REVIEW

Chronic Malnutrition Among Under Five Children of Ethiopia May Not Be Economic. A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Ethiopia is one of the four low income countries in achieving MDG4, however, minimizing child under-nutrition became critical undertaking thus far. This review aimed at identifying the predictors of under-5 children nutrition in Ethiopia.
Methods: Databases searched were Med Line, HINARY, MedNar and Embase. Furthermore, gray literatures were also sought. All papers selected for inclusion in the review were subjected to a rigorous critical appraisal using standardized critical appraisal instruments from the Joanna Briggs Institute. Quantitative papers were pooled for statistical analysis and narrative synthesis. Odds ratios and their 95% confidence intervals were calculated for analysis. Papers of optimal quality but without optimal data set for meta-analysis were subjected for narrative synthesis
Results: Nonadherence towards Optimal feeding recommendations was the most reported predictor of stunting and wasting, while, maternal education and 'Water, Sanitation and Hygiene' factors were the second. The findings of the Meta-analysis showed no evidence of association between household income/wealth and stunting of children in Ethiopia (OR=1.14, 95% CI= 0.97, 1.34), heterogeneity test: i^2 = 92%, df = 20, (P < 0.00001). On the other hand, children in low income/wealth group were 1.73 times more likely to have wasting compared to children of the higher income/wealth households (OR=1.73, 95% C I= 1.51, 1.97) heterogeneity test: i^2 = 71%, df = 20, (P < 0.00001).
Conclusion: An over-reliance on macroeconomic growth as a solitary factor towards undernutrition should not be the way forward. Supplementary and more focused nutrition specific and sensitive interventions are needed in Ethiopia.
Key words: child undernutrition, systematic review, meta-analysis, Ethiopia

INTRODUCTION

In 2010, the Ethiopian government endorsed a comprehensive implementation plan to reduce the prevalence of stunting of under five children from 44.4 to 30% and wasting from 9.7to 3

% through the remained era of Millennium Development Goal (1). However the results were far below, only 6.4% and 0.7% percent reductions of stunting and wasting were achieved (2). There existed very high proportion of stunting (38%) and wasting (9%) among under-five children in Ethiopia (2). On the other hand, the country recorded substantial reductions in child mortality through the extraordinary commitment given to the millennium development goals for the same age group (3). Being one of the four low income countries in the world in achieving MDG4, yet, having high level of malnutrition for the same age group seems paradoxical. Ethiopia has enjoyed strong and broad based economic growth over the past decade, averaging 10.8% per year in 2003/04 - 2014/15 compared to the regional (east African) average of 5.4% (4). However, minimizing the amenable size of child under-nutrition in the country has been critical undertaking thus far.

Child under nutrition and economic growth are not always at par across the globe. According to a study, the elasticity of stunting with respect to growth in per capita is on average -0.2 in a country having 30% stunting prevalence, which is at the most one-tenth of the growth elasticity of income/consumption (5).This insignificant effect may explain why considerable variation existed in the prevalence of chronic malnutrition in less developed world (5% to 65%) (6). The extreme disparity further signals the need for in-depth look towards drivers of better child nutrition beyond macro-economic variables. Contrary to what the economy would suggest, a number of Sub-Saharan African countries has lower levels of stunting compared to East and South Asia (7). Some nations are experiencing disproportionately high levels of stunting for their economy such as India (8). Similar disparity also exist within the same continent context too, Senegal have much lower level of stunting level(19%) than its neighboring countries with similar economy such as Mali (39%) and Guinea (31%) during the period of 2010-2015 (9).

