

Prevalence and Determinants of Maternal Malnutrition in Africa: A Systematic Review

Prince L. Bestman (PLB)^{1,2,3}, Atipatsa C. Kaminga (ACK)^{4,5}, Jiayou Luo (JYL)^{1,*}

¹Department of Maternal and Child Health, Xiangya School of Public Health, Central South University, Changsha, Hunan Province, P. R. of China

²Phebe Hospital and School of Nursing, Bong County, Liberia, West Africa

³Nurse-Anesthetist John F. Kennedy Memorial hospital, Monrovia, Liberia, West Africa

⁴Mzuzu University, Department of Mathematics and Statistics, Private Bag 201, Luwingu, Mzuzu, Malawi

⁵Department of Epidemiology and Health Statistics, Changsha city, Hunan province, P.R. of China

***Corresponding Author: Prof. Jiayou Luo**, Department of Maternal and Child Health, Xiangya School of Public Health, Central South University, 110 Xiangya Rd, Changsha, Hunan, P.R. of China, **Email:** jiayouluo@126.com

Abstract

Introduction: Malnutrition is a serious public health condition affecting a huge proportion of reproductive age women worldwide. Prevalence of malnutrition among reproductive age females is unsatisfactorily high in most African setting.

Objective: This review was conducted to objectively investigate the prevalence and determinants of malnutrition in Africa

Search Strategy: The advance search option was used with the keywords; prevalence, maternal malnutrition and Africa.

Selection Criteria: Cross-sectional studies Published from January 1st, 2000 to December 31st 2019 on maternal malnutrition in Africa where body mass index or Mid Upper Arm Circumference was used to predict nutritional status of study subjects were selected.

Data Collection and Analysis: Web of Science, PubMed, science Direct, Embase, Google scholar, MEDLINE and Cochrane library were searched for relevant records.

Main Results: A total of 2,483 records were identified through electronic database searching and 16 studies involving 81,185 reproductive age females were included. Using a random effect model the overall estimated pooled prevalence of maternal malnutrition (specifically undernutrition) in Africa was 20.2 % (95%CI: 14.1-27.9; $I^2=99.482\%$).

Conclusion: Most women in Africa are suffering of malnutrition. Therefore, more focus should be directed toward ensuring appropriate and extensive application of plans for malnutrition prevention and management.

Abbreviations

ANC: Antenatal Care, BMI: Body Mass Index, CMA: Comprehensive Meta-Analysis, LBW: Low-birth-weight, MM: Maternal Malnutrition, MUAC: Mid Upper Arm Circumference, NOS: Newcastle-Ottawa Scale, PPH: Postpartum Hemorrhage, WHO: World Health Organization

Keywords: Prevalence, Determinants, Maternal Malnutrition and Africa (2000-2019).

1. INTRODUCTION

Globally, approximately two billion people are plagued by various forms of malnutrition which accounts for 11% of the worldwide burden of the disease [1]. Maternal malnutrition (MM) is known to make bigger the risk of poor

pregnancy outcomes such as obstructed labor, premature birth or low-birth-weight (LBW) babies and postpartum hemorrhage [2]. Malnutrition amongst women of reproductive age is a primary public health difficulty in many South Asian and sub-Saharan African countries,

where more than 20% of women are considered undernourished (Body Mass Index or BMI < 18.5kg/m²)[3]. Maternal malnutrition for this review indicates under nutrition, therefore both term are used interchangeably. Under nutrition is the type of malnutrition normally affecting people in many low and middle income countries, in spite of the enormous development in health offerings [4, 5]. Maternal under nutrition is particularly established in resource-poor settings, typically ranging from 10% to 19% in these settings, however achieving up to greater than 20% in some areas, such as in sub-Saharan Africa, south-central and southeastern Asia, and Yemen[6]. Maternal malnutrition in current years has turn out to be a integral theme of Public challenge as it is associated with upward push in maternal-child morbidity and mortality. The World Health Organization (WHO) classifies malnutrition as the greatest threat to public health[7]. Notwithstanding, precise dietary repute of reproductive age women is an essential thing for better effect for mothers and their children's health as well as for their family[1]. A child's development depends absolutely on the mother's dietary fame throughout fetal existence and the first six months of life after delivery [8]. Maternal malnutrition is now a vital difficulty in many countries In South Asia and sub-Saharan Africa and it have an effect on up to 40% of reproductive age females in some of these regions[3]. Children and women of reproductive age are the most inclined agencies to malnutrition due to vitamin A, iodine, anemia and iron deficiencies [9]. Multi-countries studies have furnished empirical evidences that dietary variety scores are dependable measures for micro- and macro-nutrient adequacy for women of reproductive ages[10]. Therefore, numerous diets are anticipated to enhance nutritional profile and as a result limit the risk of maternal-child morbidity and mortality. To address maternal malnutrition in low resources limited areas, many programs with proof of effectiveness have been recognized, such as iron folate and micro-vitamins supplementations programs and deworming program [11]. Regardless of the efforts taken in sinking malnutrition prevalence, the magnitude of malnutrition (body mass index [BMI] <18.5 kg/m²) remains high(10% to 40%) among reproductive age women in most low- and middle-income countries of Sub-Saharan Africa and South Central and South Eastern Asia[1].

