

Review Article

Feeding Practices among Human Immunodeficiency Virus-Exposed Infants in Ethiopia: Systematic Review and Meta-Analysis

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Background. Infant and young child feeding in the context of human immunodeficiency virus- (HIV-) infected mothers has significant challenges due to the risk of transmission of the virus via breastfeeding. In Ethiopia, a number of independent studies have been conducted to assess the feeding practice of HIV-exposed infants. But, there is no concrete evidence to show the national figure in Ethiopia. Hence, this review and meta-analysis aims to estimate the pooled prevalence of feeding practices among HIV exposed infants in Ethiopia. **Methods.** The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was followed. Articles were searched through search engines in PubMed, Cochrane Library, Google Scholar, and direct Google search. Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument adapted for cross-sectional study design was used for quality assessment. The random effects model was used to estimate the pooled prevalence of infant feeding practices. Heterogeneity and publication bias were assessed. Trim and fill analysis was performed. Additionally, meta-regression was also performed. **Results.** In this review, a total of 26, 22, and 22 studies and 7413, 6224, and 6222 study participants for exclusive breastfeeding, replacement feeding, and mixed feedings were included, respectively. The overall pooled prevalence of exclusive breastfeeding, replacement feeding, and mixed feeding of HIV exposed infant was 63.99 % (95% Confidence Interval (CI): 52.32, 75.66), 16.13% (95% CI: 11.92, 20.32), and 20.95% (95% CI: 11.35, 30.58) in Ethiopia, respectively. **Conclusion and Recommendations.** In Ethiopia, almost three in five HIV-exposed infants were exclusively breastfed. But still, mixed feeding during the period of first 6 months was practiced in almost one-fifth of the exposed infants in Ethiopia. Additionally, replacement feeding was also practiced even though not recommended for developing countries. Therefore, the government of Ethiopia should strengthen the health institutions to implement the existing infant feeding strategies and guidelines to increase exclusive breastfeeding for the first 6 months and to avoid mixed feeding during the periods of six months.

1. Background

Infant feeding, especially during the first years of life, is a major determinant of child survival and development. Even though it contributes about 15% HIV transmission, breastfeeding is universal socioculturally acceptable, nutritious way to feed and provide immunity to the infants [1].

Infant and young child feeding in the context of HIV-infected mother has significant challenges due to the risk of virus transmission through breastfeeding [2]. It should support the infants to be free from HIV and does not harm the health of the mothers [2]. Globally, an estimated 43,0000 children were newly infected with HIV in 2008; the majority of them were infected through

mother-to-child transmission (MTCT) [3,4]. Perinatal periods contribute to HIV infection in about 15% to 35% infants if there is no intervention from the infected mothers [5, 6] and about 10 to 20% are infected through breast milk during breastfeeding [7].

Before 2010, avoidance or early cessation of breastfeeding was recommended. However, the consequences for the health and survival of the infants were serious, with much higher mortality rates due to diarrhea, malnutrition, and other diseases in non-breastfed children. Due to these risks, the World Health Organization after 2010 recommends every country should decide the best option of infant feeding practices and interventions. Even though the World Health Organization (WHO) suggests different infant feeding strategies, exclusive breastfeeding is recommended for the first six months in developing countries [2]. Replacement feeding for HIV exposed infant should not be used unless it is acceptable, feasible, affordable, sustainable, and safe (AFASS) [2,8].

The method of infant feeding is clearly associated with the risk of transmission through breast milk. Exclusive breastfeeding for the first six months is associated with a 3-4 fold lower risk of HIV transmission as compared to mixed feeding [9]. About 4% of exclusively breastfed infants became infected with HIV between 6 weeks and 6 months, even in the absence of Anti-Retroviral Treatment (ART) [9]. Currently, mixed feeding is still the norm in developing countries for HIV-exposed infants less than six months and carries a greater risk of HIV transmission [10]. Exclusive breastfeeding rates among children less than 6 months of age in two-thirds of developing countries is decreasing, which is quite low (33%) in sub-Saharan Africa [11]. HIV transmission through breastfeeding can be reduced if HIV-positive women breastfeed exclusively for six months rather than practicing mixed feeding and are strongly encouraged to continue breastfeeding [3].

In Ethiopia, a number of different discrete and independent researches were conducted to assess the feeding practices of HIV-exposed infants [12–36]. These independent studies described that the feeding practices of HIV-exposed infants in Ethiopia were ranging from 18.1% up to 96.6% exclusive breastfeeding [20,24], 0.5% to 46.8% replacement feeding [12,20,30], and 3.7% to 81% mixed feeding [20, 24]. An individual study conducted in Ethiopia revealed that the prevalence of infant feeding practices among HIV exposed infants is inconsistent across regions, and there is a variation over time. Even though a meta-analysis was done in Ethiopia [37], it does not include the study on replacement feeding and it missed the number of individual. Therefore, this review and meta-analysis aimed to estimate the pooled prevalence of feeding practices of HIV-exposed infants in Ethiopia with including replacement feeding and the missed articles.

The findings of this study will be an input to program planners of the government of Ethiopia to allocate appropriate resources and design appropriate interventions to increase exclusive breastfeeding and reduce replacement feeding and mixed feeding practice among HIV-exposed infants.

2. Methods

2.1. Searching Strategies. First, to avoid duplications, databases were searched for the same systematic review and meta-analysis in Ethiopia on infant feeding practices among HIV-exposed infants. We can confirm that there were no similar review and meta-analysis on this topic in Ethiopia.