It is certainly plausible that an increase in household's income possibly influence child's nutritional outcome either by improving dietary intake or access for health care and better environment. On the other hand, poverty erodes household's potential for optimal child care and feeding leading to under nutrition. Contrary to the above more likely conditions, a significant portion of under-5 children among richest households were affected by under nutrition across the globe (10-13). In the regions with the highest rates of stunting (Sub-Saharan Africa and South Asia) quarter of the stunted under 5 children were members of richest households (12). Socioeconomic inequality in malnutrition between children of poor and rich families vary from country to country, large gaps observed in Peru and very small in Egypt (13). In summary, the existing research indicates income/expenditures matters for nutrition but the link tends to be not sufficient enough (5, 10-14). One of the reason can be due to strong suboptimal proximal factors such as inadequate feeding and ill health which could dilute any positive gains possibly achieved by distal determinants (income/expenditures).

Some measure of household economic well-being is assessed in health and nutrition studies mostly as income or wealth. However, direct expenditure on nutritional factors such as food and health care would have been appropriate to measure direct effects of economic environment on nutritional outcomes (15). In majority of nutrition studies done in developing world consumption expenditure data were not collected due to complex methodological issues (16). Studies including demographic health surveys (DHS) instead compute asset based wealth index as proxy measure of economic wellbeing (1, 15-

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17). The underlying assumption of using wealth index as a proxy of expenditure could possibly confounded by a number of important issues such as intra-household resource allocation and control over resource (15-16). Despite the limitations, using wealth indices as alternative methods is better than measuring income (15).

Most nutritional decision in the Ethiopia are based on DHS which were thus far descriptive and limited in terms of analysis of associations between nutritional status and immediate, underlining and basic factors as depicted in global framework for malnutrition (1, 12). Combining these two data set through gregarious systematic review process is appropriate in order to generate the best available evidence on determinants of under-5 children nutritional status of the country. Some of these studies were conducted with the aim of studying determinants of malnutrition, yet didn't consider economic measures such as wealth index or income. Though, such analysis seems technically correct, it does not allow to understand the isolated effect of variables like maternal education, as it is not adjusted for poverty; making the results less valuable as policy making.

The primary objective of the review was to systematically identify, appraise and synthesize the best available evidence on association of economic wellbeing of households and under-5 children nutritional outcomes in Ethiopia. Thus, we specifically questioned whether there is an association between low HH income/wealth and undernutrition among under 5 children in Ethiopia existed or not. Since the review dealt with extreme conditions, aggregating income and wealth index as the same proxy may not be a concern. Meanwhile, we also set out to critically appraise, identify and present the commonest predictors of under-5 children stunting and wasting in Ethiopia

METHODS

To conduct the present review the recommendations and tools of the Systematic the Joanna Briggs Institute (JBI) Model for Systematic Reviews of Evidence was adopted (18). Studies which included children of under five years of age, with objectively measured nutritional outcome in terms of height for age and weight for height reported, regardless of other demographic characteristics were included. All types of quantitative observational and analytical studies (cohort studies, case-control studies and cross-sectional studies) made from January 1st, 2000 to December 31st 2016 were included. No exclusion were made based on publication format and study characteristics. Conference proceedings, qualitative studies, case series and reports were excluded. The lowest income/wealth group of households as reported in the studies were extracted to compare against the remaining groups of households in the studies. All studies including those without optimal data for the meta-analysis were also subjected for the narrative synthesis done for the second objective.

Three staged search strategy was used to identify all relevant published literature in English language. An initial search of MEDLINE and Google Scholar followed by analysis of the text words in the text and abstract was done to generate comprehensive list of words and index terms. A second search was made using all identified key words and index terms across all data bases. The third search was done by analyzing reference list of included study. Databases searched were Med Line, HINARY, MedNar and Embase. Furthermore, gray literatures were sought from SCOPUS, Ethiopian higher institutions depositaries and the Ethiopian government websites. The search strategy used or modified for the various databases and search engines was with initial keywords/search terms: ["stunting" or "wasting" or "malnutrition" or "mal-nutrition" "under nutrition" or "under-nutrition" or "acute malnutrition" or "chronic malnutrition" or "protein energy malnutrition"] and ["under 5 children" or "children" or "infant" or "young child"] and ["Ethiopia"]. Further entry terms

