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Evidence on the effect of gender of newborn, antenatal care and postnatal care on breastfeeding practices in Ethiopia: a meta-analysis and meta-regression analysis of observational studies

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ABSTRACT

Objectives The aim of this systematic review and meta-analysis was to investigate the association of gender of newborn, antenatal care (ANC) and postnatal care (PNC) with timely initiation of breast feeding (TIBF) and exclusive breastfeeding (EBF) practices in Ethiopia.

Design Systematic review and meta-analysis.

Data sources To retrieve all available literature, PubMed, EMBASE, CINAHL, WHO Global Health Library, Web of Science and SCOPUS databases were systematically searched and complemented by manual searches. The search was done from August 2017 to September 2018.

Eligibility criteria All observational studies including cross-sectional, case-control, cohort studies conducted in Ethiopia from 2000 to 2018 were included. Newcastle-Ottawa Scale was used for quality assessment of included studies.

Data extraction and synthesis Study area, design, population, number of mothers (calculated sample size and participated in the study) and observed frequency data were extracted using Joanna Briggs Institute tool. To obtain the pooled effect size, a meta-analysis using weighted inverse variance random-effects model was performed. Cochran's Q X^2 test, τ^2 and I^2 statistics were used to test heterogeneity, estimate amount of total/residual heterogeneity and measure variability attributed to heterogeneity, respectively. Mixed-effects meta-regression analysis was done to identify possible sources of heterogeneity. Egger's regression test at p value threshold ≤0.01 was used to examine publication bias. Furthermore, the trend of evidence over time was examined by performing a cumulative meta-analysis.

Results Of 523 articles retrieved, 17 studies (n=26 146 mothers) on TIBF and 24 studies (n=17 819 mothers) on EBF were included in the final analysis. ANC (OR=2.24, 95% CI 1.65 to 3.04, p<0.001, I^2=90.9%), PNC (OR=1.86, 95% CI 1.41 to 2.47, p<0.001, I^2=63.4%) and gender of newborn (OR=1.31, 95% CI 1.01 to 1.68, p=0.04, I^2=81.7%) significantly associated with EBF. ANC (OR=1.70, 95% CI 1.10 to 2.65, p=0.02, I^2=93.1%) was also significantly associated with TIBF but not with gender of newborn (OR=1.02, 95% CI 0.86 to 1.21, p=0.82, I^2=66.2%).

Conclusions In line with our hypothesis, gender of newborn, ANC and PNC were significantly associated with EBF. Likewise, ANC was significantly associated with TIBF. Optimal care during pregnancy and after birth is important to ensure adequate breast feeding. This meta-analysis study provided up-to-date evidence on breastfeeding practices and its associated factors, which could be useful for breastfeeding improvement initiative in Ethiopia and cross-country and cross-cultural comparison.

Trial registration number CRD42017056768

Strengths and limitations of this study

- ► This systematic review and meta-analysis was conducted based on the registered and published protocol.
- ► Since this is the first study in Ethiopia, the evidence could be helpful for future researchers, public health practitioners and healthcare policy-makers.
- ► Almost all included studies were observational which might weaken the strength of evidence and hinder causality inference.
- ► Perhaps, the results may not be nationally representative given that studies from some regions are lacking.
- ► Based on the conventional method of heterogeneity test, a few analyses suffer from high between-study variation.

INTRODUCTION

WHO and Unicef recommend timely initiation of breast feeding (TIBF) (ie, initiating breast feeding within 1 hour of birth) and exclusive breast feeding (EBF) (ie, feeding only human milk during the first 6 months)[1] for maintaining maternal and newborn health.[2] Breast feeding provides optimal nutrition, increase cognitive development, reduce morbidity and mortality for the newborn; for

example, TIBF prevents 22% of neonatal deaths.[3] Inappropriate breastfeeding practice, on the other hand, causes more than two-thirds of under-five child mortality, of which 41% of these deaths occur in Sub-Saharan Africa.[1 4] Breast feeding also prevents maternal long-term chronic diseases, such as diabetes mellitus.[3]