Published and unpublished researches were reviewed to estimate the pooled prevalence of infant feeding practices in Ethiopia. The major databases such as PUBMED/MEDLINE, Cochrane library, Google, and Google Scholar were used to identify the published research. Whereas unpublished researches were found from institution websites and direct Google searches. The key term used in PubMed search was “Prevalence” OR “infant feeding” OR “exclusive breastfeeding,” “replacement feeding,” “mixed feeding,” “HIV-exposed infant,” AND “Ethiopia”. Medical subject headings (MeSH terms) were used to help expand the search in the advanced PubMed search. This study also used the Boolean operator (within each axis, we combined the keywords with the “OR” operator and we then linked the search strategies for the two axes with the “AND” operator). We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline during the systematic review [38].

2.2. Inclusion Criteria

2.2.1. Study Scope. All studies which report the prevalence of exclusive breastfeeding, replacement feeding practice, and mixed feeding practices among HIV-Exposed in Ethiopia was included. Study area: researches were conducted only in Ethiopia.

2.2.2. Study Design. By default, cross-sectional study designs were included.

2.2.3. Language. All articles written in English language were included.

2.2.4. Population. Studies conducted among HIV-exposed infants feeding practices in Ethiopia were included.

2.2.5. Study Year. Only articles studied until June 2020 were included.

2.2.6. Publications. Both published and unpublished articles were included.

2.3. Exclusion Criteria. Those studies, which were not fully retrieved after reading the titles, were excluded. Studies, which did not report infant feeding practices (at least one), were excluded after reviewing their full texts.

2.3.1. Abstraction. Data were extracted by two authors (TG and HT) using a standardized data extraction excel spread sheet. The data extraction format includes the primary author, study year, publication year, region of study, sample size, prevalence of exclusive breastfeeding, prevalence of replacement feeding practices, and mixed feeding practices.

2.3.2. Quality Assessment. First, the database search results were combined, and duplicate articles were removed manually using Endnote (version X 7.2). Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument adapted for the prevalence study design was used for quality assessment [39]. Each individual paper was assessed by two independent reviewers (TG and YB). Discrepancies between those reviewers were solved by discussion. If not, others were involved to resolve inconsistencies in between the two independent reviewers. Studies which scored 50% and above were included in the final review and analysis.

2.4. Outcome Measurements. This review and meta-analysis has one main outcome: the estimated pooled prevalence of infant feeding practices (exclusive breast feeding, replacement feeding, and mixed feeding practices) among HIV-exposed infant in Ethiopia.

2.4.1. Replacement Feeding. It is feeding an infant, who is not receiving breast milk, with a diet that provides all the nutrients children need until they can be fully fed on family foods [40].

2.4.2. Exclusive Breastfeeding. The infant receives only breast milk without any other liquids or solids, not even water, except for oral rehydration solution or drops or syrups of vitamins, minerals, or medicines [40].

2.4.3. Mixed Feeding. An infant younger than six months of age is given other liquids and/or food together with breast milk [40].

2.5. Data Analysis. Firstly, the data extraction was done by using excel sheet, and then the excel data were saved as CSV (delimited, comma) and then imported to STATA 14 for analysis. To estimate the pooled prevalence, first, the standard error of each individual studies was generated. After generating the standard errors for each prevalence value, the pooled prevalence was reported with 95% CI. Heterogeneity across studies was assessed by using the inverse variance (I^2) at 25%, 50%, and 75% as low, moderate, and considerable heterogeneity, respectively, with a p value less than 0.05 [41]. Due to the presence of heterogeneity (by fixed effects model), the random effects meta-analysis model was used to estimate the pooled prevalence of infant feeding practices among HIV-exposed infants in Ethiopia. To visualize the presence of heterogeneity subjectively, the forest plot also used. Subgroup analysis was conducted to identify the source of heterogeneity. Also, publication bias was assessed using both Egger's and

Begg's tests at p value less than 0.05 [42, 43]. Trim and fill meta-analysis [44] has been done to see and adjust the influence of publication bias. Finally, meta-regression was performed to show the association between the selected variables with heterogeneity of the pooled prevalence of infant feeding practices and declare the statistically significance at p value less than 0.05.

3. Results

3.1. Selection of Studies. A total of 398 studies were retrieved through electronic searching. From these, 140 duplicated records were excluded, and from 258 articles screened using their titles and abstracts, 232 were excluded. Twenty-six full-text articles were assessed for eligibility. All the 26 studies were included in the final systematic review and meta-analysis, but only 22 were included for mixed and replacement feedings (Figure 1).

3.2. Characteristics of Included Studies. In this systematic review and meta-analysis, five regions and one town administrative in Ethiopia were represented. From the total studies, seven were from the Amhara region [15, 17, 18, 21, 31, 34, 45], six were from Addis Ababa [13, 14, 16, 27, 29, 30], six were from Oromia [12, 20, 23, 32, 33, 35], four were from South Nations Nationalities and People (SNNP) [19, 24–26], and three were from Tigray region [22, 28, 36]. From the total studies, twenty-one studies were published, while five studies were unpublished (Table 1). All the included studies used cross-sectional study design. Twenty-four studies were institution based while two studies were community based (Table 1). The sample size of the included studies ranged from 87 [25] to 657 [19]. In this review, a total of 7413, 6224, and 6222 study participants were included to estimate the pooled prevalence of exclusive breastfeeding replacement feeding and mixed feeding practices in Ethiopia (Table 1).