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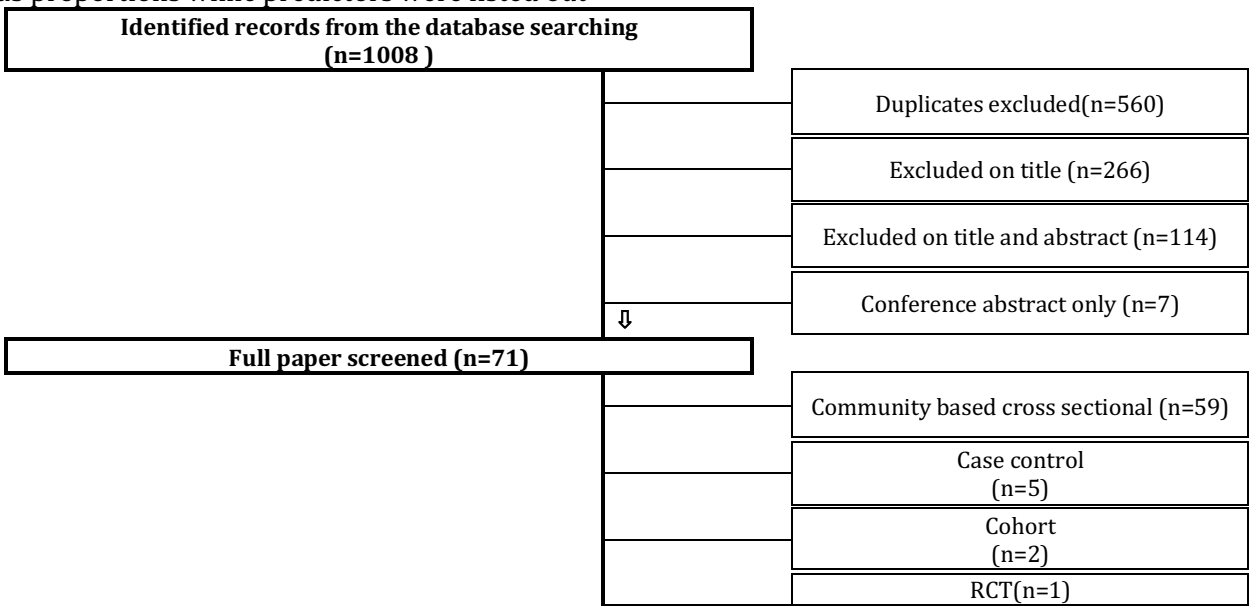
were collected following what was obtained from initial search.

Study selection appraisal and extraction were made in duplicate to reduce reviewer error. All papers selected for inclusion in the review were subjected to a rigorous, independent appraisal by the investigators prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute (JBI-MAStARI critical appraisal tool) (18). This check list has different modules based on the study design. Appraisal were made by both reviewers independently and disagreements were solved through discussion. For inclusion, only studies which scored above 50% of the risk of bias assessment were included as per the instrument recommendations.

Quantitative papers were pooled in statistical meta-analysis using the Review Manager Software (Rev Man 5.3) (19). We used random effect model in the Meta-analysis and Mantel–Haenszel model to calculate odds ratios and their 95% confidence intervals. Papers of optimal quality but without optimal data for meta-analysis were subjected for narrative synthesis. Data on the outcome and their distribution in income/wealth were extracted as proportions while predictors were listed out for descriptive analysis. To enhance objectivity and considering their variability in measurement we have pre- formulated composite predictors thematically as optimal feeding, 'Water and Environmental sanitation and hygiene' (WASH) factors, socio-demographic, biologic and health care seeking and related factors.

