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Prevalence and Major Contributors of Child Malnutrition in Developing Countries: Systematic Review and Meta-Analysis

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Abstract

Introduction: Malnutrition Ignited from various underlying causes and inequalities was part of the human phenomenon and daily encountering bad news. Children, pregnant and lactating women, an old and sick person were highly vulnerable to inequalities and malnutrition; requiring special focus to addresses underlying cause in addition; to the provision of dietary assistance.

Objective: The main objective of this systematic review and meta-analysis was determining the prevalence and major contributors of under-five children malnutrition in developing countries.

Methods and materials: We conducted an exhaustive search of literature published between 2006 and 2015 on under-five malnutrition using pub med, Embase, and Google Scholar search engine. Data has been abstracted from 10 articles published in developing countries. For data abstraction, excel spreadsheet was used. In addition; STATA 11 software was used to run meta-analysis, subgroup analysis, and meta-regression.

Finding: Even though heterogeneity was high between studies the overall prevalence under-five malnutrition in developing countries was about 43% but it varies between 20% and 71%. Meta-analysis and subgroup analysis has revealed high heterogeneity between included studies and meta-regression by using the year of publication as covariate has indicated insignificant coefficient.

Discussion and Conclusion: Under-five children's nutritional problem was embedded in health and nutritional status of mothers during adolescence, pregnancy and breastfeeding periods. Factors like food insecurity coping strategies, the health status of children, maternal health, political systems the country, and communities cultural background were major determinants of under-five children malnutrition. Strategies developed against under five children

malnutrition has to focus on prevention, treatment, and control through considering nutrition specific and nutrition-sensitive programs with evidence-based; multi-level and multi-stakeholder involvement.

Introduction

It is not more than a decade for recognizing nutrition as "nutrition is many things". The first well recognized high-level declaration "eliminate hunger and all forms of malnutrition within a decade" have been held in Rome Italy in 1992 after decades of suffering. But ensuring healthy nutrition for citizens has an irreplaceable role beyond satisfying a sense of hunger by improving human capital, reducing healthcare expenditure, boosting learning potential and competitiveness, increasing work task force, improving productivity, resolving threats for climatic change, environmental degradation, conflict and migration and achievement of broad national and global goals [1].

Currently, nearly 1 billion people were undernourished; 1 billion of them were already overweight and obese and almost 2 billion were suffering from hidden hunger globally. When basic, underlying and immediate causes of malnutrition are examined critically the issue of malnutrition if not limited to food shortage. It can be addressed if and only if there is a commitment, multi-level, multi-sectorial and multi-stakeholder responsibility and evidence-based intervention focusing on the undertaking of nutrition specific and nutrition-sensitive programs targeting on prevention, control and treatment of malnutrition but not by dumping quintals of refined, energy dense nutrient empty agricultural products [2].

Children are with high nutritional need but most vulnerable due to low social status, poor diet, and ill health and inappropriate care. In addition, children of rural smallholders and urban poor were also highly vulnerable to malnutrition due to inability to withstand the effect of the climatic change,

volatile food price, globalization and global trade on nutrition [2]. About 255 million under-five children were suffering from malnutrition that impacts mortality, morbidity, impaired learning potential, and limited participation in individual affairs, community and national development and productivity agendas. The problem was propagated from various factors including food insecurity, lack of provision of care, limited access to health care services, inability access and utilizes commonest community resources like water and land [3]. Therefore this systematic review was based on the argument of “malnutrition is so much more than shortage of food” and has no one fit for all solution to treat, control and prevention: evidence-based intervention is urgent and mandatory.

Objective of the Review

The objective of this systematic review and meta-analysis of literature was determining the prevalence and major contributors of under-five children malnutrition in developing countries in addition to visible food shortage and food insecurity.

Method and Materials

Materials

A nine-item new castle–Ottawa quality assessment tool was used to assess and appraise the quality of eligible articles for this systematic review. We used excel spreadsheet for extraction of data for meta-analysis and Meta-regression. Heterogeneity test, publication bias test, meta-analysis, subgroup analysis and meta-regression were fitted using the Stata 11 software.