Maternal under nutrition is an international health issue affecting more ladies in developing countries[12]. The burden of malnutrition in the form of under nutrition among reproductive age women is a global public health problem that need more attention[13]. Maternal under nutrition affect fetal growth and development during the first 2 years of life and is a major contributor of both stunting of linear growth and subsequent obesity and non-communicable diseases later on in adulthood[11]. Maternal under nutrition affect fetal growth and development at some stage in the first two years of life and is an essential contributor of both stunting of linear growth. Maternal under nutrition decreases efficiency, prolong restoration time from sickness and amplify susceptibility to infections and death[14]. In general, malnutrition have a lengthy records of unsafe results on women and children health, therefore, working on its prevention is a durable asset that will benefits the current and future generations[15, 16]. Maternal under-nutrition is a worldwide public health problem that is persistent and destructive in many low and middle-income countries, affecting higher proportion of reproductive age females in these settings, where approximately more than 3.5 million females of reproductive age die annually due to direct or indirect causes[17].

The prevalence of maternal malnutrition in Africa is still not too clear as there exist relative difference in reported prevalence rate among published studies. Few studies have assessed the prevalence of maternal malnutrition, but the results are controversial across studies and regions. According to the 2018 World Health Organization (WHO) African regional data, between 2000 and 2015, nine countries in Africa had maternal malnutrition Prevalence rates above 15%. Maternal underweight exceeds 20% in Ethiopia, Madagascar and Senegal while the lowest rates of underweight amongst women have been determined in Benin, Cameroon, Ghana, Lesotho, Rwanda and Togo[18]. In a study conducted among rural women of reproductive age in Bangladesh, the prevalence of malnutrition among the study population was estimated to be 34%[19].

Screening equipment for measuring maternal malnutrition varies from one place to another in Africa. Most studies used the body mass index (BMI) and mid-upper arm circumference (MUAC) as screening equipment for measuring maternal malnutrition in Africa. These tools are necessary in identification of not only

malnourished females but also of females at threat of malnutrition. Women whose BMI is <18.5kg/m² or with Mid Upper Arm Circumference (MUAC) under 21 cm might have unhealthy pregnancy outcomes due to the risk of malnutrition[20]. Preexisting conditions like under nutrition and anemia are among the most frequent cause of 28% maternal death[20]. These maternal health issues can be minimized and prevented through iron folic supplementation programs for reproductive age women to improve pregnancy outcomes. Provision of quality antenatal care (ANC) services with splendid records keeping is also essential for good pregnancy outcome.

The World Health Assembly and the Sustainable Development Goal files definitely highlight the significance of introducing vitamin policy applications that offers exceptional interest to mother and infant diet among member nations. Implementation of such strategies place in national and global documents need to be decentralize in every setting in low and middle incomes countries, especially in rural African communities for the prevention and control of malnutrition. Concrete Information on maternal malnutrition in Africa is essential for prioritizing, designing and initiating intervention programs aimed at preventing maternal-child morbidity and mortality. We therefore, performed this systematic review with the aimed to provide evidence base report of the prevalence and determinants of maternal malnutrition in Africa that will serve as a tangible data for future

research and for policy making and implementation of strategy to reduce maternal-child morbidity and mortality.