RESULTS

A total of 1008 relevant papers were identified in the literature search, 560 were duplicates, remaining 448 were retrieved for examination. Following review of titles and abstracts against the review objectives and inclusion criteria, 377 titles were excluded. The full texts of the remaining 71 studies were retrieved for detailed evaluation, after which, 16 of these were excluded. The remaining 55 studies were assessed for methodological quality using the JBI-MAStARI critical appraisal tool, and, subsequently 10 were excluded because of sub optimal quality. The remaining 45 were included in the current systematic review. Over 90% of the included studies were surveys, distributed north to south. Data set to conduct meta-analysis for the primary objective were available only in 23 studies. All studies were included in the narrative synthesis (Figure 1).



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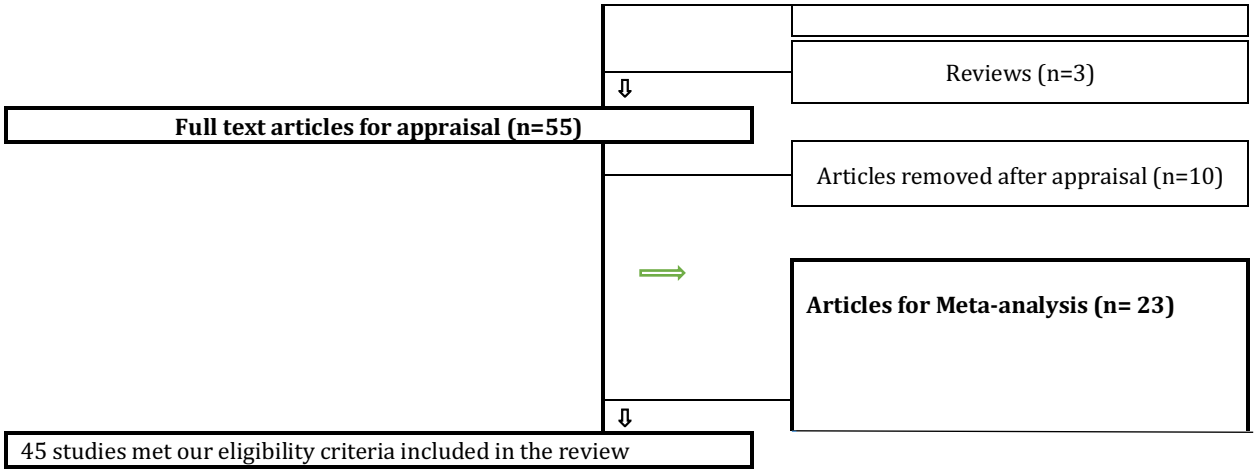

Figure 1. Flowchart of literature review process

Association of stunting and households income/wealth in Ethiopia

On Meta-analysis, anthropometric data of 53,708 children were stratified based on their income/wealth strata, as low and high income/wealth households. Accordingly, from the total children, 18172 were members of households with low income/wealth, while the remaining 35,536 children were residents of households with higher income/wealth. Among children of households with low income/wealth almost half (49%) had stunting. On the other hand, 15,522 (43.7%) of children living in higher income/wealth group were found to have stunting.

The finding of the Meta-analysis showed no evidence of association between income/wealth and stunting of children in Ethiopia (Odds ratio=1.14, 95% Confidence Interval= 0.97, 1.34), heterogeneity test: i^2 = 92%, df = 20, (P < 0.00001). The test for overall effect also showed statistical insignificance at conventional levels (P=0.12) (Figure 2).

