Immunization coverage in Ethiopia among 12-23 month children: systematic review and meta-analysis.

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Abstract

Background: Immunization is cost-effective public health interventions strategies of the decade which under go long and careful process to ensure vaccine safeness before it reaches to the target children, it averts nearly three million mortality annually and immunization coverage is very low comparing all plans at national and regional. The aim of this systematic review and meta-analysis is to assess pooled immunization coverage in Ethiopia.

Method: systematic search was done from PubMed, Google Scholar, Embase, and Hinari, SCOPUS, WHO's Institutional Repository for Information Sharing (IRIS), African Journals Online databases, grey literature and reviewing reference lists of already identified articles. Checklist from the Joanna Briggs Institute was used to assess risk of bias of the included study while heterogeneity was assessed using I^2 . Funnel plot were used to assess publication bias. Meta-analysis using random effect model was used to estimate the pooled prevalence of immunization among 12-23 month children using STATA 13 software.

Result: twenty eight articles were included in the meta-analysis with, a total sample size of 20,048 12-23 months children. The pooled prevalence of immunization among 12-23 month children in Ethiopia was found 47 % (95%, CI: 46.0, 47.0). Subgroup analysis by region indicated the lowest proportion of immunized children in Afar region, 21% (95%, CI: 18.0, 24.0) and the highest in Amhara region, 89% (95%, CI: 85.0, 92.0).

Conclusion: Nearly 50% of 12-23 month children were fully vaccinated for this systematic review and meta-analysis but coverage is still low with clear disparity among regions. Mobile and outreach immunization sites should be planned for hard to reach area of pastoral and semi-pastoral regions. Immunization service should be integrated to private for profit and not for profit health facilities which cover 11% of health service coverage in Ethiopia.

Background

Immunization is one of the cost-effective public health interventions that are used to eliminate life threatening childhood illness like diphtheria, pertussis, tetanus, hepatitis virus, measles, mumps, pneumonia, polio virus and rotavirus. Globally, it decreases 2–3million mortality yearly, whereas vaccine preventable diseases (VPD) accounts worldwide over 2 million under five deaths annually majority of them from sub-Sahara African countries [1–3].

According to World Health Organization (WHO) children are considered fully immunized when they received one dose of Bacillus Calmette Guerin (BCG), three doses of DPT, three doses of polio vaccines, and one dose of measles vaccination by the age of 9–12months [4, 5]

2017 WHO report revealed that, 116.2 million infants (85%) received third dose of DPT, internationally, only 123 (63%) of 194 countries achieved three doses of DPT coverage $\geq 90\%$. vaccine uptake is dramatically increased but new and underused vaccines which makes 19.9 million under one year children are not received DPT 3 vaccine, 12.4 million did not complete three doses, 13.7 million did not receive any DTP dose ("left out") and 6.2 million are dropped [6–8].

WHO 2018 reported that That 19.4 million infants are completed DPT3 where 13.5 million didn't received initial dose of vaccine due to lack of access to immunization services, while Ethiopia and other nine countries hold 11.7 million of 19.4 under and unimmunized children which accounts 60% [9]

Over 6 million under five children died worldwide in 2013, which several deaths are attributed by VPD. Government improved service utilization by training of 38,000 health extension workers with 15000 health posts integrated community case management in 2010; endorsing SDG #3 targets 3.2 aimed preventable deaths of newborns and under-five children by 2030. Despite availability of cost effective and affordable interventions to decrease under-five mortality there is alarming of VPD like: diarrhea, measles and pneumonia which annually cause 3, 370 00 cases of measles, pneumonia, and diarrhea [5, 10–15]

There are contributing factors that significantly associate with vaccine coverage in Ethiopia, those are rural residence, employer, female household head, primary and secondary school, antenatal care follow up, delivering health facility, Level of maternal education, good knowledge on immunization, short distance to health facility, having four or more family size can increase vaccine coverage in contrary fear of side effect, low wealth status, being too busy, hearing rumor about vaccination were predictors and barrier of fully vaccination[6, 16–19]

