

Associated Factors for Adolescent Under Nutrition in Ethiopia: A Systematic Review and Meta-Analysis

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Abstract

Introduction

In Ethiopia, there are different pocket studies assessing the risk factors for adolescent under nutrition which comes up with inconsistent and inconclusive findings. Therefore, quantifying the risk factor using meta-analysis is crucial for evidence based intervention.

Objective

To assess the associated factors for adolescent under nutrition in Ethiopia

Methods

Systematic review of eligible articles was conducted using preferred reporting items for systemic reviews and meta-analysis (PRISMA) guidelines. A comprehensive search of literature was made in PubMed, Google and Google Scholar. Article quality was assessed using Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. The odds ratio of the associated factors with its 95% confidence interval was computed using STATA version 14 software.

Results

Twenty two studies were included in the meta-analysis with a total of 17,854 adolescents. Random effects model was used for analysis. Rural residence, family size >=5, unprotected water source for drinking and household food insecurity were significant risk factors for adolescent stunting. Early adolescent age (10-14 years), family size >=5, food insecure household, lack of latrine, WHO diet diversity score<6, mother educational status were statistically significant risk factors for adolescent underweight.

Conclusion

Early adolescents' age, low WHO diet score, family size>=5, illiteracy of mother, food insecure household, unsafe water source for drinking, lack of latrine and rural residence were statistical significant factors for adolescent under nutrition. Therefore, Adolescent nutritional interventions addressing the above risk factors should be designed and implemented in the country.

Keywords: Adolescent, undernutrition, associated factors, Ethiopia.

Introduction

Adolescent is defined as person aged 10-19 years which is a period of gradual transition from childhood to adulthood. Adolescence is the second most critical period of physical growth in the life cycle after the first year. This period is very sensitive to malnutrition due to increased physiologic need of nutrition. Female adolescent malnutrition affects not only themselves but also their future generation. Thus, adolescents are key to break the cycle of intergenerational transmission of malnutrition, poverty and food insecurity. Investing in this group of population will ensure longer-term sustainable results for reduced poverty, food insecurity, fertility, and malnutrition. However, this group has received minimal attention in the developing country including Ethiopia. Due to this, adolescent under nutrition is widespread problems prominently in economically developing countries including Ethiopia (1-5). The prevalence of adolescent under nutrition in Ethiopia is very high and is increases over time. For example, according to the 2005 and 2011 Ethiopian demographic and health survey report, the prevalence of underweight in adolescent girls was 32% and 36%, respectively (6, 7).

Early marriage and subsequent pregnancy, lack of educational attainment, poor access to safe water and sanitation, Lack of health services targeted for adolescents, lack of knowledge on the existing adolescent health services, cultures, and low utilization of family planning methods were reported as a contributing factor to adolescent under nutrition. The consequences of adolescent under nutrition includes: delayed growth, retarded intellectual development, goiter, increase risk of infection, blindness, anemia, inadequate bone mineralization. In adolescent girls future consequences of stunting include increased risk of adverse reproductive outcomes. E.g. Risk for low birth weight, cephalo-pelvic disproportion, dystocia and cesarean section. Again Low body mass in adolescent girls is associated with reduced bone mass in early adulthood and may result in postmenopausal osteoporosis and its sequel (8-10).

Current efforts and investments in the 1000 days that focus on preventing stunting in children will be more effective and sustainable if the nutrition of adolescent girls improves. So far, most of the interventions have either focused on children aged 0-5 years or on pregnant women and on lactating women. However, not much attention has been paid to adolescents by nutrition-related programs in developing countries. If adolescents are well nourished, they can make optimal use of their skills, talents and energies today, and be healthy and responsible citizens and parents of healthy babies tomorrow. To accomplish such a task, and in order to break the intergenerational cycle of malnutrition, a special focus for overcoming adolescent under nutrition is needed (11). Notably, there are different studies which assessed the associated factors for adolescent under nutrition in Ethiopia. However, they came up with inconsistence and inconclusive findings. Moreover, there is no study which estimated the effect of the above stated factors on the level of adolescent under nutrition. Therefore, this systematic review and meta-analysis was conducted to quantify the associated factors which could help for evidence based interventions.