According to a new 2017 global Unicef and WHO report, only 42% start breast feeding within an hour of birth, leaving an estimated 78 million newborns to wait over 1 hour to be put to the breast, the majority born in low-income and middle-income countries.[5] The prevalence rate of TIBF varies widely across regions from 35% in the Middle East and North Africa to 65% in Eastern and Southern Africa. Another report also shows that only two in five infants <6 months of age are exclusively breast fed.[6] The prevalence rate of EBF ranges from 22% in East Asia and Pacific to 56% in Eastern and Southern Africa.[6] Based on our meta-analysis in 2018, the prevalence of TIBF and EBF in Ethiopia is 66.5% and 60.1% respectively.[7] To date, globally, only 22 nations have achieved the WHO goal of 70% coverage in TIBF and 23 countries have achieved at least 60% coverage in EBF.[2]

To promote optimal breast feeding, WHO, Unicef and other (inter)national organisations have been working in developing countries, and several studies have been conducted on the advantages of breast feeding. However, it is still challenging to achieve the expected coverage and attributed to several factors including antenatal (ANC), postnatal care (PNC) and gender of newborn,[8 9] and breastfeeding coverage continued to be suboptimal as a result. In Ethiopia, several meta-analyses studies were done on infant and young child feeding.[7 10–14] In our previous meta-analysis, we explored the association between maternal employment, lactation counselling, mode of delivery, place of delivery, maternal age, newborn age and discarding colostrum breastfeeding practices (ie, TIBF and EBF).[7 10] We also separately studied the association between TIBF and EBF.[7] However, none of these meta-analyses did study the pooled effect of gender of newborn, ANC and PNC on TIBF and EBF. Given the absence of pooled estimates, up-to-date evidence is required to design intervention-based studies targeting these factors. Therefore, we aimed to investigate whether TIBF and EBF in Ethiopia are influenced by gender of newborn, ANC and PNC. We hypothesised at least one ANC or PNC visit significantly improves TIBF and EBF practices. Additionally, mothers with male newborn have higher odds of TIBF and EBF compared with mothers with female newborn.

METHODS

Protocol registration and publication

The study protocol was registered with the University of York, Centre for Reviews and Dissemination, International prospective register of systematic reviews (PROSPERO) and published.[15]

Search strategy and databases

PubMed, EMBASE, CINAHL, WHO Global Health Library, Web of Science and SCOPUS electronic databases were searched to extract all available literature. The search strategy was developed using Population Exposure Controls and Outcome (PECO) searching guide in consultation with a medical information specialist (online supplementary file 1). The search was done from August 2017 to September 2018. Grey literature and cross-references of included articles and previous meta-analysis were also hand searched.

PECO guide

Population

All mothers with newborn up to 23 months of age.

Exposure

Gender of the newborn, ANC and PNC visit (at least one visit).

Comparison

Female newborn, no ANC visit and no PNC visit.

Outcome

TIBF and EBF practices.

Inclusion and exclusion criteria

Studies were included if they met the following criteria: (1) observational studies including cross-sectional, case-control, cohort studies; (2) conducted in Ethiopia; (3) published in English language and (4) published between 2000 and 2018. Studies were excluded on any one of the following conditions: (1) conducted in women with HIV/AIDS, preterm newborn and newborn in intensive care unit; (2) published in language other than English; (3) abstracts without full text and (4) qualitative studies, symposium/conference proceedings, essays, commentaries and case reports.

Selection and quality assessment

Initially, all identified articles were exported to Refwork citation manager (RefWorks 2.0; ProQuest LLC, Bethesda, Maryland, USA, http://www.refworks.com), and duplicate studies were cancelled. Next, a pair of independent reviewers identified articles by analysing the title and abstract for relevance and its compliance with the proposed review topic. Agreement between the two reviewers, as measured by Cohen's Kappa,[16] was 0.76. After removing irrelevant studies through a respective decision after discussion, full texts were systematically reviewed for further eligibility analysis. Newcastle-Ottawa Scale (NOS) was used to examine the quality of studies and for potential risk of bias.[17] In line with the WHO standard definition, outcome measurements were TIBF (the percentage of newborn who breast feed within the first hour of birth) and EBF (the percentage of infants who exclusively breast fed up to 6 months since birth). Finally, Joanna Briggs Institute (JBI) tool[18] was used to extract the following data: study area (region and place), method (design), population, number of mothers (calculated sample size and participated in

the study) and observed data (ie, 2×2 table). Geographic regions were categorised based on the current Federal Democratic Republic of Ethiopia administrative structure.[19] Disagreement between reviewers was solved through discussion and consensus.