Although private for profit and not for profit health facilities accounts for about 11% of health service coverage in Ethiopia all most all of them are not providing routine immunization if they provide routine immunization with free cost may contribute a lot to the coverage[20]

Understanding the extent of vaccine coverage and its associated factors is important for designing strategies that can reduce the burden of vaccine preventable diseases. There is no review and meta-analysis conducted in Ethiopia on immunization coverage among 12–23 month old. Therefore, aims of this meta-analysis was to pool and synthesize recent evidence on the prevalence of vaccine coverage among 12–23 months children using small fragmented regional studied to pool and form national result to consolidate available data and determine current prevalence of vaccine coverage in Ethiopia.

Methods

Search strategy and appraisal of studies

All published studies conducted in Ethiopia reporting the fully vaccinated or immunization coverage from September 2009 to 2019 were included. The search was limited to English language, human and cross sectional studies. This study was conducted according to the Preferred Reporting Items of Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) checklist guidelines [21]. The electronic databases searched were PubMed, Google Scholar, Embase, and Hinari, SCOPUS, WHO's Institutional Repository for Information Sharing (IRIS), and African Journals Online databases. In addition to that, articles were also searched through a review of the grey literature available on local university shelves, and institutional repositories, and by reviewing the reference lists of already identified articles. The key terms used for the database searches were connected by bloomean operators in our search below Medical Subject Headings (MeSH terms): "Epidemiologic" OR "Child" OR "Children" AND "Coverage, Vaccination" OR "Vaccination coverages" OR "Immunization Coverage" OR

Coverage, Immunization" OR "coverages, Immunization" OR "Immunization coverage" AND "Ethiopia". The search was Publication date from 2009/01/01 to 2019/11/01.

Inclusion and exclusion criteria

All English-language, full-text articles for studies conducted in Ethiopia, published from 2009 to September 2019, in peer-reviewed journals or found in the grey literature were eligible for inclusion. Case definition were adopted from WHO EPI Fully immunized is defined when they have received one dose of Bacillus Calmette Guerin (BCG), three doses of DPT, three doses of polio vaccines, and one dose of measles vaccination by the age of 9–12 months [4, 22]. All studies that reported the vaccination coverage in children 12–23 month were eligible for inclusion. Studies that did not report specific outcomes for immunization quantitatively, age >12–23 month and study design other than cross-sectional study design were excluded.

Data abstraction procedure

Two authors (TY and AM) independently extracted data using Joanna Briggs Institute data extraction tool for cross-sectional study design, any disagreement was resolved through discussion and consensus reached through third person. Outcome data extraction format contain author, publication year, region, sample size, study design, response rate, prevalence rate with 95% confidence interval. Retrieved articles were evaluated based on their title, objective, and methodology. At this stage, irrelevant articles were excluded and the full text of the remainder articles was reviewed for inclusion criteria. Articles that fulfilled the prior criteria were used as a source of data for the final analysis

The database search results were exported

Duplicate articles were removed using EndNote software (version X7; Thomson Reuters, New York, NY). Two independent reviewers critically appraised each individual article using the using quality assessment checklist for prevalence studies before analysis which was included representation, sampling, random selection, non-response rate, data collection, case definition, reliability and validity of study tool, method of data collection, prevalence, numerator and denominator lastly quality summary [23]. It was categorized as having low risk of bias "yes" high risk of bias "no" if the score is 8–10 we consider it as having "low risk of bias" 6–7 score "moderate risk of bias" 0–5 score "high risk of bias" (Table 1).

Any disagreement between reviewers was resolved through discussion and reaching consensus including a third reviewer. The average of two independent reviewer's quality scores was used to determine whether the articles should be included. Articles with methodological errors or incomplete reporting of results those with no full text were excluded from the final analysis.