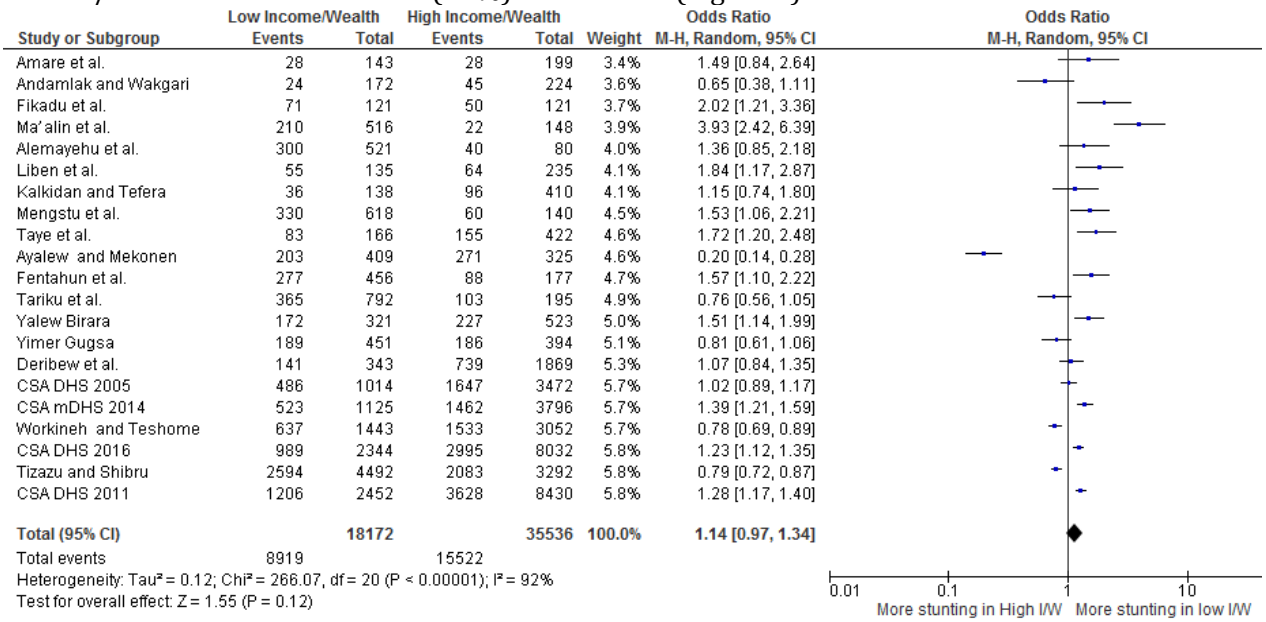

Figure 2. Forest plot Income/wealth versus under 5 children stunting in Ethiopia

Association of wasting and households income/wealth in Ethiopia

On Meta-analysis, anthropometric data of 46540 children were stratified based on their

household income/wealth strata, of which 17250 were children living in households having low income/wealth Among households in low income/wealth, 2694 (15.6%) children were found to have wasting. On the other hand a lower proportion of children were found in households having higher income/wealth group 2834 (9.7%). The finding of the Meta-analysis showed children in low income/wealth group were 1.73 times more likely to have wasting compared to children of the higher income/wealth households (Odds ratio=1.73, 95% Confidence Interval= 1.51, 1.97) heterogeneity test: i^2 = 71%, df = 20, (P < 0.00001). The test for overall effect also showed a high statistical significance at conventional levels (P<0.00001) (Figure 3).

Predictors of wasting and stunting in Ethiopia

In the current review, non-adherence towards Optimal feeding recommendations of WHO was found the most reported predictor of stunting (n=21studies) while maternal education is the second most reported independent predictor (n=19studies) of stunting. Among biologic factors Child's age (n=18 studies) and