Methods and materials

Protocol and search strategy

Systematic review of eligible articles was conducted using Preferred Reporting Items for Systemic Reviews and Meta-Analysis (PRISMA) guidelines (12). A comprehensive search of articles published in English since January 1990 through January 2018 was made from PubMed, Google and Google Scholar. In addition to this data bases, the reference list of the included studies was scanned to find potential articles. The search was done using key terms such as: adolescent under nutrition, adolescent malnutrition, and prevalence of adolescent under nutrition, magnitude of adolescent under nutrition, assessment of adolescent under nutrition, adolescent nutrition disorders, associated factors, risk factors, determinants and Ethiopia separately and/or in combination using the Boolean operator like “OR” or “AND”. Authors made the search independently. Articles retrieved from the data bases were exported to EndNote version X6 to facilitate the article selection process and manage citation.

Eligibility criteria, information sources and study selection

This review and meta-analysis included studies conducted in Ethiopia with primary objective of identifying associated factors for adolescent under nutrition. Articles published in English emanated from both facility and community based studies were included. Studies conducted in adolescents who had co-morbidities like HIV/AIDS, renal diseases and other surgical and medical conditions were excluded. Articles were assessed for inclusion criteria using their title, abstract, and then a full review of the article before inclusion in the final review. When the associated factors were not reported, we contacted the authors, and if they did not respond or told us that the required data were not available, we excluded the study from the analysis. When one population was reported in more than one publication, only the most recent one or with maximum information was included in the review to avoid sample overlapping.

Data extraction, data items, risk of bias in individual studies

Authors independently assessed the qualities of the eligible studies and controlled for possible bias by adapting specific protocol characteristics and the criteria proposed in the Newcastle-Ottawa Scale for non-randomized studies (13). The following parameters were assessed: sampling strategy, inclusion/exclusion criteria, sample size, cut-offs and reference for assessment of adolescent under nutritional status, criteria to identify undernutrition and covariates included in statistical models to assess associated factors. The final scoring system comprised 10 criteria of rating different quality elements for each eligible article (Table 1). Any discrepancy between the two reviewers was resolved through discussion and by involving a third reviewer. Using a predefined data extraction format, information on the name of the author/s, year of publication, study period, study design, sample size, residence (rural, urban, both), age of study participants, sex of study participants, region and associated factors were extracted from the selected studies.

Outcome measure

The primary outcome was the associated factors for adolescent under nutrition in Ethiopia. Associated factor identified in two and above studies was considered in the review and meta-analysis. Age, diet diversity score (DDS), family size, food insecurity, residence, sex and water protection were identified associated factors for adolescent stunting (height for age <2 standard deviation) likewise, diet diversity score (DDS), family size, father education status, food insecurity, latrine, mother education status and sex were identified associated factors for adolescent underweight (body mass index <2 standard deviation).

Synthesis of results

Statistical analysis was carried out using the statistical software package STATA version 14. Initially, data were entered into Microsoft Excel and then exported to STATA version14 software for further analysis. The effect

size of the meta-analysis was adjusted odd ratio (OR) of the associated factors. We examined associated factors for adolescent undernutrition that met the meta-analysis eligibility criteria, by looking at the adjusted ORs and 95% confidence interval (CI) reported in each study. Random effects model was utilized to pool the effect sizes of the individual associated factors (12). Forest plot was used to present the combined estimates with its 95% (CI). The effect of selected associated factors which include; Age, diet diversity score (DDS), family size, food insecurity, residence, sex and water protection for adolescent stunting, and diet diversity score (DDS), family size, father education status, food insecurity, latrine, mother education status and sex for adolescent underweight was analyzed using separate categories of meta-analysis. The findings of the review and meta-analysis were presented using tables, forest plots and Odds Ratio (OR) and 95% (CI). A p-value less than 0.05 was used to declare factor's statistical significance.

Publication bias and heterogeneity

To retrieve the extent of publication bias, funnel plots were scattered and tested for asymmetry and, additionally, Egger's test was computed (14). A p-value less than 0.05 were used to declare statistical significance of publication bias. After detailed examination of the study by the investigators, the existence of heterogeneity in the studies was checked using I^2 test statistics. I^2 describes the total variation across studies. The I^2 test statistics of <50%, 50% - 75% and >75% was declared as low, moderate and high heterogeneity respectively (15).

Results

Study searches and selection

In the initial search, we found a total of 2100 records from different electronic search databases which include; PubMed (800), Google (713) and Google Scholar (587). From this, 250 duplicate records were removed and 1800 records were excluded after screening by title and abstracts. We assessed the full texts of 50 remaining records for eligibility, and 28 records were further excluded by the inclusion and exclusion criteria. Finally, 22 studies were included in the final quantitative meta-analysis (7, 16-36) (Figure 1).