2. MATERIALS AND METHODS

A priori inclusion and exclusion criteria were developed by reviewers to pre-define the objectives and methods for the review. An initial limited systematic search was performed in a selection of relevant databases to find published research-based articles reporting on maternal malnutrition. The search was performed to primarily identify Cross-Sectional studies published from January 1st, 2000 to December 31st, 2019 that reported on outcome of interest to the review. Seven relevant electronic databases were searched to identify eligible articles for inclusion into the review. The reference lists of all identified articles were also searched for additional records that may have not been captured during the initial electronic database search. The systematic search performed yielded a total of 2,483 records, (google scholar: 2,200results, Elsevier/Science Direct: 185results, Web of science: 65results, PubMed: 16results, Embase: 5results, Cochrane library: 5results, Medline: 4results and 3 additional records obtained from reference searching). Reference management software, End Note X9 was used for recording and organizing all relevant bibliographic citations for the review. Initially, keywords used to search each data base were: Prevalence, determinants, maternal malnutrition and Africa. See Table 1 for detail of the final search terms and search strategy used per database.

Table 1. Search terms and Search strategy per database

Search terms	Search Strategy Per database
Prevalence Maternal- Malnutrition Africa 2000-2019	<p>Web of science core collection: advance search: #1 TS=prevalence (Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2019), #2 TS=maternal malnutrition (Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2019), #3 TS=Africa (Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2019). #3 AND #2 AND #1 Combine= (Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2019).</p> <p>MEDLINE: advance search: #1 TS=prevalence (Indexes=MEDLINE Timespan=2000-2019), #2 TS="maternal malnutrition" (Indexes=MEDLINE Timespan=2000-2019), #3 TS=Africa (Indexes=MEDLINE Timespan=2000-2019), #3 AND #2 AND #1 Combine= (Indexes=MEDLINE Timespan=2000-2019).</p> <p>Cochrane library: advance search: Title abstract keywords=Prevalence AND "maternal malnutrition" AND Africa, send to search manager.</p> <p>EMBASE: advance search: 'prevalence' AND 'maternal malnutrition' AND 'Africa' AND [2000-2019]/py.</p> <p>PubMed: advance search: ((prevalence) AND "maternal malnutrition") AND Africa.</p>

	<p>Elsevier/Science Direct: advance search: Prevalence AND “maternal malnutrition” AND Africa (2000-2019). Google scholar advance search: “Prevalence” AND “Maternal malnutrition” AND “Africa”.</p>
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Institutional Review Board or Ethics Committee approval was not needed/obtained because this review data was collected from secondary sources and has to direct effect on human health. Inform consent or ethical approval was not necessary because information in this review is based on data collected from secondary sources and because this review post no direct harm to human health.

Two authors (PLB and JYL) systematically screened records to identified articles relevant

for inclusion. Inclusion criteria: Cross-sectional studies Published from January 1st, 2000 to December 31st 2019 that assessed the prevalence or determinants of maternal malnutrition in Africa, where body mass index (BMI) or Mid Upper Arm Circumference (MUAC) was used to predict nutritional status of study subjects were included Exclusion criteria: Case reports, reviews and animal studies were excluded. Studies reported as abstracts were not included if there was insufficient information to allow assessment of the risk of bias.

Table 2. Assessment of methodological quality using the Newcastle – Ottawa Scale (NOS)

Study	Selection			Comparability				Outcomes
	Representativeness Of the sample	Sample Size justification	Non-respondents	Ascertainment of the exposure	Comparability of Subjects & Control of Confounding factors	Assessment of the outcome	Statistical test	
Dadi AF, et al. 2019	*	*	*	**	*	**	*	9 stars
Hadiya H. et al. 2019	*	*	*	**	*	**	*	9 stars
Shiferaw A, et al. 2019	*	*	*	**	*	**	*	9 stars
H. Kedir et al. 2016	*	*	*	**	*	**	*	9 stars
Amugsi DA, et al. 2019	*	*		**	*	**	*	8 stars
Petry N, et al. 2019	*	*		**	*	**	*	8 stars
Gebre et al. 2018	*	*	*	**	*	*	*	8 stars
Ravaoarisoa et al. 2018	*	*		**	*	**	*	8 stars
Ferede A, et al. 2017	*	*	*	**	*	*	*	8 stars
Saaka M, et al. 2017	*	*	*	**	*	**		8 stars
Negash C, et al. 2015	*	*	*	**	*	*	*	8 stars
Senbanjo et al. 2013	*	*		**	*	**	*	8 stars
S. A. Motadi et al. 2019	*	*		**	*	**		7 stars
Kumera et al. 2018	*	*		**	*	*	*	7 stars
Mariyam , et al. 2018	*	*	*	**	*		*	7 stars
AH Mtumwa et al. 2016	*	*		**	*	**		7 stars