Inclusion Criteria

All primary research articles and national and international reports published on under-nutrition, obesity, and overweight between 2006 to 2016 on under five years children and reporting either form of malnutrition were included for this systematic review and Meta-analysis.

Search Strategy

To archive reports and articles for this systematic review, we have searched evidence from PUBMED, EMBASE, and Google Scholar by using keywords of malnutrition, under-nutrition, acute malnutrition, chronic malnutrition, underweight, overweight, and obesity. During searching of PUBMED, we used (MeSH) [1] to search medical subject headings, (MESH) [2] to look up abstract and title and (MeSH) to combine [1] with [2] using Boolean logic (Figure 1).

Results

About ten articles were included in this systematic review and meta-analysis that scored at least three New Castle-Ottawa critical appraisal points. Among included articles five had reported stunting, underweight and wasting, one study had reported stunting and overweight, two reported only stunting

and the rest two had reported only overweight. We run Meta-analysis which demonstrated high heterogeneity between studies. Heterogeneity between studies was high in subgroup analysis and meta-regression by the fitting of fixed and random effect model; we differed to systematic review only. Even though it is not possible to estimate the average due to high heterogeneity the prevalence of malnutrition was between 21% and 71% (Figures 2-5).

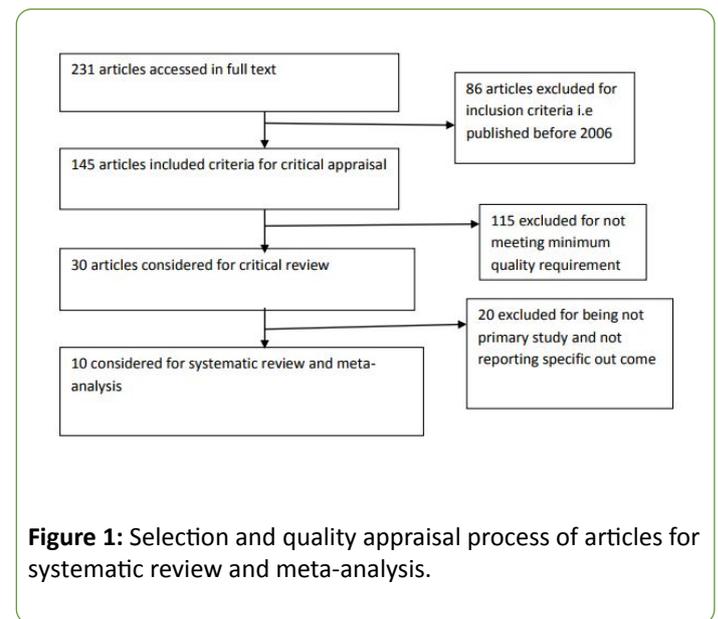


Figure 1: Selection and quality appraisal process of articles for systematic review and meta-analysis.

