household and DBM, only tertiary education (among women of childbearing age) was associated with a lower probability of a household having a DBM [23].

- **Other associated factors**

Several other factors have also been reported by studies as being associated with DBM within households. These include the gender of the head of household, the mother's occupation, household food security, the availability or non-availability of a source of drinking water within the household, the availability or non-availability of improved toilets, and parity. Regarding the gender of the head of household, Dop *et al*. report that the proportion of households with DBM is higher when the head of household is a man [24]. Dembélé *et al*. reported that, compared with mothers working in agriculture, unemployed mothers were more likely to be overweight or obese, and to have a stunted child under the age of five. Moreover, improved household food security goes hand in hand with increased DBM [25]. Christian and Dake's results also reveal that an unimproved drinking water source is associated with a lower probability of a household being anemic or having DBM. Household sanitation status, *i.e*. whether the household has improved or unimproved toilets, is significantly associated with household DBM. Specifically, households with improved toilets were more likely to have an overweight/obese child or adult female, but less likely to be undernourished. Households with better sanitation facilities were also more likely to

be DBM households. [23]. Parity was specifically associated with DBM in the study by Sassi *et al*. Households in which mothers had three or more children (as opposed to one or two) were significantly more prone to DBM [32].

4. Discussion

This study is a systematic review of the published literature, focusing on the double burden of malnutrition within households. It included seventeen studies. They were published between 2012 and 2022. The year of data collection for the various studies ranged from 2000 to 2019. This indicates that the subject has attracted scientific interest in recent years.

In these studies, age classifications varied considerably. Some studies considered individuals in the 15 - 19 age group to be adults, while others considered them to be children or adolescents. In terms of indicators, some studies used the Z-score height-for-age as an indicator of undernutrition, while others used weight-for-height or weight-for-age. Since the height-for-age Z-score better reflects chronic malnutrition, it is preferable to use it for children in DBM studies.

The national prevalence of households with DBM in these studies varied according to the type of DBM (type of combination of overweight/obesity and undernutrition) and ranged from 1.71% to 38.7%. Some studies assessed the co-occurrence of undernutrition and overweight/obesity in one child and/or one woman within households, while others assessed all household members. National prevalences of DBM within households were higher for studies on the co-occurrence of anemia and overweight/obesity in a child and/or woman within households than for studies on the co-occurrence of undernutrition and overweight/obesity in a child and/or woman within households. This could be explained by the high prevalence of anemia in the population, particularly among women of childbearing age and children under five. South Africa was the country with the highest household prevalence of DBM. We can see that the double burden of manutrition is growing in Africa, and that specific interventions need to be implemented to improve the nutritional status of populations. In the articles selected, the factors most cited as being associated with DBM within households were urban/rural residence, income, age of child and mother, household size and mother's level of education. Other factors such as the gender of the head of household, the mother's occupation, household food security, the availability or non-availability of a source of drinking water within the household, the availability or non-availability of improved toilets and parity were also cited. With regard to place of residence, studies show that peri-urban areas are factors linked to the development of double burden of malnutrition. Indeed, the urban environment is characterized by increased access to fast food. In West Africa, transnational food companies such as supermarkets, fast-food chains and beverage industries have established themselves in most major cities [39]. Transnational food companies have the ability to lower the prices of fast food or soft drinks to make them more affordable and reach a larger segment of the

market [40]. This competitive advantage leads to a situation in which healthier food can be more expensive than less healthy food, as has been reported in urban areas of South Africa [41]. Increased access to fast food is associated with childhood obesity [42]. It is estimated that a one-unit increase in fast-food consumption is associated with an increase in age-standardized BMI per capita in high-income countries [43]. Similarly, the unavailability of clean drinking water, improved toilets and limited access to food for rural populations are associated with DBM by increasing the prevalence of undernutrition. [29]. Studies have shown that the risk of an overweight or obese woman having a malnourished child increases with age. Although there is no precise age, these articles indicate that after the age of 35, this probability increases. It can be said that an obese woman increases the risk of having a low-weight child as age increases, although the effect is not yet clear [44]. The literature reports other characteristics, such as the mother's height, which affect the child's nutritional status. Indeed, this factor can be explained by the physiological inability of some short women to have their uterus support and provide the baby with the necessary nutrients [36].

The level of household income or socio-economic status was linked to the occurrence of DBM within the household. Indeed, studies emphasize that households with sufficient income are more likely to suffer from DBM. Indeed, the quality of food may not be sufficient to provide the nutrients needed for children's growth, and may lead to obesity in adults (mothers). In addition, economic barriers prevent children from benefiting from adequate nutrition and a better food environment. Indeed, low income also forces some families to live in houses with unsanitary infrastructures, which poses a threat to the health of the people living there, especially children. Thus, households with insufficient income are also likely to suffer from DBM [45].

The level of education of the mother or head of household influenced the nutritional status of household members through low knowledge of appropriate diets and the harmful effects of overeating. Education levels can also influence income levels, and therefore diet and sedentary lifestyle. In Christian and Dake's study, tertiary education (among women of childbearing age) was associated with a lower likelihood of a household having a DBM [23]. On the other hand, in a study by Kimani-Murage in South Africa, a low level of education protected against overeating [20].

The influence of mothers' occupations on the occurrence of DBM within households is not to be overlooked. On the one hand, a working mother would be able to buy more and more varied foods. Thus, the risk of DBM decreases when the mother works [46]. However, some authors claim that if mothers work, they have less time to prepare quality food and prefer to resort to fast food. Therefore, the association of mother's occupation with DBM in some households could be attributed to mothers' lack of time for proper menu planning, food selection, preparation and effective child-feeding practices [47] [48].

Household size is an important aspect contributing to the occurrence of DBM

within households. Indeed, a large family increases the economic barriers to adequate child nutrition and a better home environment [49]. Furthermore, in low-income families, the more people there are in the household, the less food each household member consumes [47].

It is therefore important to take these different parameters into account when designing and implementing the various interventions aimed at preventing the DBM in Africa. Individual, community and societal factors must also be studied and taken into account in the various interventions.

5. Conclusion

DBM at household level is a complex public health problem. In Africa, the national prevalence of households with DBM was generally above 10%. An upward trend in the prevalence of DBM has been observed in various countries. Urgent measures must be taken to counter the phenomenon. This study has identified the factors associated with this phenomenon. The main challenge is to promote a balanced diet to resolve the malnutrition paradox, while encouraging physical exercise. Intervention targeting should take into account urban/rural residence, income, age of child and mother, household size and mother's level of education, to maximize results. In the long term, educating young girls, improving their social status and reducing poverty can break the cycle of under- and over-nutrition. Improving mothers' knowledge of nutrition and health involves organizing nutritional education sessions, and disseminating nutritional and health advice in local languages.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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