QAS=Quality Assessment Score,

Two authors (PLB & ACK) independently extracted data from each of the included study. The results were compared to minimizing the likelihood that errors would go unnoticed. In case of any discrepancy, a third author (JYL) was consulted and the issue was discussed and resolved by general consensus. Information extracted were: first author name & year of publication, study design, sample-sized, country/location, time of study, method of data collection, prevalence of maternal malnutrition, tools used to assess malnutrition and cut-off point of tools used to assessed malnutrition.

The Newcastle-Ottawa Scale (NOS)[21], was used for assessing the quality of the included studies. The NOS included 3 categories with a maximum score of 10 stars. A grade of one to ten (1-10) stars was used to assess the methodological quality of the included studies (See Table 2). The quality of each study was rated using the following scoring algorithms: 8 to 10 stars were deemed as having good methodological quality, 5 to 7 stars were deemed as having fair methodological quality and 1 to 4 stars were deemed as having poor methodological quality. In order to advance the legitimacy of this systematic review result, we only included studies with good and fair methodological quality.

Using Comprehensive meta-analysis software version 2.0 & 3.0, data were collected, analyzed, and synthesized using figure and tables to facilitate classification and organization. Prevalence of maternal malnutrition obtained from each of the included studies were pooled to determine a single estimate. Heterogeneity between studies was detected using Higgins test where I^2 statistic was calculated and reported. Under representation of countries by sample size used might have affected the overall result of the review leading to high heterogeneity. Pooled estimate from random effect model was reported and subgroup-analysis was done using the study setting (country in which the included studies were conducted) along with measurement tools (BMI & MUAC) for malnutrition among reproductive age women. Using a fixed effect model, a sub-group analysis was performed to identify statistically significant determinants of maternal malnutrition.

3. RESULTS

A total of 2,483 records were identified through electronic database searching and a total of 2,467 studies were omitted through systematic

process. From the total omitted studies, 126 were duplicates, 2185 were excluded based on title and abstract screening, 156 studies were excluded from systematic review (4 reviews, 9 animals studies, 11 case report studies, 33 studies with different study design, 22 studies not conducted in Africa and 77 studies did not report on any outcomes of interest to the current review). Finally 16 studies involving 81,185 reproductive age females were included in this systematic review (see figure 1). The qualities of the 16 included studies were assessed using the New Castle-Ottawa Scale for cross sectional studies (see Table 2). Twelve of the included studies had good methodological quality and four had fair methodological quality. The study with the smallest sample size by Negash C, et al. 2015 included 197 subjects[22], while a multi-country study by Amugsi DA, et al. 2019 had the largest sample size of 64,698 subjects[11].The smallest prevalence of maternal malnutrition was estimated by Senbanjo et al. 2013 (6.7%)[23], while the largest prevalence was estimated by Ferede A, et al. 2017 (48.6%) [1].The 16 included studies were conducted in ten countries in different regions of Africa. Regions and countries where the studies were conducted are: East Africa (Ethiopia, Kenya, Madagascar & Tanzania), West Africa (Gambia, Ghana, & Nigeria), Central Africa (Democratic Republic of Congo), southern region of Africa (South Africa) and Mozambique in the South-Eastern region of Africa. All the sixteen included studies used cross-sectional design. Regarding measurement of nutritional status, Mid-Upper Arm Circumference (MUAC) and Body Mass Index (BMI) were used to estimate the nutritional status of reproductive age women in all the included studies. Two studies mention the used both MUAC and BMI, while each of the others studies used either BMI or MUAC. According to NOS standard grading score for the included studies, twelve studies had strong quality and four studies had moderately strong quality (see Table 2). Using a random effect model with the help of the comprehensive meta-analysis (CMA 2 &3) software, the overall pooled prevalence of maternal malnutrition (particularly under nutrition) among reproductive age women in Africa was estimated to be 20.2 % (95%CI: 14.1- 27.9; $I^2=99.482\%$) see table 4. Based on the current systematic review pooled effect size findings; Poor habit of hand washing practices 0.706 (95% CI: 0.657, 0.751), food insecurity 0.676 (95%CI: 0.632, 0.718), low family income 0.655 (95%CI: 0.580, 0.723), Illiterate