From the total studies, four studies did not report the prevalence of replacement feeding [14, 16, 18, 23] and mixed feeding practices [14, 16, 18, 27] of HIV-exposed infant in Ethiopia. Five studies used nonprobability sampling techniques, while the twenty-one studies used probability sampling techniques (Table 1).

3.3. Pooled Prevalence of Infant Feeding Practices of HIV-Exposed Infant in Ethiopia (Meta-Analysis). The pooled prevalence of exclusive breastfeeding practices among HIV exposed infant in Ethiopia was 63.99 % (95% CI: 52.32, 75.66). The random effects model was used to estimate the pooled prevalence of infant feeding practices. Both graphically and statistically significant heterogeneity was observed ($I^2 = 99.4\%$; $P < 0.001$) (Figure 2). The pooled prevalence of replacement and mixed feeding practices of HIV-exposed infants was 16.13 % (95% CI: 11.94, 20.31) and 20.95% (95% CI: 11.35, 30.58) with severe heterogeneity ($I^2 = 98.9\%$; $P < 0.001$) and ($I^2 = 99.3\%$; $P < 0.001$) (Figures 3 and 4), respectively. The presence of significant heterogeneity leads to conduct subgroup analysis to identify the sources of heterogeneity.

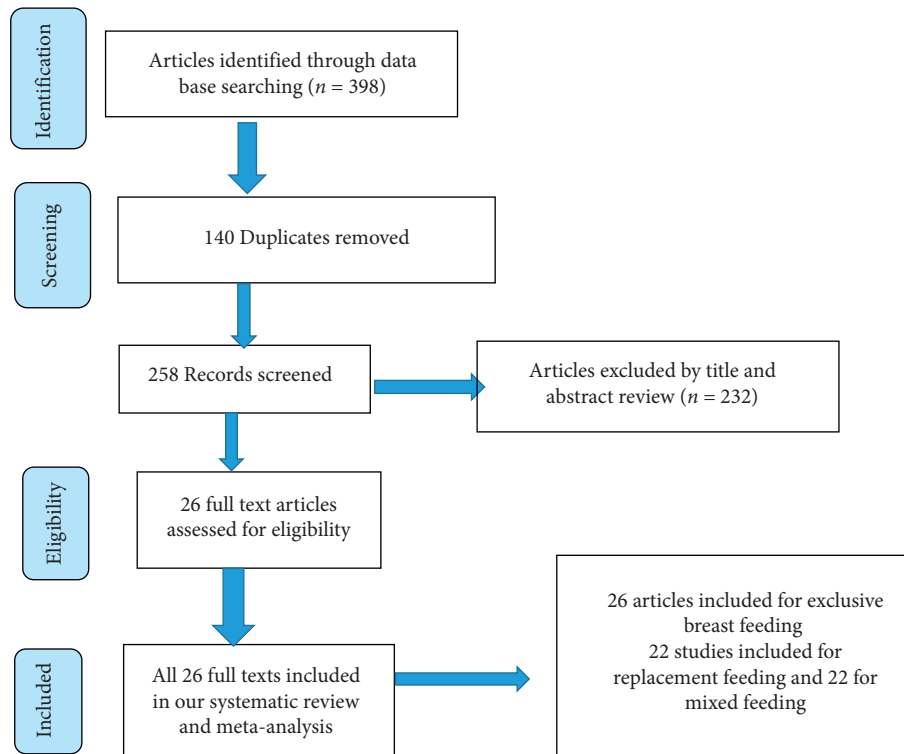


FIGURE 1: PRISMA flow diagram of included studies to estimate the pooled prevalence of HIV-exposed infant feeding practices in Ethiopia.

3.4. Subgroup Analysis. In this meta-analysis, there is a significant heterogeneity across studies among HIV-exposed infant feeding options in Ethiopia (Figures 2, 3, and 4). Therefore, subgroup analysis based on regions of the study, study years, and sampling techniques was performed to identify the possible source of heterogeneity. The results indicated that the source of heterogeneity was not due to regions, study years, and sampling techniques.

The highest prevalence of exclusive breastfeeding practice was observed in Tigray region, 89.75 % (87.56, 91.95) followed by Amhara region, 72.84% (62.41, 83.28), $I^2 = 96.8\%$, $P < 0.001$. The pooled prevalence of exclusive breastfeeding was 58.75 % (42.69, 74.82) before the year of 2015 and 71.21 % (59.19, 83.22) 2015 and after 2015 (Table 2). The studies conducted by using convenient (consecutive) sampling techniques relatively had higher pooled prevalence of exclusive feeding practice 71.26% (43.26, 99.26) (Table 2).

Replacement feeding was highly practiced in Addis Ababa 23.80 % (7.95, 39.66) while the lowest prevalence was in Tigray region (3.92 % (2.52, 5.33)) and Oromia (13.27 % (5.75, 20.79) region. Additionally, lowest prevalence of replacement feeding was indicated in studies that were used random sampling techniques (11.47% (4.48, 18.46)). There is no significant difference in pooled prevalence of replacement feeding before and after 2015 years (Table 2).

Mixed feeding was more prevalent in Addis Ababa (40.03%) followed by Oromia region (26.46%) while the lowest prevalence was seen in Tigray regions (6.29%). There was significant decrement of mixed feeding practices starting from 2015 (8.98 % (4.19, 13.77)) (Table 2).