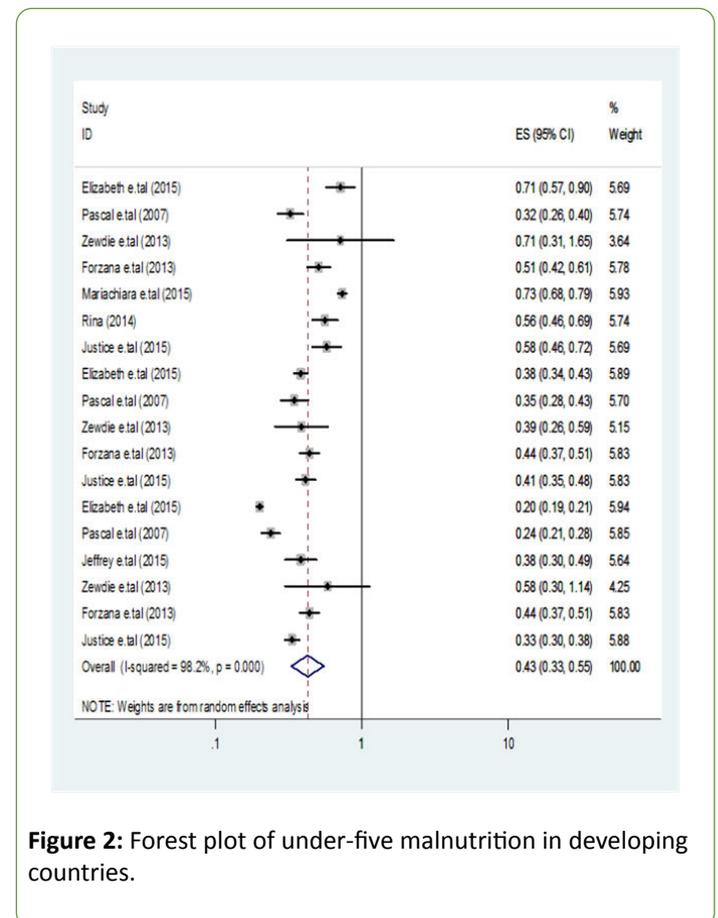


Figure 2: Forest plot of under-five malnutrition in developing countries.

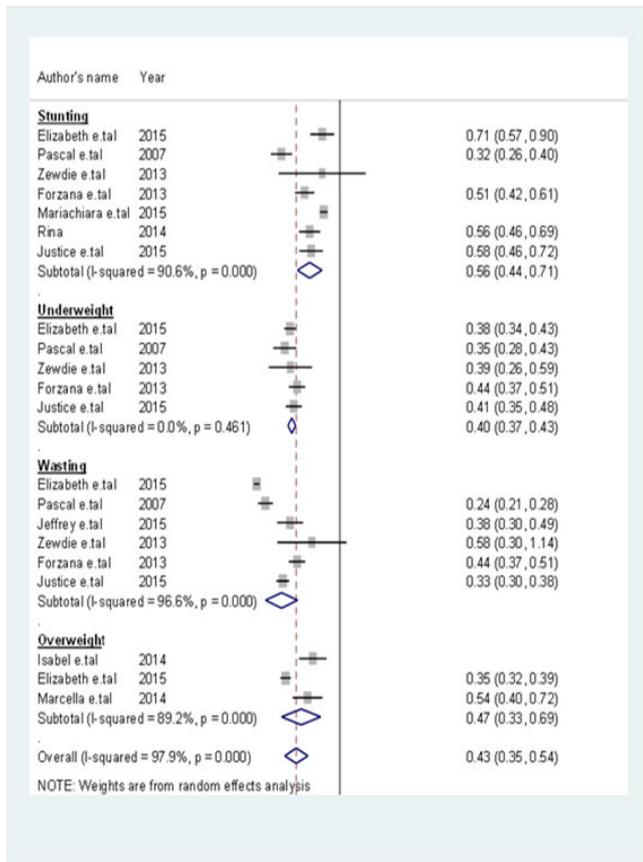


Figure 3: Forest plot of subgroup analysis of under-five children malnutrition by malnutrition category.

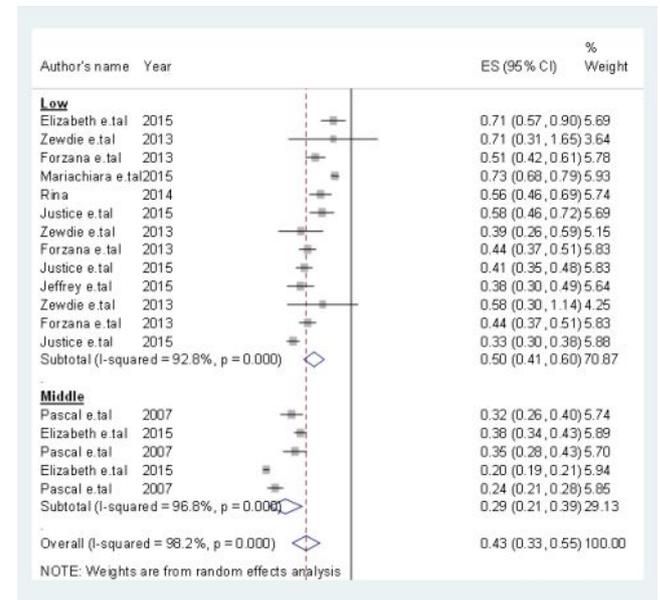


Figure 5: Forest plot of under-five malnutrition by malnutrition category.