Characteristics of the studies, risk of bias with in studies and result of individual studies

All of the 22 articles included in the review were cross sectional studies. A total of 17,854 adolescents were included in the analysis. The included studies reported sample size ranged from 211(17) to 3,724(7). Thirteen, 59.1% of the included studies were conducted in urban and rural areas (7, 16, 18, 19, 25, 27, 29, 31-36). Most of the regions in Ethiopia were represented in this review. One of the study was conducted in Addis Ababa, capital city of Ethiopia (23) and one study was done at national level (7), 5 studies were from Eastern part of the country (Ethiopia), 4 were from West, 5 were from North and 6 were from South part of the country (Table1).

Risk factor for adolescent undernutrition and heterogeneity

Eleven studies were included for the analysis of risk factors for stunting. Accordingly six associated factors had data that could be used in the meta-analysis. The pooled odds ratios ranged from 0.87 to 3.39. Low heterogeneity was observed and the identified associated factors for the analysis were residence, adolescent age, family size>=5, unprotected water source for drinking, food insecure households and sex. Of these factors residence, family size>=5, unprotected water source for drinking and food insecure household were statistically significant for adolescent stunting (Table 2).

Similarly, sixteen studies were included for the analysis of associated factor for adolescent underweight, and eight risk factors were included in the meta-analysis. The pooled odds ratios ranged from 0.69 to 4.1 and low heterogeneity was also observed among studies evaluating adolescent age, family size, food insecurity, sex, latrine availability, diet diversity score (DDS), father educational status, and mother educational status. Early adolescent age (10-14 years)), family size>=5, food insecure household, lack of latrine, WHO diet diversity score<6, mothers with no formal education were statistically significant factors for adolescent underweight (Table 3).

Publication bias

We assessed the funnel plot for asymmetry by visual inspection for association factors. The funnel plot was appeared quite symmetrical and found no publication bias and Egger's test was also done for associated factors similar to the funnel plot it revealed evidence of no publication bias (Table 2 and 3).

Discussion

This review and meta-analysis was conducted to determine associated factors for adolescent under nutrition in Ethiopia. In this review, random effects model was used for meta-analysis, considering the likelihood of significant heterogeneity amongst studies. In this review the odds of having stunted adolescent was 2.25 times higher in households with family size of >=5 members. Likewise, household with family size of >=5members

were 2.95 time higher in underweight than non-underweight adolescents. This might be due increased sharing of the available food among the large household members causing inadequate consumption of food. In addition to this, large family size usually found in uneducated parents who are more likely to accept and practice food taboo that affecting adolescent nutrition. In this review food insecure households were high among stunted adolescents. Food insecurity is one of the underline causes of under nutrition which could resulted in chronic nutritional problems in adolescent and cause long term negative effects in life and future child (37, 38) (Figure 2).

Residence (rural) and unprotected source of drinking water were the other significant risk factors for adolescent stunting. This could be explained by the inequalities in access to medical services, socio-economic status and health information in urban and rural settings. Similarly, the unprotected source of drinking water is vehicle for intestinal parasites which leads to loss of appetite and consuming of important nutrients which results in poor nutritional status. Because of repeated infections there is depressed immunity and making the severity and duration of disease more sever contributing to poor nutritional status of the adolescents. Age of adolescent (early age adolescent) was identified as risk factor for adolescent underweight. This is due to increasing growth and development in the early age of adolescent (10-14 years) as compared to late adolescent (15-19 years). Hence, if the requirement for achieving their maximum need for growth and development is not fulfilled, they will be prone to develop underweight (Figure 3).

Lack of latrine is statistically significant factor for adolescent underweight (AOR=2.2, 95%CI: 1.1,4,4, p-value=0.03). In areas where there is scarcity of proper latrine utilization, contamination and infections is common. Environmental sanitation is poor and bare foot walking may serve as a means of contracting parasitic infection. Dietary diversity has been used as proxy indicators for food quality and security, which may be due to its ability to capture consumption of both macro and micronutrients or a more balanced diet in the general sense without the need of measuring the quantity of food consumed. In this review, WHO diet diversity score (DDS) less than 6 was 1.95 times higher in underweight adolescent than non-underweight adolescent (AOR=1.95 95%CI: 1.3, 2.9, p-value=0.001). Poor diet is one of the immediate causes of undernutrition. This is because when the DDS is low, adolescents will not get adequate energy and other important nutrients which results in adolescent underweight. Mother educational status was found risk factor for adolescent underweight. Educated mothers are cautious of what the family eats than uneducated mothers. Educational attainment of mother could lead to higher income and may imply a higher availability of food and household resources. It might be positively associated with higher nutritional awareness as well as better caring practices of adolescent. Educated mothers can allocate family resources for nutrition and have health decision-making power which ultimately affects the nutritional status of the adolescent(1, 38). This review used a comprehensive search strategy and more than two reviewers were involved in each step of the review process. PRISMA guideline was strictly followed during the review process. This review, however, has certain limitations like all the studies included were cross-sectional which could affect the temporal relationship between the identified associated factors and adolescent under nutrition.

