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Burden of intestinal parasitic infections in children and its association with hand washing practice in Ethiopia: a systematic review and meta-analysis

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Abstract

Background: Intestinal parasitic infections (IPIs) are a major public health challenges in developing countries including Ethiopia, although few studies previously estimated the magnitude of IPIs and associated factors in the country. Reports from these scarce studies were also widely varied and remained inconsistent. This study thus aimed to synthesize the pooled magnitude of IPIs and factors affecting it.

Methods: Internationally broad based medical database including MEDLINE/PubMed, EMBASE, PsychINFO and Web of Science, and Google Scholar for grey literature were exhaustively searched using *a priori* set criteria to identify studies estimating the prevalence of IPIs among children from 2000-2018. PRISMA guideline was used to systematically review and meta-analyze these studies. Details of study characteristics including sample size, magnitude of effect sizes (including odds ratios (ORs)) and standard errors were extracted. Random-effects model was used to calculate pooled estimates in Stata/se version-14. I^2 and meta-bias statistics assessed heterogeneity and Egger's test for publication bias. Sub-group analyses were also carried out based on age of children and regions.

Results: Forty-three studies were included in the final analysis (N = 20,008 children). The overall prevalence of IPIs, with one or more species, was 48.2% (95% CI: 40.1, 56.3) in Ethiopian children. Based on sub-group analyses, the highest prevalence of IPIs was observed among school-age children (52.4% (95% CI, 41.3, 63.5)) and in Amhara regional state (52.1% (95% CI, 37.3-66.8)). The odds of having IPIs was nearly six times higher in children who were not practicing hand washing as compared to their counterparts (pooled OR = 5.6 (95% CI: 3.4,9.3). Funnel plot analysis and Egger's test detected no publication bias.

Conclusion: On aggregate, the pooled prevalence of IPIs among Ethiopian children is significantly high. Not hand washing before eating was a risk factor for IPIs. The establishment of applicable sanitation services and health education will help reduce the magnitude of IPIs and promote a healthier childhood.

Keywords: Intestinal parasitic infections, systematic review and meta-analysis, Ethiopia

Background

Intestinal parasitic infections (IPIs) are serious public health challenges globally [1] whereby one-third of the total population is infected with intestinal parasites (IP), and an estimated 4.5 billion people are at risk of infection with one of the three common IPIs – ascaris lumbricoides (800–1000 million), *hookworm* (700- 900 million) and *trichuris trichiura* (500 million) [*2-4*] contributing for significant illnesses and disability-adjusted life year lost [5]. Sadly, around 12% of global burden of disease caused by IPIs occur among school-age children in developing countries [7] especially in sub-Saharan African countries ranging from 27.7% to 95% [8-12], and attributable to major causes of morbidity and mortality among these children [1].

Multifactorial causes contribute to the escalation of IPIs in children including overcrowding, lack of safe water, poor personal hygiene, poor hand washing and nutritional disorders [20, 21]. Indeed, IPIs can be consequences of poor socio-economic status and also contribute to a substantial economic burden [6]. That is, IPIs are closely interrelated with poor socioeconomic status of the family, lack of sanitation, inadequate access to pure water and waste disposal especially in low- and middle-income countries [13-15]. In particular, under-five and school-aged children in these settings are categorized as high-risk population for IPIs [16]. Furthermore, these infections are causes and consequences for anemia and other comorbidities as well as physical and cognitive developmental delays [17, 18] resulting in suboptimal child survival, poor growth and development as well as meager educational performance [8, 10, 18]. In addition, chronic forms of IPIs are associated with the transmission and severity of other infections and/or diseases such as leprosy and human immune-deficiency virus (HIV) [19].

Interestingly, these infections have recently been receiving a high priority from global community. Cognizant to this, the World Health Organization (WHO) has permitted preventive chemoprophylaxis as worldwide mainstay strategy to control the communicability of these infections [22]. In this strategy, scheduled administration of safe and efficacious deworming drugs for risk groups is recommended, setting a minimum target at 75%, and maximum 100% for success rate [22-24]. In fact, general cleanliness or sanitation are imperative indicators to achieve these standards at a community level [25].

Numerous studies have studied the magnitude of IPIs in preschool and school-age children in Ethiopia. However, there is a significant variability in the reports and an aggregate figure is implicated to know the 'real' burden of IPIs. We thus carried out a systematic review and meta-analysis on the prevalence of IPIs and its association with common indicators including hand washing practice in children. These analyses were carried out in the context of in-depth methodological application and rigorous statistical analyses that could be helpful for estimating national level burden of IPIs as previous studies are characterized by high spatial variation.