Outcome measurements and statistical analysis

The main aim of this review was to assess pooled prevalence of immunization coverage among children 12–23 month in Ethiopia. It was measured as the number of children who took one dose BCG, 3 doses of DTP, 3 doses of OPV and one dose of measles vaccine divided by the total number of children in a study multiplied by 100.

Information on the studies characteristics such as publication year, study region, study design, sample size, non-respondent and immunization coverage were extracted from each study using a Microsoft Excel spreadsheet template. Then, data were exported to Stata (version 13; Stata Corp, College Station, TX) for further analysis. A random effect model was used to estimate pooled prevalence of fully vaccinated children with 95% confidence interval (CI) in Ethiopia. Funnel plot asymmetry was used to check for publication bias (Figure 3). Heterogeneity between studies was assessed using I-squared (I^2) statistics and the cutoffs of 25, 50, 75% was used to declare heterogeneity as low, moderate and high respectively [24] also subgroup analysis was conducted to detect prevalence of immunization coverage and heterogeneity among regional states of the country.

Operational definitions

Pastoralist and semi-pastoralist: means communities, located in Benishangul Gumuz, Gambella, Oromia, Somali, and Southern Nations, Nationalities and Peoples' regions [25].

Fully vaccinated: when children receive one dose of Bacillus Calmette Guerin (BCG), three doses of DPT, three doses of polio vaccines, and one dose of measles vaccination by the age of 9–12 months [4, 5]

Results

In the first step of our search, 363 articles were retrieved about immunization coverage among children aged 12–23 month using different electronic databases were searched: like PubMed, Google Scholar, Embase, and Hinari, Web of Science, SCOPUS, WHO's Institutional Repository for Information Sharing (IRIS), and African Journals Online databases. 22 articles were excluded due to duplication, from remaining 341 articles 308 articles were excluded not related to the topic, not done in Ethiopia and study design. Only 35 full text articles were accessed and assessed for their eligibility based on inclusion criteria. Finally 28 articles were eligible and included in this meta-analysis (figure 1).

Characteristics of included studies

All retained twenty eight studies in this systematic review and meta-analysis conducted in Ethiopia all of them were cross sectional; twenty five of them were conducted from eight regional states and three national survey, a total sample size of 20,048 of (aged 12–23 months) old children included. The minimum sample size was 173[26] and maximum sample size was 2004[27]. Nin (32.1%) of studies were from Amhara region [28–36], six (21.4%) from South Nation Nationality and People's region[18, 26, 37–40], four (14.3%) from Oromia region[41–44], were three (10.7%) survey nationwide [27, 45, 46], two (7.1%) from pastoral and semi-pastoral area of the country [25, 47], lastly one (3.6%) from Somali state [48] and one (3.6%) from Tigray regional states[49]. All studies were published in peer review journals that fulfills WHO/UNICEF case definition for maternal recall, immunization card and score were used.

An estimated over all pooled prevalence of immunization coverage among 12–23 month children in Ethiopia was 47 % (95% confidence interval (CI: 46/0,047.0)) (figure 2). The lowest

Proportion included studies was 21% (95%,CI:18.0,24.0)[50] and the highest 89% (95%,CI:85.0,92.0)[31]. The I-square test shown that there was no heterogeneity among included studies ($I^2 = 0.00$, p-value < 0.005). Studies with largest weight were EDHS 2016[27], EDHS 2011[51] and Mebrahtom and Birhane [52] 9.99,9.62,7.65 respectively. Those with smallest weight were Facha wolde [40], Porth et al [37] and Gualu and Dillie [31] with respective weight of 1.05, 1.16 and 1.44.

Heterogeneity test showed that there was no significant publication bias among studies after we run funnel plot as shown ($I^2 = 0.000$, p-value<0.005) (Figure 2).