Conclusion and recommendation

The associated factors for adolescent under nutrition includes early adolescents' age, WHO diet score <6, family size >=5, illiteracy of mother, food insecure household, unprotected water for drinking lack of latrine and rural residence of adolescents. Therefore, Adolescent nutritional interventions addressing the above associated factors should be designed and implemented in the country.

List of Abbreviations

AOR: Adjusted Odd Ratio
CI: Confidence Interval
DDS: Diet Diversity Score
EDHS: Ethiopian Demographic and Health Survey
PRISMA: Preferred Reporting Items for Systematic review and Meta-Analysis
WHO: World Health Organization

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Authors' contributions
KBT involved in study design, selection of articles, data extraction, statistical analysis and manuscript writing. AKB, GG and AG also involved in data extraction, statistical analysis and manuscript writing. All authors read and approved the draft of the manuscript.
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Table 1: Summary of included studies on associated factors for adolescent undernutrition in Ethiopia, January, 2018

S.No	Author	Year	Study design	Place of study	Region	Sex	Sample size	Quality score (out of 10)
1	Abdulkadir	2016	cross sectional	Rural & Urban	East	Both	616	10
2	Afework M	2009	cross sectional	Rural	North	Female	211	9
3	Ahmed Y	2015	cross sectional	Rural & Urban	South	Female	212	7
4	Assefa H	2013	cross sectional	Rural & Urban	West	Both	2084	10
5	Damie	2014	cross sectional	Urban	East	Both	291	10
6	Gebregyorgis	2016	cross sectional	Urban	North	Female	807	10
7	Gebreyohanes	2014	cross sectional	Urban	Central	Both	1024	10
8	Hadush G	2015	cross sectional	Urban	North	Both	555	7
9	Herrador	2014	cross sectional	Rural & Urban	West	Both	886	9
10	Kt Roba	2016	cross sectional	Urban	South	Female	706	10
11	Mekonnen	2013	cross sectional	Rural & Urban	West	Both	790	8
12	Melaku	2015	cross sectional	Rural & Urban	North	Both	348	10
13	Meseret Y	2010	cross sectional	Rural	West	Both	425	7
14	TeJI K	2016	cross sectional	Rural & Urban	Eastern	Female	546	9
15	TM Berheto	2015	cross sectional	Rural & Urban	South	Female	613	8
16	Wassie Molla	2015	cross sectional	Rural & Urban	North	Female	1281	10
17	Wolde M	2015	cross sectional	Rural & Urban	South	Both	450	6
18	Yebyo	2015	cross sectional	Rural & Urban	Easter	Both	411	8
19	Mekonen Tegegne	2016	cross sectional	Urban	South	Female	598	10
20	Dessalegn A.	2017	cross sectional	Urban	South	Both	634	8
21	Yayehyirad Yemaneh,	2017	cross sectional	Rural & Urban	East	Female	642	10
22	EDHS	2012	cross sectional	Rural & Urban	All(National)	Female	3,724	9

NR: Not Reported, EDHS: Ethiopian Demographic Health Survey

Table 2: Summary of the meta-analysis of associated factors for adolescent stunting in Ethiopia, January, 2018

s.no	Factor	No. of studies	Point estimate (OR)	95%CI	2 tail p-value	Heterogeneity				Publication bias (p-value of Egger's test)
						Q-value	Df (Q)	p-value	I-squared	
1	Residence (rural)	3	2.19	1.59,3.02	0.000	2.49	2	0.29	19.89	0.08
2	Age (early adolescent)	7	0.87	0.29,2.55	0.79	230	6	0.32	47.39	0.38
3	Family size(>=5)	2	2.25	1.6,3.13	0.000	0.44	1	0.51	37.7	0.16
4	Source of drinking water (unprotected)	2	3.39	2.34,4.91	0.000	0.19	1	0.66	32.4	0.23
5	Food insecure household	3	2.04	1.67,2.49	0.000	1.79	2	0.41	39.05	0.73
6	Sex(female)	5	0.99	0.57,1.71	0.96	22.97	4	0.63	52.59	0.84