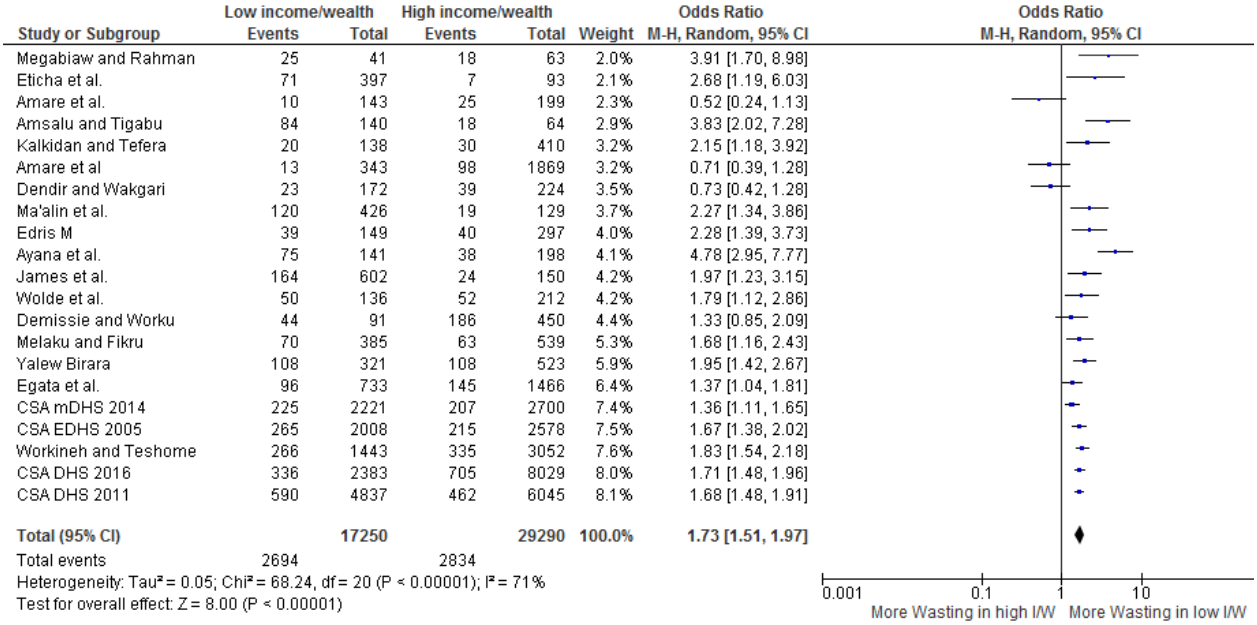

Figure 3.Forest plot Income/wealth versus under 5 children stunting in Ethiopia

child's Sex (n=10 studies) reported as predictors of stunting. Morbidity (n=6 studies), optimal health care practice by the mother or the child (immunization, deworming, antenatal care, family planning) were also reported by 4 studies. Residence (urban versus rural) is the most reported socio-demographic variable (n=9 studies) while 'Water, Sanitation and Hygiene' (WASH) factors were reported by five authors predicting stunting. Morbidity (fever, diarrhea, ARI) was reported by six authors. Few authors reported food insecurity as predictor of stunting (n=2 studies). In similar analysis of wasting, non-adherence towards Optimal feeding recommendations of WHO was found the most reported predictor of wasting (n=12 studies). Unlike stunting factors "Water, Sanitation and Hygiene" factors were found the second most important predictors (n=10 studies). Maternal education is also reported by six authors. Among biologic factors Child's age (n=4studies) and child Sex of the child (n=6 studies) were the most reported predictor of wasting. Morbidity (n=6

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studies), optimal health care practice by the mother or the child (immunization, antenatal care and family planning) were reported as predictor by four authors. Residence and family size were reported each by three authors. Similar to stunting predictors, food insecurity is reported only by two authors as predictor of wasting.

DISCUSSION

In the current review, results of both analysis were complimentary, affirming the need to have more reliance on optimal child feeding and maternal education to achieve better under-5 children nutrition than macro-economic growth in Ethiopia. It is not surprising to have optimal child feeding appeared the commonest predictor of undernutrition in the studies, considering the prevalent maternal illiteracy in the country (47.6 %) (2). According to the recent DHS reports, only 2% of mother adhere to the WHO IYCF recommendations and only 7 percent of children age 6-23 months have met the criteria for a minimum acceptable diet (2, 39). The fact that optimal feeding and maternal education commonly appearing in the reviewed literatures has a clear policy implication regarding the focus of nutrition interventions. Making the mother at "the center" of policy and nutrition programs is indispensable in Ethiopia. Similar to the current review, maternal education regularly emerges as a key element of an overall strategy to address malnutrition in developing world (63-64). A global study of Smith et al (2009), also confirmed women education responsible for 43% of the total 15.5% reduction in the child malnutrition rate of 63 developing countries during the period 1970-95(64).