husband 0.392 (95% CI: 0.357, 0.427), low decision making autonomy 0.345 (95% CI: 0.314, 0.377), multi-parity 0.292 (95% CI: 0.195, 0.413), bad marital condition from a wife's perspective 0.081 (95% CI: 0.046, 0.141),

frequently coffee consumption 0.252 (95% CI: 0.186, 0.332) maternal age 0.152 (95% CI: 0.108, 0.210) are statistically significant factors that determine maternal under nutrition (see table 6).

Table 3. Characteristics of the included studies

	Study Design	Cases	Sample Size	MDC	Measuring tools	Cut-off value	Prevalence	Country/ Location	QAS
Dadi AF, et al. 2019	Cross-Sectional	135	940	IAQ	MUAC	< 22	14.40%	Ethiopia	Good
Ferede A, et al. 2017	Cross-Sectional	209	430	Q	BMI	<18.5 kg/m ²	48.60%	Ethiopia	Good
Gebre et al. 2018	Cross-Sectional	216	900	IAQ	MUAC	< 21 cm	24.00%	Ethiopia	Good
H. Kedir et al. 2016	Cross-Sectional	733	1,731		MUAC	< 22 cm	42.35%	Ethiopia	Good
Ravaoarisoa et al. 2018	Cross-Sectional	114	670		BMI MUAC	<18.5 kg/m ² <220 mm	17.00% 9.00%	Madagascar	Good
Shiferaw A, et al. 2019	Cross-Sectional	168	374	I, O, & AMSC	MUAC	<23cm	44.92%	Ethiopia	Good
Kumera et al. 2018	Cross-Sectional	65	402	IAQ	MUAC	< 22 cm	16.20%	Ethiopia	Fair
AH Mtumwa et al. 2016	Cross-Sectional	785	6,933	TDHS 2010	BMI	≤ 18.5 kg/m ²	11.32%	Tanzania	Fair
Saaka M, et al. 2017	Cross-Sectional	115	400	I & Q	MUAC	< 25.0 cm	28.80%	Ghana	Good
Mariyam et al. 2018	Cross-Sectional	196	616	Q & CL	MUAC	<21 cm	31.82%	Ethiopia	Fair
Senbanjo et al. 2013	Cross-Sectional	20	300		BMI	<18.5 kg/m ²	6.70%	Nigeria	Good
Petry N, et al. 2019	Cross-Sectional	263	1703	Q	BMI MUAC	<18.5 kg/m ² <23 cm,	11.50%	Gambia	Good
Hadiya H. et al. 2019	Cross-Sectional	83	478	SQ	BMI	<18.5 kg/m ²	17.40%	Ethiopia	Good
Amugsi DA, et al. 2019	Cross-Sectional	5,888	64,698	SDQ	BMI	<18.5 kg/m ²	9.10%		Good
		1,208	9,506		BMI	<18.5 kg/m ²	12.70%	DRC	
		160	3,012		BMI	<18.5 kg/m ²	5.31%	Ghana	
		1,180	9,993		BMI	<18.5 kg/m ²	11.80%	Kenya	
		628	11,017		BMI	<18.5 kg/m ²	5.70%	Mozambique	
		2,712	31,170		BMI	<18.5 kg/m ²	8.70%	Nigeria	
						<18.5 kg/m ²			
Negash C, et al. 2015	Cross-Sectional	28	197	SQ	BMI	<18.5 kg/m ²	14.20%	Ethiopia	Good
S. A. Motadi et al. 2019	Cross-Sectional	39	240	IAQ & FFQ	BMI	<18.5 kg/m ² >30 kg/m ²	16.30%	South Africa	Fair

QAS=Quality Assessment Score, IAQ=interview administered questionnaire, MUAC=Mid Upper Arm circumference, BMI=Body Mass Index, I=Interview, HMR=Hospital Medical Records, CL=Checklist, SI=Structure Interview, SQ=Structure Questionnaire, SDQ=Standardized Questionnaires, FFQ=Food Frequency Questionnaire, AMSC=Anthropometric measurements and standard checklists, O=Observation, TDHS=Tanzania Demographic and Health Survey, DRC=Democratic Republic of Congo

Table 4. Comprehensive Meta-analysis of Maternal Malnutrition Prevalence rate in Africa (Random effect model, N=16).