Methods

Study design and search strategy

Using broad-based computerized international databases, we employed systematic searches to find all published studies on the prevalence of IPIs in Ethiopian children from 2000-2020. Databases included MEDLINE/PubMed, EMBASE, Psych INFO and Web of Science, and Google Scholar for grey literature. Reference lists of eligible articles, hand searches for grey literature and relevant scientific conference websites were also appraised to enhance electronic searches. Observational studies conducted on the prevalence of IPIs among children in Ethiopia were selected for this systematic review and meta-analysis. Search protocol was developed by using such keywords as "prevalence" OR "Epidemiology" AND "intestinal parasite," "intestinal helminthes", "intestinal protozoa", "soil-transmitted helminthes" AND "associated factors" OR "predictors" AND "Ethiopia". To make a certain scientific rigor, we strictly adhered to the Preferred Reporting of Systematic Reviews and Meta-Analysis (PRISMA) guideline [26].

Inclusion criteria

All studies written in English, estimating the prevalence of IPIs in Ethiopian children and of high-quality scores were entered into the final meta-analysis.

Exclusion Criteria

Studies that did not estimate the prevalence of IPIs, articles without definite sample size or full-text, those that did not achieve the minimum quality scores, case reports, case series, and experimental studies were excluded from the meta-analysis.

Data Extraction

Two reviewers (FW and AT) screened the downloaded titles and abstracts using the eligibility criteria. Discussions and mutual consensus were in place when possible arguments raised between the reviewers. Two reviewers (FW and AT) then assessed full-texts of potentially eligible papers. We made some efforts to communicate the authors whenever further information was needed. Numerator and denominator data and beta coefficients and their standard errors (if given) were used to calculate ORs, where ORs with 95% CI were not available. The data extraction format included first author, study year, region of study, study design and sample size, and prevalence of IPIs.

Quality Appraisal

Articles were assessed for quality, with only high-quality studies included in the analysis. Two authors (FW, AT) independently evaluated the quality of each relevant article. The reviewer's cross-checked their quality appraisal scores and resolved any disparity before calculating the final appraisal score. Moreover, Kappa statistic was used to measure agreement between reviewers to determine uniformity of amongst eligible full-text articles using guidelines proposed by Landis and Koch [31]: < 0.20 = slight agreement; 0.21–0.40 = fair agreement; 0.41–0.60 = moderate agreement; 0.61–0.80 = substantial agreement; and $>$ 0.80 = almost perfect agreement. Finally, AA reviewed overall quality of extracted data and edited the manuscript. Newcastle-Ottawa Scale adapted for prevalence studies methodological quality assessment tool was also used [27]. The tool has three components in general–the first component graded as five stars gives a due emphasis on the methodological quality of each original study. The second component of the tool explores the comparability of the study. The third component focuses on the outcome and statistical analysis of studies. Articles with a score of $\geq$ 6 out of 10 were considered as high-quality. Accordingly, all eligible studies had high quality scores.

Data analysis

Information about study designs, study sample and country were summarized using Microsoft Excel and then exported to STATA/se version-14 for analysis. Meta-analysis of the magnitude of IPIs was carried out using a random-effects model, generating a pooled prevalence with 95% CIs. Heterogeneity among included studies was assessed using Cochran's Q and I^2 statistic [28]. I^2 statistic estimates the percentage of heterogeneity across studies. Forest plots were also used to estimate the pool effect sizes and weight of overall and each included study with respective CI to offer a graphic summary of the data. Publication bias was determined based on the symmetry of funnel plots [29], and Egger's test [30]. Sub-group analysis was carried out, based on age of participants and regional states, because of the presence of significant heterogeneity across the included studies.

Results

Our search yielded 2,896 articles; of these, 442 duplications and 2,411 unrelated articles were excluded. Kappa coefficient revealed that agreement rate between the two reviewers for the included articles was 0.81. Fifteen full-text articles [32-46] were excluded due to unmet outcome of interest or location. Finally, 43 eligible studies representing 20,008 participants met the inclusion criteria for this review that determine the burden of IPIs (**Figure 1).**

Descriptive characteristics of the included studies

Descriptive characteristics for the included epidemiological studies is presented in Table 1. Of these, 42 studies were cross-sectional in design and only one study was case-control [47]. Children were classified based on presence versus absence of an IPI for any species. The largest sample size was reported by the study conducted by Grimes J et al [50] and smallest for the study done by Mulatu G [16]. Similarly, the prevalence of IPI was highest for the study conducted by Worku L et al [48] and lowest for the study conducted by Zemene T [49] (**Table 1**).