Discussion

Malnutrition is so much more than Shortage of Food and Food Insecurity

Migration, household composition and greater distance from food store were associated factors with food insecurity and food shortage [4]. The issue of malnutrition is not only limited to the shortage of agricultural yield or its availability. Review of literature had indicated accessibility, utilization, and sustainability as important dimensions for malnutrition to be addressed. Those with the above characteristics were more vulnerable to malnutrition due to accessibility, utilization, and sustainability problems in addition to the availability of food. Borrowing money, sharing food, and relying on family and community programming were qualitatively identified food insecurity coping strategies [5]. Such coping strategies were potential risks for under-five children malnutrition by affecting the quality, quantity, and diversity of food served for under-five children. On the other hand, there would be none or less spending for health and education that affects all dimensions of nutrition. Altering food purchasing and eating pattern, reducing an amount of adult meal, purchasing less expensive food and consuming expensive food less frequently were coping strategies food insecurity and food shortage [6]. Such strategy has effect on the quality, quantity, diversity, and safety of food to be served for the family members including children putting at risk of malnutrition and illness.

Sending household members to the rural area and incorporating additional members were also food insecurity coping strategies [7-10]. Both coping strategies have a great effect on malnutrition through reduced care, nutrition, emotional support, and separation could also make children

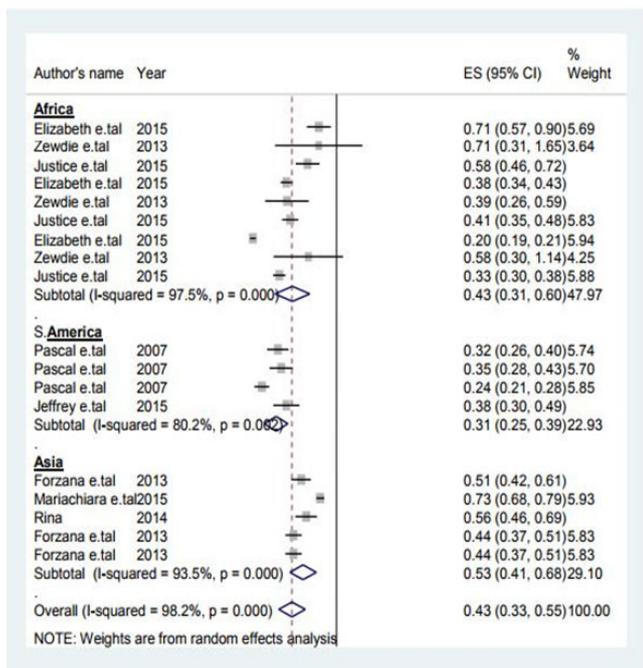


Figure 4: Forest plot of under-five malnutrition by study region.

more vulnerable to abuse, exploitation, and violation that worsens health and nutritional status. Annexation of an additional family member as food insecurity coping strategy exposes children to diarrheal and respiratory diseases related overcrowding and lack of hygiene a risk for child malnutrition. The absence of sewerage connection has had statistically associated with iron deficiency anemia and low anthropometric measurement among children [11]. Hygiene and sanitation problem can contribute to under-nutrition by increasing rate of parasitic and helminthic infection, altering consumption and increases expenditure and by increasing rate, frequency and severity of diarrheal diseases resulting loss of nutrients and electrolytes.

Severe acute malnutrition was coexisted with gastroenteritis among hospital admitted children [12]. Acute malnutrition can coexist with health disorders like gastroenteritis and HIV which usually manifested with diarrhea, abdominal pain, vomiting, and abdominal discomfort all resulting in reduced consumption, disturbed digestion, and distributed absorption and increases the loss of minerals and nutrients that attribute for child malnutrition. High prevalence of *Plasmodium falciparum* infection was positively associated with stunting [13]. Blood parasites may induce loss of appetite, make oral intake difficult during acute attack periods, increase the expenditure and make vulnerable to various infectious diseases that endanger the nutritional status of children.