Table 3: Summary of the meta-analysis of associated factors for adolescent underweight in Ethiopia, January, 2018

s.no	Factor	No. of studies	Point estimate (OR)	95%CI	2 tail p-value	Heterogeneity				Publication bias (p-value of Egger's test)
						Q-value	Df(Q)	p-value	I-squared	
1	Age (early adolescent)	9	2.45	1.46,4.1	0.001	83.14	8	0.54	50.34	0.45
2	Family size(>=5)	4	2.95	1.76, 4.93	0.000	17.62	3	0.1	42.97	0.69
3	Food insecure household	2	2.38	1.54,3.69	0.000	1.22	1	0.27	17.91	
4	Sex(female)	8	0.69	0.41,1.12	0.18	77.46	7	0.43	30.96	0.65
5	Lack of latrine	2	2.19	1.09,4.4	0.03	8.8	1	0.3	48.65	
6	WHO Diet diversity score (<6)	5	1.95	1.31,2.92	0.001	14.39	4	0.6	42.2	0.88
7	Father education (with no formal school)	2	0.89	0.64,1.26	0.5	0.93	1	0.34	39	
8	Mother education (with no formal school)	5	4.1	2.42,6.95	0.000	25.59	4	0.62	34.37	0.47

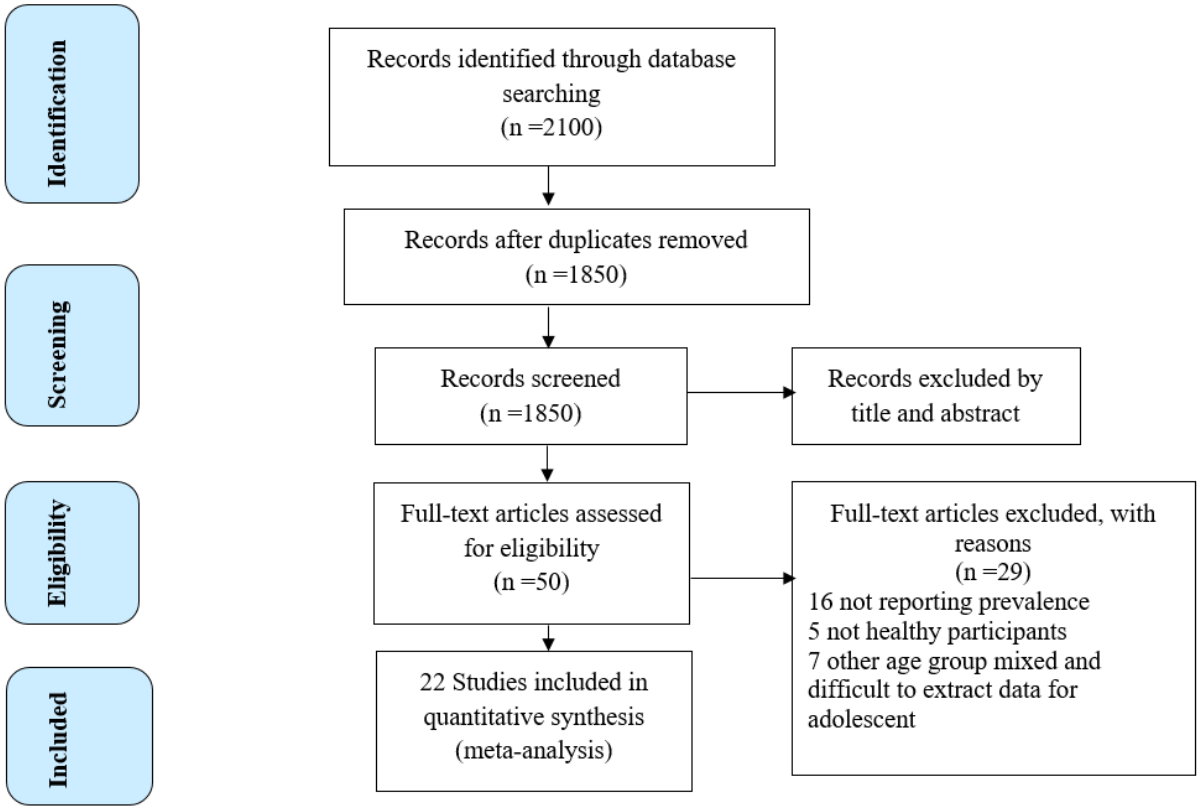

Figure 1: Flow diagram of the studies included in the meta-analysis of adolescent under nutrition in Ethiopia, January, 2018