Even though the subgroup analysis could not decrease the level of heterogeneity, substantial variation of infant feeding practices was observed among regions, study year, and sampling techniques.

3.5. Publication Bias. Publication bias was also checked using funnel plot statistically by Begg's and Egger's tests [42, 43]. Egger's and Begg's tests (p -value < 0.05) indicated that there was publication bias for replacement feeding practice among HIV-exposed infants. Additionally, the funnel plot indicates the presence of publication bias of replacement feeding (Figure 5). Therefore, Trim and fill meta-analysis [44] was done to explain the publication bias of replacement feeding practice. The prevalence of replacement feeding practice among HIV-exposed infants after adjusting by using trim-fill analysis was similar (16.13%) to the pooled prevalence of replacement feeding practices. Therefore, no significant change was reported. Egger's and Begg's tests also indicated that the publication bias was not observed for exclusive breastfeeding (P value > 0.05) and mixed feeding practices (P value > 0.05). Also, there is no publication bias for exclusive breastfeeding and mixed feeding practice by using funnel plots (Figures 6 and 7).

3.6. Sensitivity Analysis. Sensitivity analysis was checked to identify the outliers of the studies for EPF, replacement, and mixed feeding practices. There was not any individual study which influences the overall pooled estimate of exclusive breast feeding. But, Yetayesh et al., Tadelech Mebratu, Chernet et al., and Tefera et al. influenced the pooled

TABLE 1: . Characteristics of 26 included studies to estimate the pooled prevalence of exclusive breastfeeding and 24 studies for replacement feeding and mixed feeding practices of HIV-exposed infants in Ethiopia.

S.no	Authors	Study region	Study years	Publication years	Sample size	Study design	Study setting	Sampling technique	Prevalence EBF	Prevalence RF	Prevalence MF
1	Mengistu and Kedir [12]	Oromia	2016	2017	327	Cross sectional	Institution	Simple random sampling	30.6	46.8	15.3
2	Mukerem M and Haidar J [14]	Addis ababa	2012	2012	348	Cross sectional	Institution	Consecutive	73	—	—
3	Sendo et al [15]	Amhara	2017	2018	230	Cross sectional	Institution	Systematic random	75.2	13.9	10.9
4	Demelew MZ and Abdeta G [16]	Addis ababa	2011	2014	356	Cross sectional	Institution	Systematic random	68	—	—
5	Muluye et al [17]	Amhara	2011	2012	209	Cross sectional	Institution	Simple random	83.8	5.7	10.5
6	Genetu et al [18]	Amhara	2016	2017	367	Cross sectional	Institution	Systematic random	86.4	—	—
7	Tefera B. and Challi [19]	SNNP	2004	2007	657	Cross sectional	Community	Systematic random	16	61	16
8	Chernet Hailu [20]	Oromia	2005	-	643	Cross sectional	Community	Cluster	18.1	0.6	81
9	Wakwoya et al [21]	Amhara	2013	2016	260	Cross sectional	Institution	Simple random	77.3	8.5	14.2
10	Girma et al [22]	Tigray	2013	2014	207	Cross sectional	Institution	Systematic random	90.3	3.4	6.3
11	Bekere et al [23]	Oromia	2014	2014	118	Cross sectional	Institution	Systematic random	80.5	-	19.5
12	Demissie et al [24]	SNNP	2016	2016	146	Cross sectional	Institution	Consecutive	96.6	2.7	3.7
13	Maru Y and Haidar J [13]	Addis ababa	2008	2009	327	Cross sectional	Institution	Consecutive	30.6	46.8	15.3
14	Mengstie A. and Tadese T [25]	SNNP	2011	2016	87	Cross sectional	Institution	Random sampling	56.3	8.1	35.6
15	Modjo KE. and Amanta NW [26]	SNNP	2013	2015	436	Cross sectional	Institution	Consecutive	48.2	12.8	34.6
16	Wondie T. and Worku B [27]	Addis ababa	2010	-	116	Cross sectional	Institution	Systematic random	56	44	-
17	Ali Y. and Reddy PS [45]	Amhara	2012	2015	373	Cross sectional	Institution	Systematic random	74.8	13.4	11.8
18	Gejo NG et al [36]	Tigray	2016	2019	304	Cross sectional	Institution	Systematic random	88.8	4.6	6.6
19	Amdom G/Hiwot et al [28]	Tigray	2014	2014	219	Cross sectional	Institution	Systematic random	90.4	3.7	5.9
20	Negash et al [29]	Addis ababa	2018	2019	348	Cross sectional	Institution	Systematic random	70.7	6	23.3

TABLE 1: Continued.