Model	Study ID	Event rate	Lower limit	Upper limit	p-value
	Dadi AF, et al. 2019	0.144	0.123	0.168	0.000
	Ferede A, et al. 2017	0.486	0.439	0.533	0.563
	Gebre et al. 2018	0.240	0.213	0.269	0.000
	H. Kedir et al. 2016	0.423	0.400	0.447	0.000
	Ravaoarisoa et al. 2018	0.170	0.144	0.201	0.000
	Shiferaw A, et al. 2019	0.449	0.399	0.500	0.050
	Kumera et al. 2018	0.162	0.129	0.201	0.000
	AH Mtumwa et al.2016	0.113	0.106	0.121	0.000
	Saaka M, et al. 2017	0.288	0.245	0.334	0.000
	Mariyam , et al. 2018	0.318	0.283	0.356	0.000
	Senbanjo et al. 2013	0.067	0.043	0.101	0.000
	Petry N, et al. 2019	0.154	0.138	0.172	0.000
	Hadiya H. et al. 2019	0.174	0.142	0.210	0.000
	Amugsi DA, et al. 2019	0.091	0.089	0.093	0.000
	Negash C, et al. 2015	0.142	0.100	0.198	0.000
	S. A. Motadi et al. 2019	0.163	0.121	0.215	0.000
Random	Overall pooled estimate	0.202	0.141	0.279	0.000

Table 5. A Comprehensive sub-group analysis on Prevalence of Maternal Malnutrition among reproductive age females in Africa (Random effect model, N=16).

Variables	# of Studies	Sample size	Pooled estimate, (95% CI)	p-value
Country where study was conducted				
Ethiopia	9	6068	0.302(0.291, 0.314)	0.000
Other African countries	7	74944	0.096(0.094, 0.099)	0.000
Tools used for Measuring malnutrition				
BMI	9	75,649	0.098(0.096, 0.100)	0.000
MUAC	7	5363	0.304(0.291, 0.316)	0.000

BMI=Body Mass Index, MUAC= Mid-Upper Arm Circumference

PRISMA 2009 Flow Diagram

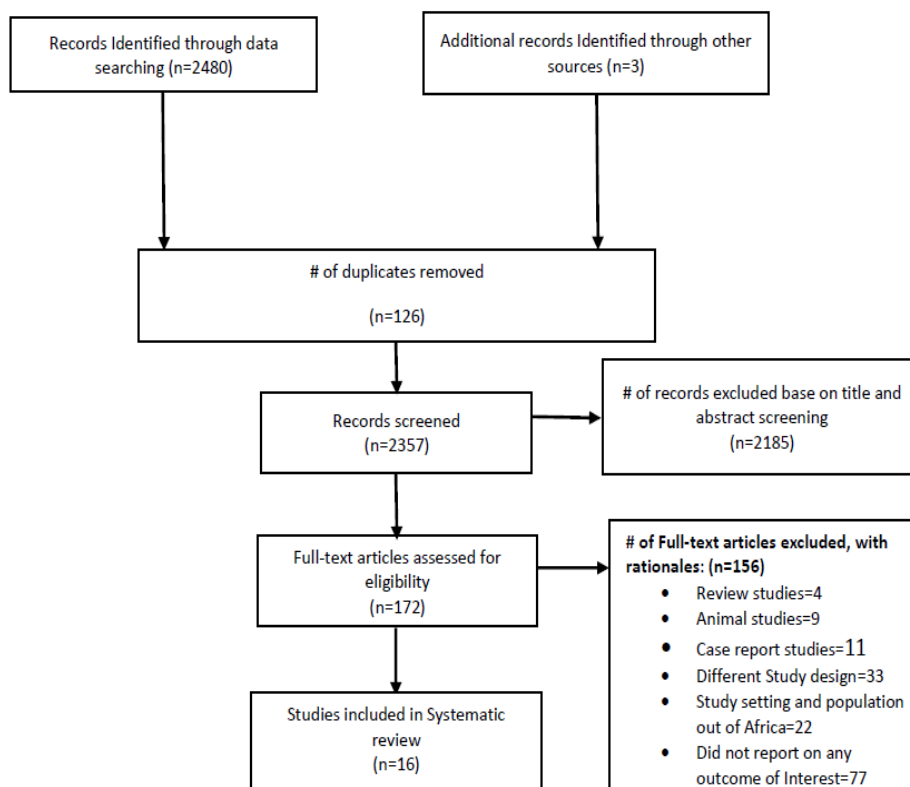


Figure 1. Process of study selection for inclusion in this systematic review

Table 6. Sub-group analysis on determinants of maternal undernutrition among reproductive age (15-49years) females in Africa (Using the Fixed effect model).