Statistical analysis

A meta-analysis using a weighted inverse variance random-effects model was performed to obtain a pooled OR. In addition, a cumulative meta-analysis was done to illustrate the trend of evidence regarding the effect of gender of newborn, ANC and PNC on breastfeeding practices. Publication bias was assessed by visual inspection of a funnel plot and Egger's regression test for funnel plot asymmetry using SE as a predictor in mixed-effects meta-regression model at a p value threshold ≤0.010.[20] Duval and Tweedie trim-and-fill method[21] was used to manage publication bias. Cochran's Q X^2 test, τ^2 and I^2 statistics were used to test heterogeneity, estimate amount of total/residual heterogeneity and measure variability attributed to heterogeneity, respectively.[22] Mixed-effects meta-regression analysis was done to examine the effect of variation in study area (region), residence of women, sample size and publication year on between-study heterogeneity.[23] The total amount of heterogeneity (R^2) accounted for these factors was calculated by subtracting the residual amount of heterogeneity from the total amount of heterogeneity and dividing by the total amount of heterogeneity. Moreover, to assess the moderation effect of these factors, Omnibus test of moderators was applied. The data were analysed using 'metafor' packages in R software V.3.2.1 for Windows.[23]

Data synthesis and reporting

We analysed the data in two groups based on outcome measurements (ie, TIBF and EBF). Results are presented using forest plots. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was strictly followed to report our results.[24]

Minor post hoc protocol changes

Based on the authors' decision and reviewers' recommendation, the following changes were made to our published protocol methods.[15] We added the JBI tool[18] to extract the data. In addition, we used the Duval and Tweedie trim-and-fill method to manage publication bias. Furthermore, cumulative meta-analysis and mixed-effects meta-regression analysis were done to reveal the trends of evidence and identify possible sources of between-study heterogeneity, respectively.

Patient and public involvement

The research questions and outcome measures were developed by the authors (TDH and NTS) in consultation with public health professionals and previous studies. Given this is a systematic review and meta-analysis based on published data, patients/study participants were not directly involved in the design and analysis of this study. The results of this study will be disseminated to patients/study participants through health education on factors affecting breast feeding and disseminating the key findings using brochure in the local language.

RESULTS

Search results

In total, we obtained 533 articles from PubMed (n=169), EMBASE (n=24), Web of Science (n=200), SCOPUS (n=85) and CINHAL and WHO Global Health Library (n=5). Fifty additional articles were found through manual search. After removing duplicates and screening of titles and abstracts, 84 studies were selected for full-text review. Of these, 43 articles were excluded due to several reasons: 19 studies on complementary feeding, 3 studies on prelacteal feeding, 3 studies on malnutrition, 17 studies with different variables of interest and 1 project review report. As a result, 41 articles fulfilled the inclusion criteria and used in this meta-analysis: 17 studies investigated the association between TIBF and gender of newborn and ANC whereas 24 studies between EBF and gender of newborn, ANC and PNC. The PRISMA flow diagram of literature screening and selection process is shown in figure 1. One study could report more than one outcome measures or associated factors.

Study characteristics

As presented in table 1, 17 studies reported the association of TIBF and gender of newborn and ANC in 26 146 mothers. Among these studies, 13 of them were conducted in Amhara (n=5), Oromia (n=4) and Southern Nations, Nationalities and Peoples' (SNNP) (n=4) region. Regarding the residence status, eight studies were conducted in both urban and rural whereas six studies in urban women. All studies passed the NOS quality assessment criteria at a cut-off value ≥7.

Twenty-four studies reported the association between EBF and gender of newborn, ANC and PNC in 17 819 mothers. Of these studies, 11 were conducted in Amhara and seven in SNNP region. Based on the residence status, 10 studies were conducted in urban, 8 in urban and rural, and 6 in rural women. Even though almost all studies were cross-sectional, five studies have used nationally representative data of the Ethiopian Demographic Health Survey.[19–23] Detailed characteristics of the included studies are shown in table 2.

Meta-analysis

Timely initiation of breast feeding

Among the 17 selected studies, 10 studies[25–34] reported the association between TIBF and gender of newborn in 16 411 mothers (table 1A). The pooled OR of gender of newborn was 1.02 (95% CI 0.86 to 1.21, p=0.82, I^2=66.2%) (figure 2). Mothers with male newborn had 2% higher chance of initiating breast feeding within 1 hour of birth compared with female newborn although not statistically significant. There was no significant publication bias (z=0.41, p=0.68) (online supplementary figure 1).