S.no	Authors	Study region	Study years	Publication years	Sample size	Study design	Study setting	Sampling technique	Prevalence EBF	Prevalence RF	Prevalence MF
21	Tadelech Mebratu [30]	Addis ababa	2014	-	313	Cross sectional	Institution	Random sampling	18	0.5	81.5
22	Dagnev AB et al [31]	Amhara	2018	2019	213	Cross sectional	Institution	Systematic random	36.2	47.4	16.4
23	Ejara et al [32]	Oromia	2016	2018	283	Cross sectional	Institution	Random sampling	83.5	1.8	8.3
24	Zelalem Ketema [33]	Oromia	2016	-	190	Cross sectional	Institution	Consecutive	84.7	3.2	6.3
25	Fikir Tadese [34]	Amhara	2017	-	230	Cross sectional	Institution	Systematic random	75.2	13.9	10.9
26	Kefyalew Taye Belete [35]	Oromia	2019	2020	106	Cross sectional	Institution	Systematic random	53.8	17.9	28.3

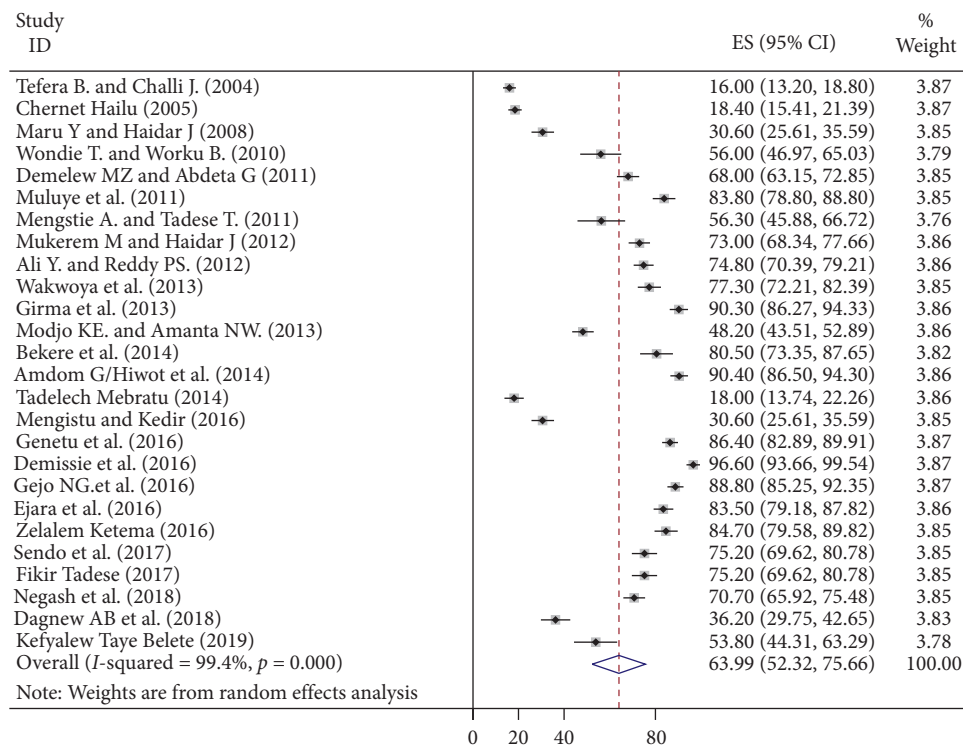


FIGURE 2: Forest plot showing the pooled prevalence of exclusive breastfeeding practice of HIV-exposed infants in Ethiopia.

prevalence of replacement feeding. Additionally, mixed feeding was influenced by Tadelech Mebratu.

3.7. Meta Regression. Meta-regression was performed by considering both continuous and categorical data to identify factors of heterogeneity for the pooled prevalence infant feeding practices among HIV-exposed infants. Sample size, study year, and study area (regions) were considered to perform meta-regression. But, the result of

meta-regression showed that the pooled prevalence of infant feeding practices was not associated with study area and study years. However, sample size was associated with exclusive breastfeeding practices (*P* value 0.007) (Table 3). So, subgroup analysis was done to see the variations, and it indicated that the pooled prevalence was decreased when the sample size was 384 and above (27.42% (10.96, 43.88, *P* < 0.001, *I*² = 98.6%)). But, it has not decreased the heterogeneity. The pooled prevalence of EBF among sample size less than 384 was 68.81 % (59.45, 78.17).

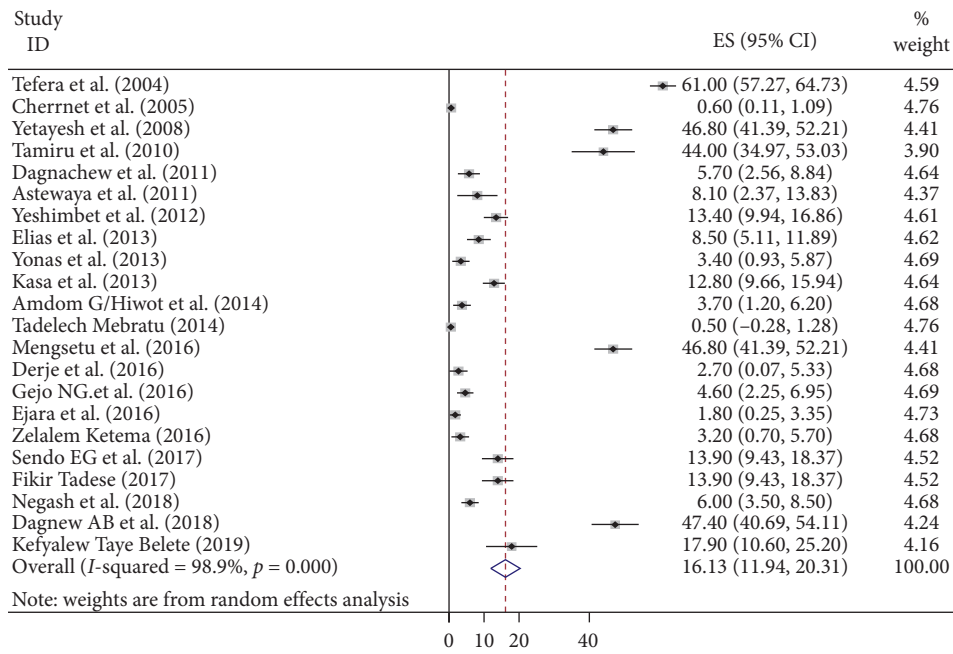


FIGURE 3: Forest plot showing the pooled prevalence of replacement feeding practice of HIV-exposed infants in Ethiopia.