Prevalence of IPIs in children

The overall prevalence of IPIs with one or more species was 48.2% (95% CI: 40.1, 56.3%) in Ethiopian children (**Figure 2**). We performed subgroup analyses based on regional states and age of participants as there was significant hetrogeniety across included studies. For instance, the prevalence of IPIs was 52.4% (95% CI: 41.3, 63.5) in school-age children and 52.1% (95% CI: 37.3, 66.8) of children with IPIs lived in Amhara regional state (**Table 2**). Overall Egger's test revealed no statistically significant publication bias, p-value = 0.62 (**Additional file 1**).

Association of residence and hand washing practice with IPIs

Five studies were included to determine the association of hand washing before eating on IPIs (**Table 3**). Children without hand washing before eating experienced six times more likely the occurrence of IPIs (OR: 5.6 (95% CI: 3.4, 9.3)) as compared to hand washing before eating (**Figure 3**). However, the association between residence (urban versus rural) showed a non-significant association with IPIs (OR: 1.1 (95% CI: 0.5, 2.1) (**Figure 4**).

Discussions

This study estimated the pooled prevalence of IPIs with one or more species in Ethiopian children and its association with residence and hand washing practice, using the documented data from systematic literature review, which was assembled from different regions of the country. After diligent search through scientific databases, scientific reports and grey literature, 43 studies were included in the final analysis. Accordingly, the overall pooled prevalence of IPIs among Ethiopian children was 48.2%. This finding was in line with previous studies that revealed 42.5% IPIs in Syria [51], 47.6% in Afghanistan [52] and 38% in Iran [53]. In contrast, the prevalence of IPIs observed in current study is higher compared to studies in Thailand that reported 38.8% [54], in Shush country (5.14%) [55], in Turkey (17%) [56] and in Korea (10.5%) [57]. This observed variation could be due to socio-economic status, poor hygienic practice and sanitary facilities, inadequate safe drinking water and environmental factors as well as different methods used for the diagnosis of IPIs.

We performed sub-group analysis based on the age of participants and regional states of the country. Accordingly, the evidence revealed that the prevalence of IPIs among school-age children was two-fold higher than that in under five-children. The difference observed between under-five and school-age children might be because of the following reasons–first, close contact between students and unhygienic conditions in the school compound; second, variation in sanitation and human development indices; and finally, due to implementation of continuing deworming programme for under-five children by ministry of health. Likewise, the highest prevalence of IPIs were observed in Amhara regional states and the lowest prevalence was in Tigray state. This regional discrepancy might be because of cultural habits (sanitary status) among the regions, variations in methodology and sample size. The advancement of public health measures and policy implementation could also vary across regions that might attribute for the difference.

In an effort to examine the association between residence and hand washing before eating and IPIs, hand washing before eating was associated with a significant reduction in the occurrence of IPIs. Indeed, IPIs is frequently caused by *hookworms*, *ascaris lumbricoides* and *trichuris trichiura* and affected over one billion individuals globally [58]. This could be due to probable to be hand contaminated with cysts of *giardia*, *cryptosporidium* and other species. The meager association between residence and IPIs in this meta-analysis is supported by previous studies [60, 61]. This might be because of variations among studies, although Egger's test for publication bias showed no statistically significant evidence, p-value = 0.06.

The findings of this study may have both clinical and public health implications towards scaling up effective and efficient management of IPIs by informing decision makers and practitioners. In other words, understanding the magnitude and distribution of IPIs is an important precondition for planning and evaluating intervention programs. For instance, safe water and personal hygiene as a basic human right will indisputably result in major health improvements and prevention of different diseases including parasitic infections [59]. That is, since almost all of IPIs are feco-oral communicable infections, delivery of tape water and latrines, health education on personal hygiene and environmental sanitation are crucial to control and reduce IPIs in the country.

However, these findings need to be considered in the context of some important limitations; these include: (i) significant heterogeneity across studies might have contributed for meager association between residence and IPIs, although presumably children in urban areas have better access to personal and environmental hygiene; (ii) this study did not determine other possible risk factors contributing to the occurrence of IPIs; (iii) the gold standard diagnosis of Pinworm infection is Gram staining, though several studies had employed only wet smear; and (iv) stool samples were taken at once but standard diagnosis usually take at least 3 samples.