Diarrhea, sepsis, bronchopneumonia, HIV, tuberculosis, scabies and otitis media were identified co-morbidities for children admitted to hospital due to protein-energy malnutrition [14,15]. All these have a negative effect on consumption, digestion, and absorption of menials and nutrients that increases the rate of expenditure and loss minerals and nutrients. Reduced weight gain was recorded with increased episode and duration of diarrheal and upper respiratory tract infection

Wasting can be a result of low consumption resulted from the suffering of diarrheal and respiratory symptoms and massive loss of minerals from diarrhea which increases with increased duration and episode.

Under-five under-nutrition was associated with food or water borne diseases [16,17]. Food and water-borne disease contribute for malnutrition by reducing consumption, increases loss and altered digestion and absorption of menials and nutrients due to disturbed integrity and function of the gastrointestinal system. Under-five children drinking water from sources of unprotected well, surface water, spring water and rainwater were with a high incidence rate of under-nutrition. Lack of sanitation and safe water supply are closely related to frequency and severity of acquiring of diarrhea, parasitic and helminthic diseases which have a direct and indirect effect on under-five malnourishment

Under-five children were risk group for a high rate of parasitic infection that simultaneously predisposes to malnutrition, hidden hunger, cognitive impairment and other chronic and acute infectious disease [18]. The absence of window screening material was shown as a predictor for reduced weight for weight

[19]. Using bed net and window screening materials can reduce the risk of vector-borne diseases risks for acute malnutrition. Immunization status, illness, antenatal care, family size, the household source of water supply and availability of latrine facility were strong predictors of undernourishment among under-five children [20]. All of the above factors can have a direct effect on children's nutritional status through altering child and maternal health, breastfeeding, dietary consumption and care of children in case if there is the alteration of the health of mothers of caretakers.

Obesity has physiological background [21]. Children born from malnourished mothers, short stature mothers, mothers affected by stress, obesity, and chronic disease were highly vulnerable to overweight and obesity at their childhood period that may be related to disproportional weight gain than gaining of height, increased intake of energy-dense nutrient-empty food and limited physical activity risk the extent of overweight and obesity. Non-optimal feeding practice, dietary diversity, breastfeeding problem, hygienic problem, inability to feed iron rich food were factors that worsen stunting [22]. All of these factors were closely related to maternal health and awareness which can be effectively address through improving maternal health and awareness during a period of pregnancy and breastfeeding in addition to ensuring food supply.

The prevalence of under-five malnutrition has a wide variability within and between regions [23]. Geographic and socioeconomic inequalities among mothers and children resulted from variability in malnutrition by limiting equitable utilization public service and reducing the capacity of withstanding difficult situations that could complicated health and nutritional problem mothers and under-five children. Low birth weight, preterm birth, multiple birth and multiparity were predictors for stunting, wasting and underweight [24]. All could affect the nutritional status of a child due to maternal health problem as it is being children of morbid, disabled or died mother were less or non-breast feed and receives less care and service which have the effect on nutritional status. Being a child of older mothers was one of the identified risk factors for stunting [25]. Older age was generally associated with the highest prevalence of chronic maternal diseases which generally related reduced household income, increased health expenditure for chronic illness and complication of pregnancy and childbirth, the difficulty of breastfeeding and provision of care that affects health and nutritional status of under-five children.

Mothers who are not covered by national health insurance are associated with increased risk of malnutrition [26]. Health insurance may have an effect on motivation and utilization of health care services during pregnancy and breastfeeding periods that may have a direct effect on under-five nutritional status through influencing breastfeeding, optimum child feeding practice, maternal and child health. Heavy workload during the third trimester, abuse during pregnancy, home delivery, less frequent ANC visit and non-utilization of postnatal service were a risk for child hold malnutrition [27]. Childhood nutritional status is highly dependent on maternal health and nutritional status that the above factors affect maternal health and

nutrition which were also determinants of under-five children malnutrition.