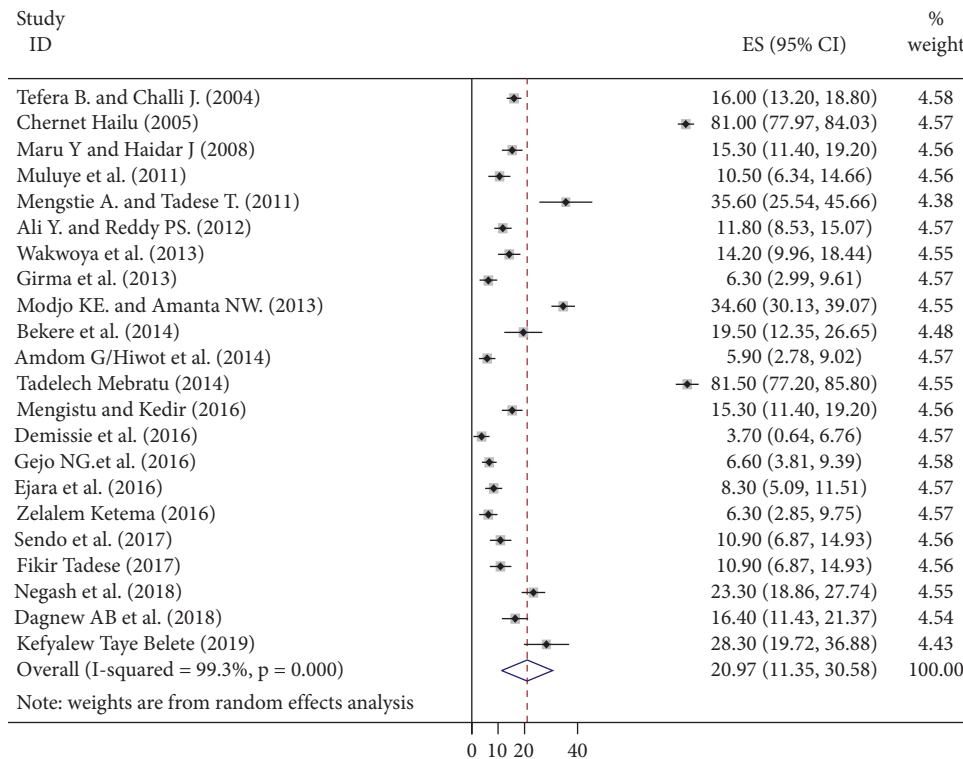


FIGURE 4: Forest plot showing the pooled prevalence of mixed feeding practice of HIV-exposed infants in Ethiopia.

4. Discussion

We used 26 studies to estimate the pooled prevalence of exclusive breastfeeding among HIV-exposed infants in Ethiopia. Even though WHO recommends exclusive breastfeeding for the first six months of HIV-exposed infants

in developing countries, 63.99% of exposed infants were exclusive breastfed in Ethiopia. This finding is slightly greater than that of national Ethiopian Demographic Health Survey (EDHS) 2016 report of exclusive breastfeeding practices of infants in Ethiopia [46]. This finding also in line with meta-analysis done in Ethiopia among exposed infants

TABLE 2: Subgroup analysis which describes pooled prevalence of infant feeding practice among HIV-exposed infants in Ethiopia.

Subgroups		Number of studies included	Pooled prevalence (95% CI)	P value	I ²	
<i>Exclusive breast feeding practice</i>	Region	Oromia	6	56.56% (30.6, 86.51)	<0.001	99.5%
		Addis ababa	6	52.7% (32.14, 73.25)	<0.001	99.0%
		Amhara	7	72.84% (62.41, 83.28)	<0.001	96.8%
	Study year	SNNP	4	54.27 (9.63, 98.91)	<0.001	99.8%
		Tigray	3	89.75% (87.56, 91.95)	0.798	0.0%
		Before 2015	15	58.75% (42.69, 74.82)	<0.001	99.5%
	Sampling techniques	2015 and above	11	71.21% (59.19, 83.22)	<0.001	98.7%
		Random sampling	6	58.25% (32.74, 83.77)	<0.001	99.3%
		Consecutive	4	71.26% (43.26, 99.26)	<0.001	98.7%
	Systematic random	15	67.40% (53.17, 81.63)	<0.001	99.3%	
<i>Replacement feeding practice</i>	Region	Oromia	5	13.27% (5.75, 20.79)	<0.001	98.7%
		Addis ababa	4	23.80% (7.95, 39.66)	<0.001	99.2%
		Amhara	6	16.75% (8.50, 25.00)	<0.01	96.1%
	Study years	SNNP	4	21.16% (-5.05, 47.37)	<0.001	99.8%
		Tigray	3	3.92% (2.52, 5.33)	0.771	0.0%
		Before 2015	12	16.84% (10.91, 22.76)	<0.001	99.3%
	Sampling techniques	2015 and above years	10	15.37% (8.69, 22.05)	<0.001	98.0%
		Random sampling	6	11.47% (4.48, 18.46)	<0.001	98.3%
		Consecutive	4	16.16% (2.31, 30.01)	<0.001	98.7%
	Systematic random	11	20.63% (10.33, 30.93)	<0.001	99.0%	
<i>Mixed feeding practice</i>	Regions	Oromia	6	26.46% (-2.35, 55.27)	<0.001	99.7%
		Addis ababa	3	40.03% (-0.80, 80.86)	<0.001	99.6%
		Amhara	6	12.16% (10.50, 13.82)	0.405	1.8%
	Study years	SNNP	4	22.05% (8.24, 35.87)	<0.001	97.9%
		Tigray	3	6.29% (4.53, 8.05)	0.948	0.0%
		Before 2015	10	24.46% (7.72, 41.19)	<0.001	99.5%
	Sampling	2015 and above	4	8.98% (4.19, 13.77)	<0.001	87.5%
		Simple random	6	27.52% (4.48, 50.57%)	<0.001	99.4%
		Consecutive	4	14.90% (2.40, 27.40)	<0.001	97.9%
	Systematic random	11	13.53% (9.96, 17.11)	<0.001	89.4%	