Conclusion

This meta-analysis summarized a high pooled prevalence of IPIs in Ethiopian children especially among school-age children. Establishment of applicable sanitation services and health education for hand washing will help make a healthier childhood.

List of abbreviations

AA	Amanuel Abajobir
AT	Aster Tadesse
FW	Fasil Wagnew
IPIs	Intestinal Parasitic Infections
OR	Odds Ratio

Declarations

Ethics approval and consent to participate

Not applicable

Consent to publication

Not applicable

Availability of data and material

-The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

-PRISMA checklist

Competing interests

The authors declare that they have no competing interests.

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Authors' contribution

FW involved in the conception of research idea; (FW, AT, AA) undertook data extraction, analysis, interpretation, and manuscript write-up. All authors read and approved the final manuscript.

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Figure legends

Figure 1:- Flowchart diagram describing selection of studies for the burden of IPIs and association with residence and hand washing practice in Ethiopian children, 2018

Figure 2:- Forest Plot of the 31 studies that quantitatively assessed the pooled prevalence of IPIs, 2018.

Figure 3: Forest Plot of the 6 studies that quantitatively assessed the effect of hand washing before eating on the occurrences of IPIs, 2018

Figure 4:- Forest Plot of the 6 studies that quantitatively assessed the effect of residence on the occurrences of IPIs, 2018.

Additional Files

Additional file 1:- Funnel plot of the included studies for checking publication bias.

Table 1: Descriptive summary of 31 included studies on the prevalence of intestinal parasitic infections and association with residence and hand washing in Ethiopian children.

Authors name	year	Region	Design	Age of subjects	Sample size	No of people with outcome	Prevalence (%)	Quality score
Gemechu et al[62]	2017	SNNP	CS	<5yr	167	29	17.45	7
Girum Tadesse [63]	2001	SNNP	CS	school age	415	113	27.2	9
AidadeLucio et al[64]	2016	Amhara	CS	school age	393	234	59.6	7
Tamirat Hailegebri el[7]	2016	Amhara	CS	school age	359	235	65.5	7
Abossie A et al[65]	2012	SNNP	CS	school age	400	324	81	8
Zemene T et al[49]	2014	Amhara	CS	<5yr	217	38	17.4	7
Agesew A et al[66]	2015	Amhara	CS	<5yr	401	141	35.2	8
Mathewos B et al[67]	2012	Amhara	CS	school age	261	174	66.7	8
Gelaw A et al[19]	2012	Amhara	CS	school age	304	104	34.2	8
Tadege B et al[68]	2015	SNNP	CS	school age	374	254	67.9	8

Mulatu G[16]	2011	SNNP	CS	<5yr	158	42	26.6	7
Beyene G et al [69]	2012	Oromia	CS	school age	260	129	49.6	6
Hailu T et al[70]	2017	Amhara	CS	school age	409	193	47.2	7
Reji P et al[71]	2008	Oromia	CS	school age	358	127	35.5	8
Teferae E et al[72]	2010	Oromia	CS	school age	715	346	48.4	7
Alemayehu B et al[73]	2015	SNNP	CS	school age	503	363	72.2	6
Yirgalem G et al[74]	2013	Oromia	CS	<5yr	374	91	24.3	7
Firdu T et al[47]	2011	SNNP	Case-control	school age	230	84	36.52	8
Worku L et al[48]	2013	Amhara	CS	school age	385	372	96.6	9
Begna T et al[75]	2013	SNNP	CS	school age	492	131	26.6	9
Grimes J et al[50]	2017	SNNP	CS	school age	3729	874	23	7
Daniel G et al[76]	2017	Oromia	CS	school age	279	85	30.5	7
Tilahun A et al[77]	2010	Amhara	CS	school age	384	211	54.9	7
Yami A et al[78]	2008	Oromia	CS	school age	855	403	47.1	9
Abebe Alemu et al[79]	2009	Amhara	CS	school age	319	263	82.4	7
Amare B[80]	2008	Amhara	CS	school age	405	92	22.7	8
Tadesse D[81]	2000	Tigray	CS	school age	800	285	35.6	8
Derso A[82]	2012	Amhara	CS	school age	385	170	44.2	8
Ayalew A et al[9]	2010	Amhara	CS	school age	704	562	79.8	6
Legesse M et al[83]	2003	Oromia	CS	school age	259	217	83.8	6
Alamneh Aet al[84]	2014	Amhara	CS	school age	380	170	44.2	7
Tulu et al. [85]	2014	Amhara	CS	School age	340	89	26.2	8
Feleke et al. [86]	2018	Amhara	CS	<5	225	49	21.8	6