The present review findings fairly decline the association of low income/wealth of households and chronic malnutrition of under-five children in Ethiopia. The review finding corroborates, a study in *The Lancet Global Health*, which looks at DHS data from 1990 to 2011 of 36 low- and middle-income countries, and suggested that increases in per-head gross domestic product in the last two decades have generally not been associated with improvements in childhood nutritional status (65). Phenomenally, in Ethiopia, progress against child under nutrition since the millennium has been solid, with stunting prevalence reduced by 1.4 percent points per year between 2001 and 2011, then slowed down to 1.0 point per year since 2011 despite unchanged economic potential (66). The current review finding also decline earlier findings by Headey (2014) and Biadglign et al (2016) regarding wealth and stunting (66-67). The possible explanation for difference could be due to the superiority the current review in terms of number of studies included and difference in methods of analysis. Despite our approach is different, there is exact similarity of our findings with Woodruff et al, who identified variables that could have contributed to the decline of stunting in Ethiopian children less than 5 years of age as markers of child health, mother's nutritional status, mother's educational level, and environmental hygiene (57).

Unlike stunting, wasting in the current meta-analysis showed association with income/wealth. Children living in low income/wealth households were found 1.7 times more likely to have wasting. The positive effect of higher income/wealth on wasting prevalence is comprehendible as wasting drag better attention for all segment of care giving continuum. In most cases, wasting is a reflection of a recent and severe process of weight loss associated with acute starvation and/or disease state. Thus, there is high probability of wealthier families to take their sick child to health facilities before evident wasting process on their child begins. Such associations are reported throughout the DHS reports of the country (2, 39-41). On the other hand stunting often goes unrecognized in communities where short stature is so common. "Water, Sanitation and Hygiene" factors were critical in wasting prevalence in Ethiopia indicating the inter play of disease

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process (most likely diarrhea) in the existing prevalence (68). In conclusion, factors related to optimal care were dominantly appeared as predictor of under-5 children nutrition in Ethiopia over the studied economic indicators (income or wealth). In general the present evidence emphasize the need to have more focus on factors beyond economic measures to achieve local and global goals, such as, the Seqota declaration and the sustainable development goals of countries by the end of 2030 (69). The Seqota Declaration reflects the strong commitment to end child malnutrition in Ethiopia by reaching vulnerable households. In guiding such interventions, economic vulnerability alone shouldn't be taken to identify and locate vulnerable households for development of chronic malnutrition. Assessment of multiple aspects of proximal to distal determinants of optimal nutritional outcome are critically needed. Thus, an over-reliance on macroeconomic growth as a compelling solitary factor to revert chronic malnutrition should be avoided. Instead, supplementary and more focused nutrition sensitive and specific interventions that aimed at improving optimal feeding practice and child rearing environment would be more important in Ethiopia.

While using the present evidence, one should note the strength and limitations in the present analysis. The study documented less publication bias as it sourced out all quality gray literatures (figure 4 and5), subjected for critical appraisal. The funnel plot also showed studies plotted near the average, and studies which spread evenly on both sides of the average, creating a roughly funnel-shaped distribution indicating less publication bias. However, data were generally not available on important aspects of income such as intra-household resource allocation to have subgroup analysis of important aspect of income/wealth identify. Second, The analysis showed a significant heterogeneity as measured by Cochrane's I2 , which could be resulted from the variation among the included studies in measuring wealth/income.