Low weights at birth, no feeding of colostrum and children from families without social security were highly vulnerable for stunting [27]. Stunting is a form of under-nutrition indicating a chronic deprivation of health, nutrition and stimulating environment of a child and failure to attain various maternal services at pre-pregnancy, pregnancy and post-pregnancy period during breastfeeding and care of the child that intensify the nutritional status of under-five children. Children who consumed animal source food were less likely to be stunted and underweight [28]. However animal sources food was less accessible for the vulnerable group of the population particularly for under-five children related to cost and cultural factors.

Picky eaters tended to consume fewer cereals, vegetable, fish, dietary fiber, iron and zinc [29]. Picky eating behavior reduces the diversity of dietary intake by eating only picked food or diet. Egg, fruit, and vegetables are least consumed food groups than cereals, potato crisp, noncarbonated beverage, sweets and sugar-sweetened carbonated beverages [30]. If there was a disproportional intake of cereals, potato crisp, none carbonated beverage, sweets and sugar-sweetened carbonated beverages it worsens the state of obesity and overweight have immense consequences.

Lifestyle has resulted in the highest burden of obesity and obesity-induced chronic diseases [31]. Most Asian countries like India and China were facing the double burden of malnutrition related to food insecurity, the disparity in food intake, influx of western foods and presence of high intake of animal foods, sugar, and fats related to lifestyle change. Nutrition specific and nutrition-sensitive programs have a key role in addressing under-five malnutrition [32]. These programs are important to deal with intermediate and underlying causes of child malnutrition by addressing of adolescent, preconception and maternal health and nutrition, maternal dietary micronutrient supplementation, and promotion of optimum breastfeeding.

Micronutrient powders were effective in tackling of anemia and improving hemoglobin level among women [33]. However effective distribution and utilization by the target group need coordinated effort of government, committeemen of health professionals and honesty of the manufacturers, importers and distributors in importing, manufacturing and distributing appropriate quality of the powder. The age of a person taking care of child determines the nutritional status of under-five children [34]. Children with the care of other children have a strong prediction for under-five under-nutrition which may relate with the absence of optimal feeding practice, reduction in diversity and frequency of diet and there may be also the probability of drinking unsafe water.

Sex has had a special contribution for under-five children under nourishment [35]. Male children were highly vulnerable to malnutrition when compared with female children may be related to frequency of eating, energy expenditure and exposure to health problems Feeding of under-five children with diluted cow milk has a key role for undernourishment [36]. In case of

cow milk feeding it is not uncommon to dilute with ample of water and feeding children make their stomach full without considering it nutrition status. Household structure determines the extent and severity of undernourishment [37]. Children grow in female-headed households were more like to be malnourished because multiple responsibilities of mothers that reduces household income having direct relationship with child health and malnutrition.

Conclusion

Nutrition is many things. It has a bilateral relationship with health, economic development, social developments, and political system of the country. Under-five malnutrition is a phenomenon interwoven with community's cultural, social, economic and political situation. Unlike adults, nutritional status of Under-five children was greatly influenced by maternal health and nutrition at adolescence, pre-pregnancy, pregnancy and breastfeeding period. Under-five children malnutrition has had the variety of causes or contributing factors where a single fit for all solution could not alleviate the problem rather it requires evidence-based multi-sectorial, multi-level and multi-stakeholder responsibility and committed politician's good leadership promoting, facilitating and undertaking of nutrition-sensitive and nutrition specific programs.

Limitation of the Systematic Review and Meta-Analysis

Articles on overweight and obesity were studies published in the year 2014 and 2015; may be difficult to representatives of the ten years.

Strength of the Systematic Review and Meta-Analysis

Since the systematic review considers large population from ten articles: able to suggest the contributors for under-five children in addition to the shortage of food shortage.

Ethical Approval and Consent to Publication

All article included in this systematic review and Meta-analysis were ethically approved and consent to publication was secured from University of Gondar institute of public health.

Competing Interests

No competing interests.

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Author's Contribution

All authors have equally contributed to the systematic review and Meta-analysis.

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