Wegayehu et al. [87]	2011	Amhara	CS	school age	284	81	28.5	7
Aranzazu A et al[88]	2016	Amhara	CS	School age	396	306	77.5	6
Bitew et al. [89]	2016	Amhara	CS	School age	384	251	65.6	7
Mulusew A	2014	Amhara	CS	School age	357	245	68.4	7
Abate et al [90]	2013	Amhara	CS	School age	410	255	62.3	7
Aida de Lucio [64]	2016	Amhara	CS	School age	393	216	55	8
Teha Shumbej [91]	2015	SNNP	CS	<5	377	88	23.3	6
Ayalew et al. [92]	2008	Dire-Dawa	CS	School age	655	311	47.5	7
Liza A.[93]	2010	SNNP	CS	<5	288	245	85	8
Gizaw et al.[94]	2018	Amhara	CS	<5	225	58	25.8	6

CS=Cross-Sectional, SNNP= Southern Nations, Nationalities, and Peoples

Table 2: Subgroup analysis based on regions and age of participants among diabetes patients

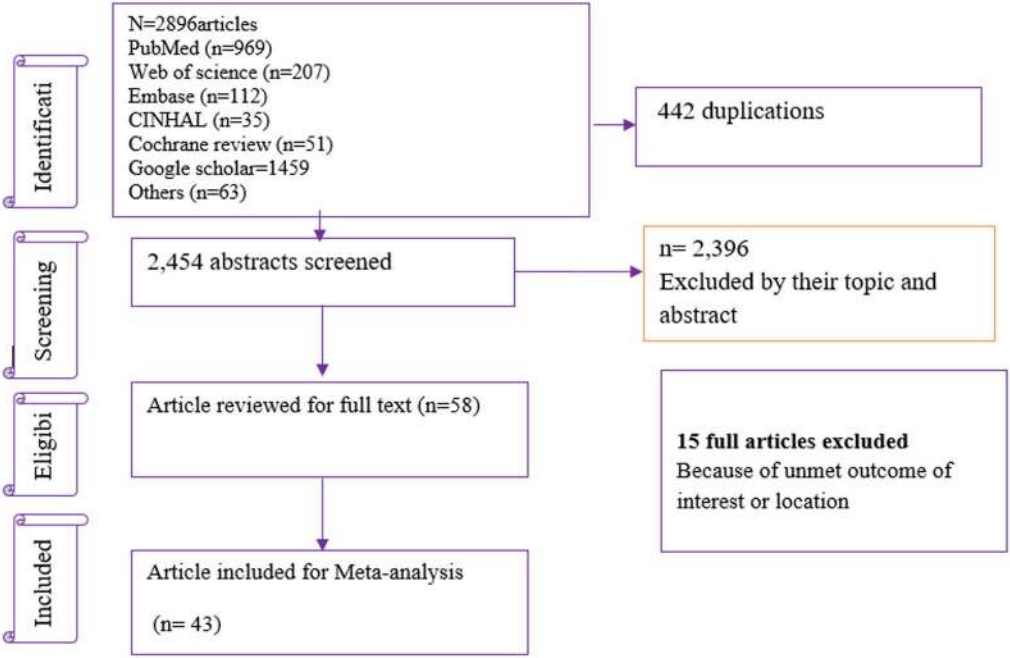
Variables	**Characteristics**	**Estimates with 95% CI**	**P-value**
Age of participant	Under-five children	24.23(17.44-31.02)	<0.001
	School-age children	52.43(41.37-63.5)	
Region	Amhara	52.1(37.3-66.8)	<0.001
	Oromia	45.1(30.9-59.3)	
	SNNP	43.9(24.9-62.9)	
	Tigray	35.6(32.2-38.9)	