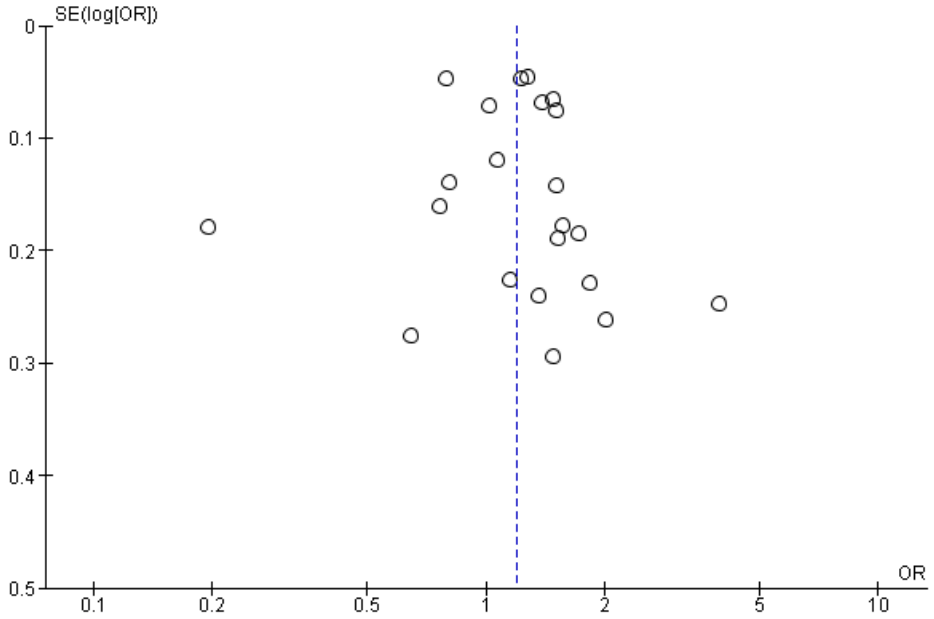

Figure 4. Funnel lot for assessment of publication bias, Income/wealth versus stunting

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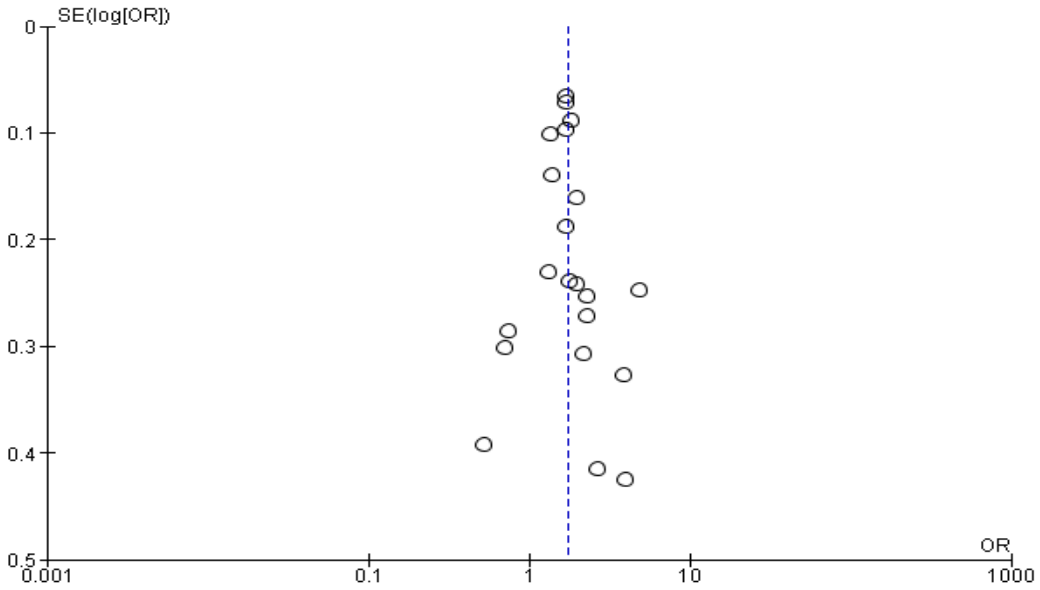

Figure 5. Funnel lot for assessment of publication bias, Income/wealth versus stunting

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