Subgroup analysis

We have conducted subgroup analysis based on regional states of the country, Tigrei region had highest prevalence of immunization coverage 12–23 month children 77% (95% CI: 74.0,81.0) followed by Amhara region 71% (95% CI: 70.0,72.0), SNNP 60% (95% CI: 58.0,62.0), Oromia region 41% (95% CI: 41.0,42.0), Somali region, 37% (95% CI: 33.0,41.0) and A far region had the smallest immunization coverage in Ethiopia 12% (95% CI: 10.0,13.0). In subgroup analysis Amhara region had the highest weight 26.06 the possible reason may be high number of study done and included on that area and lowest weight was Somali region 2.90 (Figure.3).

Publication bias

In the present study there was no publication bias because funnel plot visual presentation showed that a symmetric distribution of studies conducted this meta-analysis as illustrated below (Figure.4)

Discussion

Immunization is cost-effective public health intervention that prevents VPD and their complications like amputation of limbs, paralysis, hearing loss, convulsions, brain damage, hepatocellular carcinoma as well as death of children it is also have had greatest impact of decreasing health care cost and inequality among global population.

Ethiopian government still struggling to achieve its target of immunization coverage despite implementing different strategies and approaches. In this systematic review and meta-analysis, we assessed pooled prevalence of immunization coverage among 12–23 month children in Ethiopia. To our knowledge, this meta-analysis is first its kind in Ethiopia for immunization coverage.

Over all pooled prevalence of immunization coverage among children was 47.0 % (95% CI: 46.0, 47.1). These prevalence lower than the WHO 2018 factsheet report of 86% [9] it is also lower than DHS reports of Lower and Middle Income Countries (LMIC), such as 67.2% Kenya[53], 62.5% Cameroon[54], 77.0% Ghana[55], 75.3% Tanzania[56], 62% India[57], 70.0% Philippines[58], 82% Bangladesh[59], 76.0% Zimbabwe [60] and 61.0% South Africa [61]. It is lower than administrative /HMIS/ of fully vaccinated children which is 88% and government target of health sector transformation plan-IV (HSTP) which was 93 % [62].

But this meta-analysis is in line with other DHS reports that are nearly similar to this study with prevalence of 49.1%Madagascar[63], 55.8% Uganda[64].

In contrary this meta-analysis is higher than Nigerian DHS report and meta-analysis pooled prevalence of immunization coverage among 12–23 month children 31.0% Nigeria[65] and 34.4% (CI: 27.0, 41.9) respectively [66].

Immunization is a proven tool for controlling and eliminating life-threatening infectious disease which prevent 2–3 million under-five deaths annually. Provision of measles vaccine can support cognitive gain, school-grade attainment, decrease malnutrition, economic consequence after childhood and also prevent severe pneumonia and diarrhea [67, 68]

We found regional variation for immunization coverage among 12–23 month children lowest prevalence was observed from Afar region 12.0 % (95% CI: 10.0, 13.0) were evidences showed that access to health facilities is very low, 82.12% of population resides in rural and pastoralist due to that and other reasons under five mortality is highest in Afar region comparing other eight regional states which is (125 per 1000 live birth) high percent of death can be prevented simply providing immunization services children living hard-to-reach area [27, 69]. Somali region is next to Afar region where immunization coverage is low and 37.0% (95% CI: 33.0%, 41.0%).

Pastoral and Semi-pastoral region share same socio-demographic, socio-cultural and socio-economic characteristics special strategies and approaches are needed to answer those pastoralist regions concern which can increase access and utilization of health service particularly immunization service in those area.

The possible reason could be socio-demographic, socio-economic and cultural characteristics of the community, access to the health facilities and utilization of immunization services are very low to pastoral and Semi-pastoral area of the countries. This systematic review and meta-analysis shown low immunization coverage is public health problem in Ethiopia due to recurrent episodes of vaccine preventable disease to those low immunization coverage regions.

The highest was Amhara region 71% (95% CI: 70.1, 72.0). (Table 4) which is mostly Agrarian region and population are settled the other reason may be, educational status of the community is relatively good comparing to other region, also road access to the health facilities, other infrastructure like electricity coverage that is directly helpful to routine immunization also health service utilization is good based on evidences among different regional states of Ethiopia.