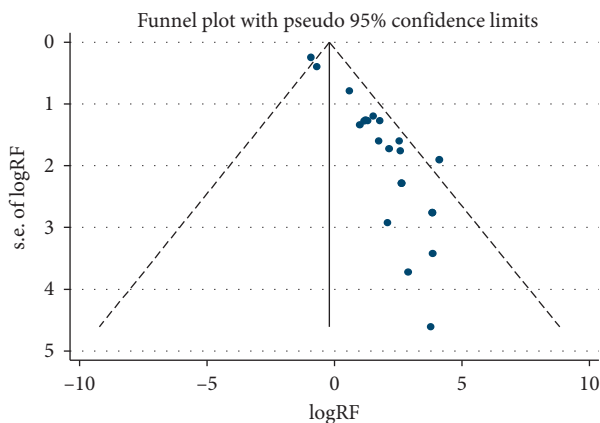


FIGURE 5: Funnel plot for publication bias for the prevalence of replacement feeding practice.

(63.43%) and the meta-analysis done on exclusive breastfeeding practices in Ethiopia (59.3%, 59.79%) [37, 47, 48]. This indicates that there is no significant difference among exposed infant feeding and other infants in Ethiopia which is in line with the World Health Organization recommendation for developing countries [49]. On the other hand, it is greater than that of the study done in Bangladesh (34.5%),

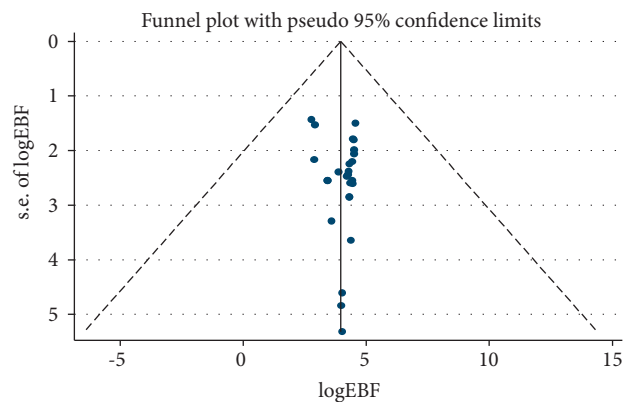


FIGURE 6: Funnel plot for publication bias for the prevalence of exclusive breastfeeding.

Rwanda (43%), and South Africa (47.9%) [50–52] but less than that of the study conducted in Kenya (73.7%) [53]. This difference might be due to difference in the implementation of infant feeding guideline and study design they used.

In this meta-analysis, substantial heterogeneity was observed. The subgroup analysis based on region showed that exclusive breastfeeding practices of HIV-exposed infants were higher in Tigray region followed by Amhara

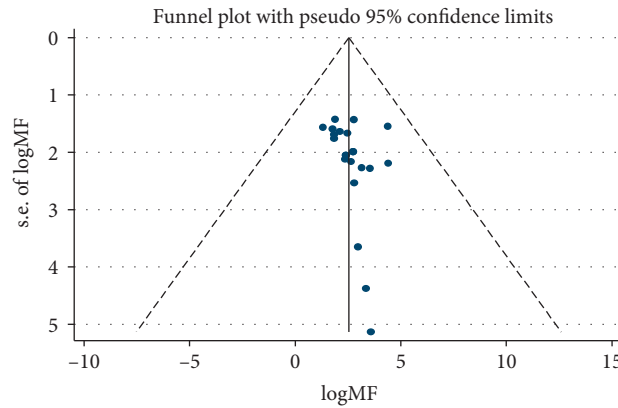


FIGURE 7: Funnel plot for publication bias for the prevalence of mixed feeding.

TABLE 3: Meta-regression to identify source of heterogeneity for the prevalence of infant feeding practices among HIV-exposed infants in Ethiopia.