SNNP= Southern Nations, Nationalities, and Peoples

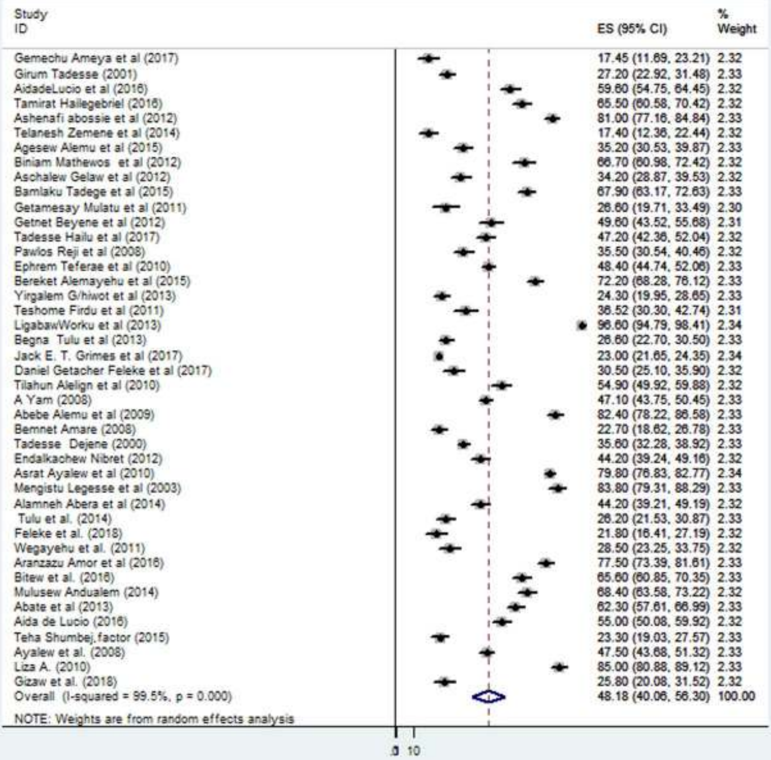
Table 3 the effect of hand washing before eating on intestinal parasitic infections in Ethiopian children.

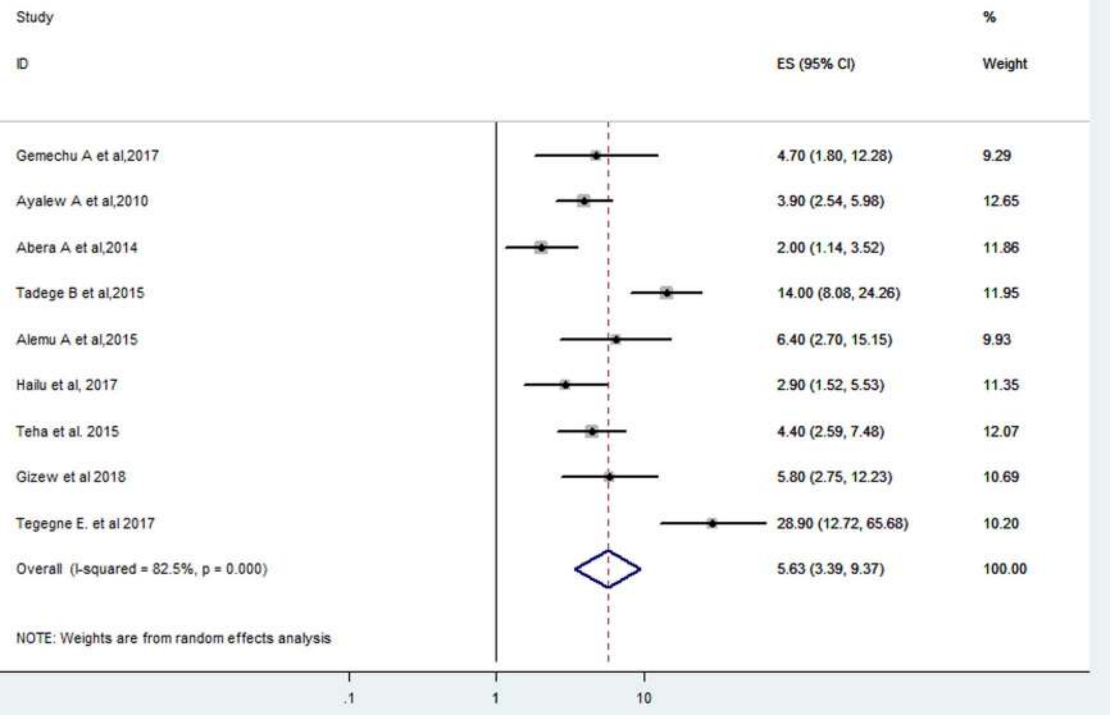
Authors and year	Region	Hand washing Before eating	Intestinal parasites Positive	negative	OR(with 95% CI)
Gemechu A et al,2017[62]	Southern	Yes	7	83	1
		NO	22	25	4.70(1.88-11.75)
Ayalew A et al,2010[9]	Amhara	Yes	261	110	1
		No	301	32	3.96(2.58-6)
Abera A et al,2014[84]	Amhara	Yes	135	191	1
		No	35	24	2.06(1.17-3.62)
Tadege B et al,2015[68]	SNNP	Yes	57	156	1
		No	140	21	14.02(8-24.3)
Alemu A et al,2015[66]	Amhara	Yes	6	96	1
		No	86	213	6.46(2.73-15.3)
Hailu et al, 2017[70]	Amhara	Yes	128	227	1
		No	40	14	2.90(1.52-5.53)
Teha et al. 2015[91]	SNNP	Yes	67	186	1
		No	21	191	4.4(2.6-7.6)
Gizew et al. 2018[94]	Amhara	Yes	10	92	1
		No	48	75	5.8(2.7-12.4)
Tegegne E. et al. 2017[95]	Amhara	Yes	22	148	1
		No	43	10	28.9(12.7-65.7)