Variables	# of studies	Total number of under nourished subjects per variable	Pooled estimate(95% CI)	I ²	p-value
maternal age	2	344	0.152(0.108, 0.210)	96.327	0.000
Low maternal educational level	2	148	0.513(0.419, 0.607)	97.283	0.784
Illiterate husband	1	733	0.392(0.357,0.427)	0.000	0.000
Food insecurity	3	460	0.676(0.632, 0.718)	76.162	0.000
Unsafe source of drinking water	2	323	0.502(0.439,0.565)	98.313	0.955
Poor habit of hand washing	2	377	0.706(0.657, 0.751)	92.981	0.000
ANC visit & service provision	2	412	0.457(0.408,0.507)	96.428	0.092
Low family income	1	168	0.655(0.580, 0.723)	0.000	0.000
Bad Marital condition from a wife's perspective	1	135	0.081(0.046, 0.141)	0.000	0.000
Coffee drinking	1	135	0.252(0.186, 0.332)	0.000	0.000
Low Decision making autonomy	2	901	0.345(0.314, 0.377)	94.808	0.000
Maternal Anemia	2	261	0.529(0.468, 0.589)	0.000	0.354
Rural residence	1	65	0.508(0.388, 0.626)	0.000	0.901
Multi-parity	1	65	0.292(0.195, 0.413)	0.000	0.001
Intestinal parasite	1	65	0.538(0.417, 0.655)	0.000	0.536

#=number, 95%CI=95%Confidence interval

4. DISCUSSION

This review assessed the prevalence of maternal malnutrition (specifically under nutrition) among reproductive age women in Africa and estimate 20.2% overall prevalence rate. This review finding is in agreement with the widespread assumption that the prevalence of maternal malnutrition appears to be much lower in almost all regions of the world except in Africa. The prevalence of maternal malnutrition in Africa was reported as 23.5% in one systematic review and meta-analysis[24] while we estimate 20.2% in this current review. Despite the drop in prevalence rate of maternal malnutrition in Africa as reported by this current review compared to past review findings, more efforts is still required to prevent and manage malnutrition because our prevalence estimate exceed 10%, which is a cut-off score for declaring maternal malnutrition as a major public health problem[25, 26].

The prevalence of maternal malnutrition in Africa has not been so clear over the past few years. Several studies have tried estimating the prevalence of maternal malnutrition but their findings varies relatively from one country to another. A study conducted on the prevalence and determinants of malnutrition among reproductive aged women of rural Bangladesh estimated 34.0% prevalence rate among the study subjects[27]. Several studies conducted in Africa on maternal malnutrition, estimated different prevalence rates for malnutrition among reproductive age women such as: 6.70%

[23], 16.2% [28], 16.30% [29], 42.35% [30], and 44.92% [17]. This variation in prevalence rate among studies is most likely associated with the screening tools used to measured malnutrition. This can be witnessed by the result from our sub-group analysis (see table5).

Maternal age showed a statistically significant association with maternal under nutrition among mothers. Based on these review findings, it is evidence that the age of a mother significantly influence hernutritional status. As the age of a mother increased by one year, her risk of under nutrition decreases. In the case of young mothers, apart from inadequate development of their reproductive system and their need of nutrition for their growing body, they are often bizarrely encircled by uncomplimentary nutritional conditions [31-33]. This finding is consistent with study conducted in Bangladesh [34], southern Ethiopia [35] and Lebanon [32]. Bad marital condition from a wife perspective was found to be an important predictor of mothers' nutritional status. A bad marital condition explained as unhappiness in a marital relationship would affect the support or care that the mother should get from her partner and this can indirectly affect her nutritional condition. Psychologically it might decrease the woman eating hobbies thus increasing her risk of malnutrition. We found that frequent coffee drinking increased the risk of under nutrition among pregnant mothers. Mothers who occasionally drink coffee are less likely to develop malnutrition compared to those who