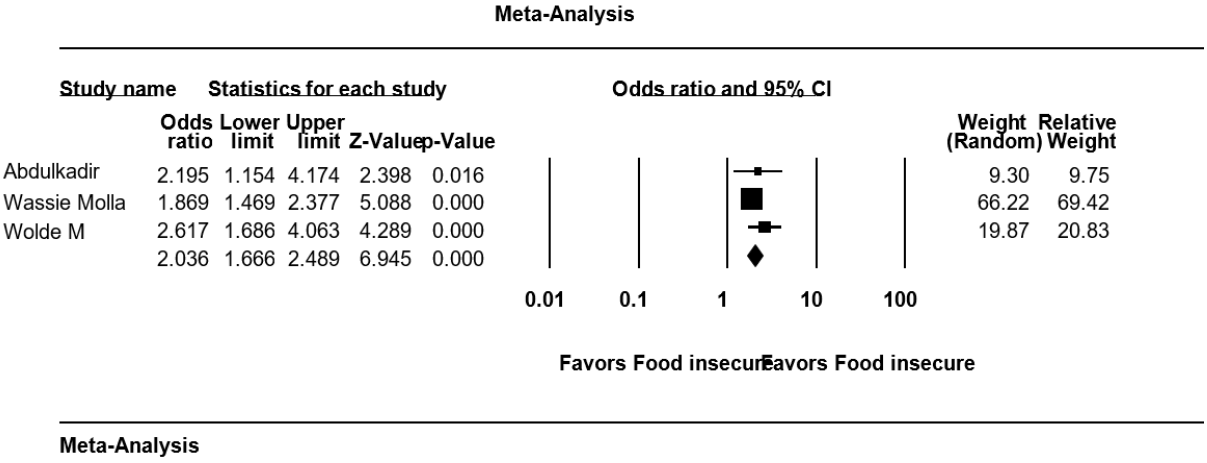

Figure 2:- Effect size of food insecure household on adolescent stunting in Ethiopia, 2018

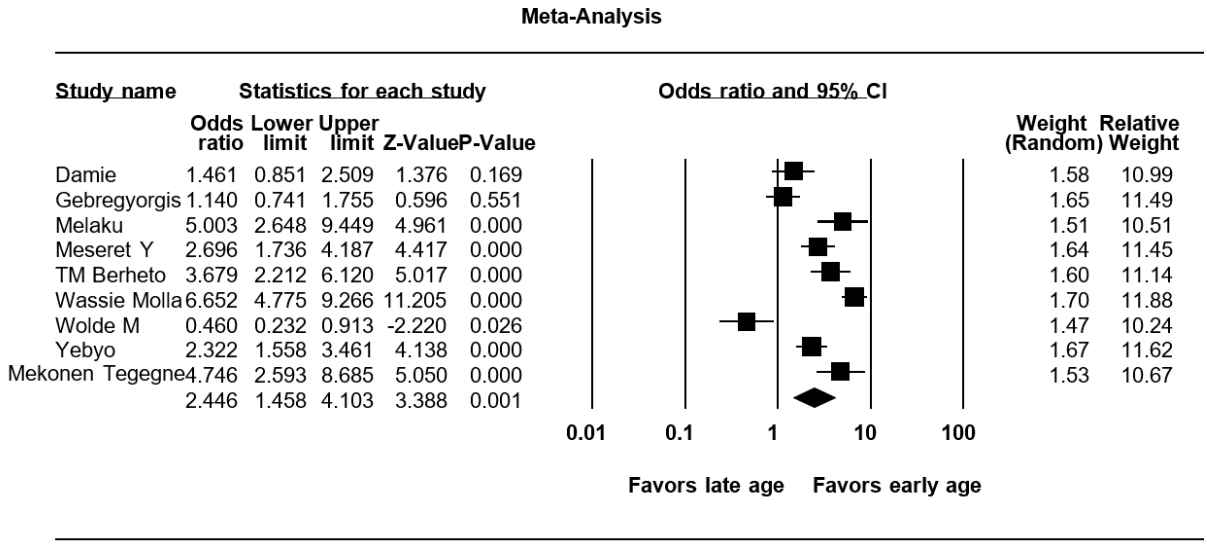

Figure 3:- Effect size of adolescent age on adolescent underweight in Ethiopia, 2018