Variables		Coefficients	P value
<i>Exclusive breast feeding practice</i>	<i>Study year</i>	2015 and above	Reference
		Before 2015	-12.4204 0.221
	Sample	Sample size	-0.0913904 0.007
		Addis ababa	-37.13872 0.039
	<i>Study area(region)</i>	Amhara	-17.08339 0.310
		Oromia	-31.30989 0.077
		SNNP	-35.57453 0.064
Tigray		Reference Reference	
<i>Replacement feeding practices</i>	<i>Study years</i>	2015 and above	-1.517622 0.856
		Before 2015	Reference Reference
	Sample size	Sample size	0.0266583 0.349
		Addis Ababa	20.07335 0.201
	<i>Study area (regions)</i>	Amhara	9.977454 0.360
		Oromia	14.39511 0.498
		SNNP	17.26341 0.267
Tigray		Reference Reference	
<i>Mixed feeding practices</i>	<i>Study years</i>	2015 and above	Reference Reference
		Before 2015	14.72224 0.111
	Sample size	Sample size	0.0581183 0.064
		Addis Ababa	33.75423 0.062
	<i>Study area(regions)</i>	Amhara	6.179347 0.678
		Oromia	20.21536 0.185
		SNNP	13.25909 0.5326
Tigray		Reference Reference	

region. This may be because these regions have better achievement on infant feeding practices. The pooled prevalence of exclusive breastfeeding among exposed infants increased after 2015 when compared to that before 2015. This is due to the cumulative effect of MDGs and sustainable development goals.

This meta-analysis also includes 22 studies to estimate the pooled prevalence of replacement feeding practice of HIV-exposed infant which was 16.13 %. This is lower than that of the study conducted in South Africa (47.3%) and Rwanda (57 %) [51, 52]. This pooled prevalence varies across regions in Ethiopia. Relatively, the highest magnitude was reported in Addis Ababa, and the lowest magnitude was reported in Tigray and Amhara regions. This is because Addis Ababa is relatively urban and has good access to health facility and gets

advices on the benefits of replacement feeding. On the other hand, they can afford for replacement feeding. There was no significant difference of replacement feeding practices among exposed infants before and after the periods of 2015 in Ethiopia. This might be because the WHO does not recommend replacement feeding practice in the developing countries including Ethiopia. Therefore, there is no need for special efforts to increase the replacement feeding practice in Ethiopia. Replacement feeding is not recommended for people who do not meet the minimum requirement of the standard stettered by the World Health Organization. Replacement feeding is recommended for Prevention of Mother to Child Transmission (PMTCT) programs in developed countries and also in developing countries if it is acceptable, feasible, affordable, sustainable, and safe [54].

Mixed feeding is also common in Ethiopia. The estimated pooled prevalence of mixed feeding practice in Ethiopia among HIV-exposed infant was 20.97%. This finding is slightly lower than that of the study conducted in Ethiopia (23.11%) [37]. This is because more articles were included to estimate the pooled prevalence of mixed feeding than that of the previous study. This result is also much higher than that of the study performed in South Africa (4.3%) [52].

The subgroup analysis showed that the pooled prevalence of mixed feeding among HIV-exposed infants varied across the regions of Ethiopia. Addis Ababa has the highest while Tigray region has the lowest pooled prevalence of mixed feeding practices. There was also three times decrement of mixed feeding practices after 2015 in Ethiopia than that before 2015. This is due to the effort made to reduce the risk of HIV transmission through the programs called option B⁺ [55], which was implemented for the last eight years in Ethiopia in different health facilities.

In this meta-analysis, there was publication bias of replacement feeding practices. Even though there was publication bias, there is no significant difference on the estimated pooled prevalence after conducting the trim and fill analysis. And also, there are some individual studies that influence the pooled prevalence of infant feeding practices especially replacement and mixed feeding.

4.1. Limitations of the Study. This review only reports the prevalence of HIV-exposed infant feeding practices in Ethiopia and does not consider different factors contributed to infant feeding practices.

5. Conclusion and Recommendations

In Ethiopia, almost three out of five HIV-exposed infants were exclusively breastfed. But still, mixed feeding during the period of 6 months was practiced in almost one-fifth of the exposed infants in Ethiopia. Additionally, replacement feeding was also practiced even though not recommended for developing countries. This indicates that infant feeding practices of HIV-exposed infant in Ethiopia still have a problem and deviated from the WHO recommendation for developing countries. There are regional and time variations among the pooled prevalence of exposed infant feeding practices in Ethiopia. Therefore, special focus will be made to reduce the prevalence of mixed feeding practices, increase the exclusive breastfeeding practices, strengthen the PMTCT service in each health facility, and strictly follow the guidelines for developing countries in each health facility. The government of Ethiopia should strengthen the appropriate exposed infant feeding practices by designating strategies to implement the existing guidelines. Finally, researchers should consider factors that affect infant feeding on the context of HIV-positive mothers.

Abbreviations

AFASS: Acceptable, feasible, affordable, sustainable, and safe
ART: Anti-Retroviral Treatment

CI: Confidence interval
EDHS: Ethiopian Demographic Health Survey
EBF: Exclusive breastfeeding
HIV: Human immunodeficiency virus
MTCT: Mother-to-child transmission
MDG: Millennium development goals
OR: Odds ratio
PMTCT: Prevention of mother-to-child transmission
WHO: The World Health Organization
SNNP: South Nations, Nationalities, and People's region.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors' Contributions

H. T., T. G., and Y. B were involved in the design, selection of study, data extraction, statistical analysis, and developing the initial drafts of the manuscript. H. T., T. G., A. N., M. D., and D. H were involved in the quality assessment. H. T and A. N prepared the final draft of the manuscript. W. W and A. A. A. were involved in the editing our manuscript. All the authors read and approved the final draft of the manuscript.

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