consumed coffee frequently. This is scientifically evidenced that moderate caffeine intake (300 mg/day) or taking about three cups of coffee is probably not harmful to pregnant mothers [36, 37] but taking a large amounts of caffeine may cause nutrient depletion and interfere with nutrient absorption [36, 38] thus increasing the risk of malnutrition. Household food insecurity was also another variable that showed statistically significant association with maternal under nutrition. Women from household with food insecurity have 67.6% increased risk of becoming undernourished as compared to their counterparts. This finding is consistent with findings of studies conducted in Tigray region [39], Gambella [40] and in Nepal (Acharya SR BJ, Timilsina DP. 2017). Women who had low decision making autonomy at household level have 34.5% increased risk of being malnourished as compared to those who had high decision making autonomy. This finding is consistent with findings from studies conducted in eastern Ethiopia by Kedir H BY in 2016 and in rural India by Oakley L BC in 2017. This review found that the probability of being undernourished among women who demonstrated poor habit of hand washing practices is 70.6% higher than that of their counter parts in Africa. This finding on hand washing habit should be highlighted for preventive intervention measures in all of Africa. This review found that women from household with low family income >30.00USD or >1000 Ethiopian Birr monthly have 65.5% increase risk of being undernourished as compared to those from household with better family income. This finding is consistent with the findings from studies conducted in eastern Ethiopia by Kedir H BY in 2016 and in rural Bangladesh [27]. Another finding of this review that affects women's nutritional status is multiparity. The risk of under nutrition increases as parity advances. Multiparous women have 29.2% increase risk of being malnourished as compared to their counterparts. This finding is consistent with the facts that repeated reproductive cycles deplete maternal nutrition store. Moreover, higher-level of parity compels women to take care of their children rather than protecting their own health and nutritional status mostly in limited household resources event. This finding is also found in previous studies by Belete Y NB and Firehiwot M in 2016 and by Okwu GN UA in 2008. The current review report that women with illiterate husbands has 39.2% risk of being malnourished. Women, whose husbands are educated, may have better

access to information regarding nutrition during pregnancy through their husbands. Therefore, women in this category may get better health and nutritional support than their counterparts.

Nutrition has profound effects on human's health throughout the course of life and it is indistinguishably associated with cognitive and social development of children, specifically in early childhood. Nutritional standing of reproductive age women before conception and during pregnancy is critical for fetal growth and development. Mtumwa AH in 2016 reported that malnutrition among women don't only have a major impact on their health, but also on their children's health, because a chronically undernourished woman is most likely to give birth to an undernourished child, causing the cycle of under nutrition to be repeated over generations. In most low resource settings, maternal malnutrition is associated with an increased risk of maternal morbidity and mortality and with poor pregnancy outcomes such as low birth weight and preterm birth babies [25]. Children born in such condition might not be able to achieve their full growth and developmental potential because of effects of maternal malnutrition during fetal life. Sub-optimal dietary practices, lack of education and limited access to nutritional diet and information, compromise the nutritional status of reproductive age women in resource poor settings (Hadiya Hassen Tikuye 2019). In agreement with these findings, it would be correct to estimate that 20.2% of reproductive age females in Africa are suffering from malnutrition (specifically under nutrition).

5. LIMITATIONS

This review is subject to few limitations. Firstly, there was no eligible study from some regions in Africa to be included in this review. For example, none of the included studies in this review came from the Northern region of Africa. For some African countries, there were only few studies with sample size which might not have been representative of the whole population in that region. Additionally, few of the included studies had large sample size which might have influenced the overall result of this review.

6. CONCLUSIONS

The interrelationship between a mother and her child nutritional status stresses the value of improving maternal nutritional status as this could improve both maternal and child health

outcomes. Adequately addressing challenges of maternal malnutrition in Africa is essential to ensuring optimal cognitive growth and development for women of reproductive age. Therefore, more is required of policy makers, health care providers, civil society organizations and programs implementers in combating this deadly disease.

7. AUTHORS' CONTRIBUTIONS

PLB developed the search strategy, which was reviewed by JYL. PLB and ACK extracted data and did the statistical analysis. PLB & JYL assessed the quality of the included studies. PLB drafted the final manuscript and after reviewing it, all the authors agree it was ready for submission.

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