`SNNP= Southern Nations, Nationalities, and Peoples



Identificati
Screening
Eligibi
Included
N=2896articles
PubMed (n=969)
Web of science (n=207)
Embase (n=112)
CINHAL (n=35)
Cochrane review (n=51)
Google scholar=1459
Others (n=63)
442 duplications
2,454 abstracts screened
n= 2,396
Excluded by their topic and abstract
Article reviewed for full text (n=58)
15 full articles excluded
Because of unmet outcome of interest or location
Article included for Meta-analysis
(n= 43)


Study ID
ES (95% CI)
% Weight
Gemechu Ameya et al (2017) 17.45 (11.69, 23.21) 2.32
Girum Tadesse (2001) 27.20 (22.92, 31.48) 2.33
AidadeLucio et al (2016) 59.60 (54.75, 64.45) 2.32
Tamirat Hailegebriel (2016) 65.50 (60.58, 70.42) 2.32
Ashenafi abossie et al (2012) 81.00 (77.16, 84.84) 2.33
Telanesh Zemene et al (2014) 17.40 (12.36, 22.44) 2.32
Agesew Alemu et al (2015) 35.20 (30.53, 39.87) 2.33
Biniam Mathewos et al (2012) 66.70 (60.98, 72.42) 2.32
Aschalew Gelaw et al (2012) 34.20 (28.87, 39.53) 2.32
Bamlaku Tadege et al (2015) 67.90 (63.17, 72.63) 2.33
Getamesay Mulatu et al (2011) 26.60 (19.71, 33.49) 2.30
Getnet Beyene et al (2012) 49.60 (43.52, 55.68) 2.31
Tadesse Hailu et al (2017) 47.20 (42.36, 52.04) 2.32
Pawlos Reji et al (2008) 35.50 (30.54, 40.46) 2.32
Ephrem Teferae et al (2010) 48.40 (44.74, 52.06) 2.33
Bereket Alemayehu et al (2015) 72.20 (68.28, 76.12) 2.33
Yirgalem G/hiwot et al (2013) 24.30 (19.95, 28.65) 2.33
Teshome Firdu et al (2011) 36.52 (30.30, 42.74) 2.31
LigabawWorku et al (2013) 96.60 (94.79, 98.41) 2.34
Begna Tulu et al (2013) 26.60 (22.70, 30.50) 2.33
Jack E. T. Grimes et al (2017) 23.00 (21.65, 24.35) 2.34
Daniel Getacher Feleke et al (2017) 30.50 (25.10, 35.90) 2.32
Tilahun Alelign et al (2010) 54.90 (49.92, 59.88) 2.32
A Yam (2008) 47.10 (43.75, 50.45) 2.33
Abebe Alemu et al (2009) 82.40 (78.22, 86.58) 2.33
Bemnet Amare (2008) 22.70 (18.62, 26.78) 2.33
Tadesse Dejene (2000) 35.60 (32.28, 38.92) 2.33
Endalkachew Nibret (2012) 44.20 (39.24, 49.16) 2.32
Asrat Ayalew et al (2010) 79.80 (76.83, 82.77) 2.34
Mengistu Legesse et al (2003) 83.80 (79.31, 88.29) 2.33
Alamneh Abera et al (2014) 44.20 (39.21, 49.19) 2.32
Tulu et al. (2014) 26.20 (21.53, 30.87) 2.33
Feleke et al. (2018) 21.80 (16.41, 27.19) 2.32
Wegayehu et al. (2011) 28.50 (23.25, 33.75) 2.32
Aranzazu Amor et al (2016) 77.50 (73.39, 81.61) 2.33
Bitew et al. (2016) 65.60 (60.85, 70.35) 2.33
Mulusew Andualem (2014) 68.40 (63.58, 73.22) 2.32
Abate et al (2013) 62.30 (57.61, 66.99) 2.33
Aida de Lucio (2016) 55.00 (50.08, 59.92) 2.32
Teha Shumbej.factor (2015) 23.30 (19.03, 27.57) 2.33
Ayalew et al. (2008) 47.50 (43.68, 51.32) 2.33
Liza A. (2010) 85.00 (80.88, 89.12) 2.33
Gizaw et al. (2018) 25.80 (20.08, 31.52) 2.32
Overall (I-squared = 99.5%, p = 0.000) 48.18 (40.06, 56.30) 100.00
NOTE: Weights are from random effects analysis
0 10