Although Trends of immunization coverage in Ethiopia is slightly increased for 24% to 43 from 2011–2019 respectively[27, 45, 51] but still there are challenges which need special consideration particularly pastoral and semi-pastoral regions that deserve to give special consideration when routine immunization programs are planning.

This review was done extensive search and more than two reviewer involved to minimize all possible risk of bias. But there are some limitation of this review we only reviewed cross-sectional studies which are prone for confounding, the number of studies distributed among region was not equal, Only English language, some articles were published emerging journals, and numbers of studies were very few all the above mentioned points may affect the overall result.

Conclusion

Study found that pooled prevalence of immunization coverage among 12–23 month children were very low comparing both international and national immunization coverage. Therefore, we strongly recommend government should strength mobile and outreach immunization site for hard to reach of pastoral and semi-pastoral areas, integrating both human and animal health posts, Integrate immunization service both private for profit and not for profit health facilities because they account 11% of health coverage of the country which hardly provide free immunization service, also future research should be considered for all states of the country that may reveal more about prevalence of immunization coverage.

Abbreviations

BCG Bacillus Calmette Guerin

CI Confidence Interval

DHS Demographic Health Survey

DPT Diphtheria Pertussis Tetanus

EDHS Ethiopia Demographic Health Survey

EPI Expanded Program of Immunization

HMIS Health Management Information System

IRIS Institutional Repository for Information Sharing

JBI Joanna Briggs Institute

LMIC Low and Middle Income Countries

PRISMA Preferred Reporting Items of Systematic Reviews

And Meta-Analysis

SDG Sustainable Development Goals

VPD Vaccine Preventable Diseases

WHO World Health organization

Declarations

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Authors' contributions

TY conceived the study, study selection, preparation of protocol, searching strategy for literature, participated data analyzes, interpretation and manuscript preparation. AM and OM involved in developing protocol, searching strategy, critical appraisal, data extraction and draft of manuscript, KH prepared and supported, final draft of manuscript. All authors (TY, AM, OM and KH) involved all steps read and approved final draft of manuscript.

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Availability of data and materials

The dataset for this study is available from the corresponding author on reasonable request.

Ethical approval and Consent of participants

Not applicable

Consent for publication

Not applicable

Competing interests

The author declares there was no competing of interest

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Appendix

Search Child or children AND Coverage, Vaccination OR Coverages, Vaccination OR Vaccination Coverages OR Immunization Coverage OR Coverage, Immunization OR Coverages, Immunization OR Immunization Coverages AND Ethiopia Filters: Free full text; Publication date from 2009/01/01 to 2019/12/31; Humans Sort by: [pubsolr12]

Tables

Figures

Table 1 Risk of bias assessment of eligible articles using the Hoy 2012 tool

study	Representation	sampling	Random selection	Non response rate	Data collection	Case definition	Reliability and Validity of study tool	Method of Data collection	prevalence	Numerator and Denominator
Animaw et al[22]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Etana and Deressa[70]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Gualu and Dilie[31]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Hailu et al[38]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Girmay and Dadi[16]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Kassahun et al[71]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Lake et al[32]	High risk	High risk	Low risk	Low risk	High risk	Low risk	High risk	Low risk	Low risk	Low risk
Legesse and Dechasa[72]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Mekonnen et al[4]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Meleko et al[39]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Mohammed and Atomsa[43]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Mohamud et al[48]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Tefera et al[18]	High risk	Low risk	High risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Fite and Haili[26]	High risk	High risk	Low risk	Low risk	High risk	Low risk	High risk	Low risk	High risk	High risk
Tesfaye et al[30]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Wado et al[73]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Yismaw et al[28]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Beyene et al[74]	High risk	Low risk	Low risk	Low risk	High risk	Low risk	High risk	Low risk	Low risk	Low risk
Mebrahtom and Birhane[52]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Debie and Taye[35]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Facha W [40]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Ebrahim and Beyene[34]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Tessema et al [47]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Kidane et al[25]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Porth et al [37]	High risk	Low risk	High risk	Low risk	High risk	Low risk	High risk	Low risk	Low risk	Low risk
EDHS [51]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
EDHS [27]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
EDHS [45]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

Table 2: summary characteristics of included studies in meta-analysis of immunization coverage in Ethiopia, 2009 to 2019.