Study
ID
ES (95% CI)
%
Weight
Gemechu A et al,2017
4.70 (1.80, 12.28)
9.29
Ayalew A et al,2010
3.90 (2.54, 5.98)
12.65
Abera A et al,2014
2.00 (1.14, 3.52)
11.86
Tadege B et al,2015
14.00 (8.08, 24.26)
11.95
Alemu A et al,2015
6.40 (2.70, 15.15)
9.93
Hailu et al, 2017
2.90 (1.52, 5.53)
11.35
Teha et al. 2015
4.40 (2.59, 7.48)
12.07
Gizew et al 2018
5.80 (2.75, 12.23)
10.69
Tegegne E. et al 2017
28.90 (12.72, 65.68)
10.20
Overall (I-squared = 82.5%, p = 0.000)
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100.00
NOTE: Weights are from random effects analysis
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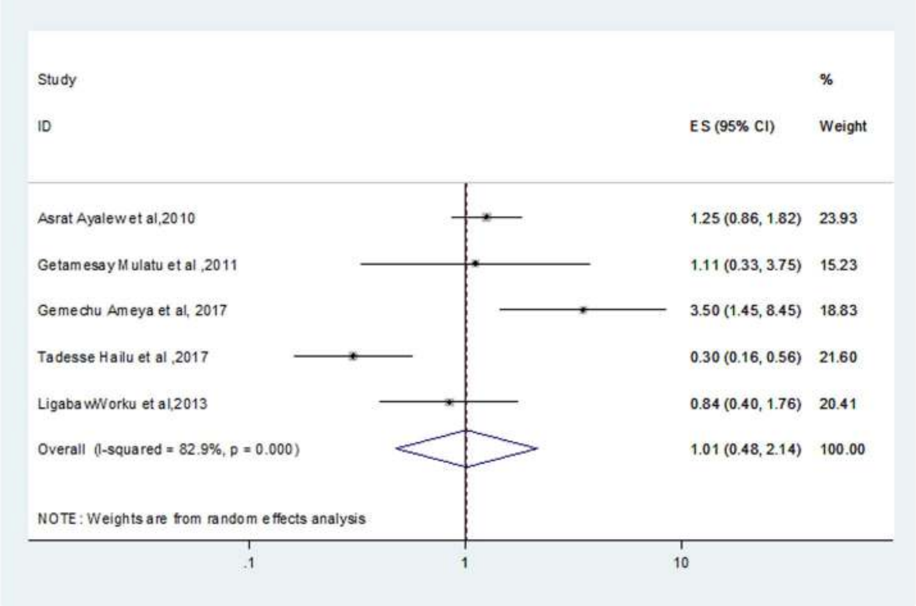
1
10


Study
ID
ES (95% CI)
%
Weight
Asrat Ayalew et al,2010
1.25 (0.86, 1.82)
23.93
Getamesay Mulatu et al ,2011
1.11 (0.33, 3.75)
15.23
Gemechu Ameya et al, 2017
3.50 (1.45, 8.45)
18.83
Tadesse Hailu et al ,2017
0.30 (0.16, 0.56)
21.60
LigabawWorku et al,2013
0.84 (0.40, 1.76)
20.41
Overall (I-squared = 82.9%, p = 0.000)
1.01 (0.48, 2.14)
100.00
NOTE: Weights are from random effects analysis
.1
1
10