Author	year	Region	study base	Event	N	Response rate	Quality score	prevalence with it is 95% CI
Animaw et al[22]	2014	Amhara	community based	461	630	100%	9	73% (70,76)
Etana and Deressa[70]	2012	Oromia	community based	193	536	100%	9	36% (32,40)
Gualu and Dilie[31]	2017	Amhara	community based	256	288	96.80%	9	89% (85,92)
Hailu et al[38]	2019	SNNP	community based	483	1116	82.70%	10	43% (40,46)
Girmay and Dadi[16]	2019	Tegrai	community based	480	620	99.50%	10	77% (74,81)
Kassahun et al[71]	2015	Amhara	community based	566	751	99.20%	9	75% (72,78)
Lake et al[32]	2016	Amhara	community based	472	724	100%	6	65% (62,69)
Legesse and Dechasa[72]	2015	Oromia	community based	393	519	98.50%	9	76% (72,79)
Mekonnen et al[4]	2019	Amhara	community based	423	566	98.80%	10	75% (71,78)
Meleko et al[39]	2017	SNNP	community based	295	322	100%	9	92% (88,94)
Mohammed and Atomsa[43]	2013	Oromia	community based	155	685	98.70%	8	23% (20,26)
Mohamud et al[48]	2014	Somali	community based	213	582	100%	9	37% (33,41)
Tefera et al[18]	2018	SNNP	community based	295	484	89.60%	7	61%(57,65)
Fite and Haili[26]	2019	SNNP	community based	130	173	100%	4	75%(68,81)
Tesfaye et al[30]	2018	Amhara	community based	494	846	98.11%	9	58% (55,62)
Wado et al[73]	2014	Oromia	community based	329	889	100%	7	37% (34,40)
Yismaw et al[28]	2019	Amhara	community based	228	301	100%	9	76% (71,80)
Beyene et al[74]	2013	Afar	community based	157	762	97.10%	7	21% (18,24)
Mebrahtom and Birhane[52]	2013	Afar	community based	124	1534	98.30%	9	8% (7.0,10)
Debie and Taye[35]	2014	Amhara	community based	236	479	100%	7	49% (45,54)
Facha W [40]	2015	SNNP	community based	112	210	100%	8	53% (47,60)
Ebrahim and Beyene[34]	2015	Amhara	community based	531	639	97.60%	9	83% (80,86)
Tessema et al [47]	2019	pastoral/semi-pastoral	community based	255	600	96.60%	9	43% (39,47)
Kidane et al[25]	2019	pastoral/semi-pastoral	community based	256	600	97%	9	43% (39,46)
Porth et al [37]	2019	SNNP	community based	174	232	100%	6	75% (69,80)
EDHS [51]	2011	National	Survey	470	1930	97%	10	24% (22,26)
EDHS [27]	2016	National	Survey	781	2004	98%	10	39% (37,41)
EDHS [45]	2019	National	Survey	443	1026	99%	10	43% (40,46)

Figure 1

PRISMA Flow chart describing searching strategies of studies for systematic review and meta-analysis of immunization coverage among 12-23 month children in Ethiopia.

Figure.2: forest plot showing immunization coverage in Ethiopia from 2009 to 2019

Figure 2

Forest plot showing immunization coverage in Ethiopia from 2009 to 2019.

Figure.3: forest plot showing immunization coverage in Ethiopia from 2009 to 2019

Figure 3

Forest plot showing immunization coverage in Ethiopia from 2009 to 2019.

Figure 4

Meta funnel presentation of immunization coverage among 12-23 month children in Ethiopia from 2009 to 2019.

Supplementary Files

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- [PRISMA2009checklist.doc](#)