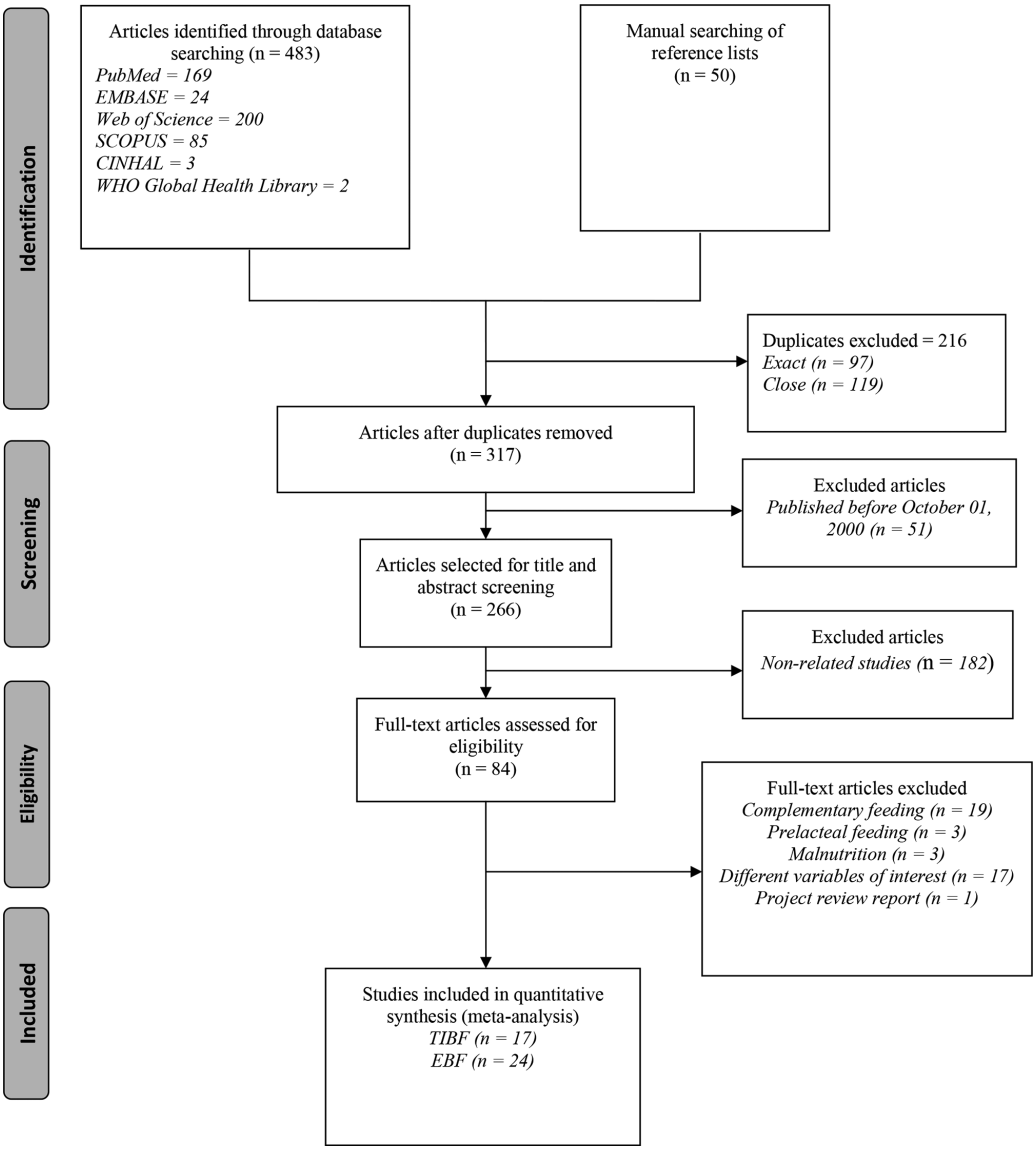

Figure 1 PRISMA flow diagram of literature screening and selection process; 'n' in each stage represents the total number of studies that fulfilled particular criteria. EBF, exclusive breast feeding; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; TIBF, timely initiation of breast feeding.

Likewise, 13 studies[27 28 30 31 33–41] reported the association between TIBF and ANC in 12 535 mothers (table 1B). The pooled OR of ANC was 1.70 (95% CI 1.10 to 2.65, p=0.02, I^2=93.1%) (figure 3). Mothers who had at least one ANC visit had 70% significantly higher chance of initiating breast feeding within 1 hour of birth compared with mothers who had no ANC visit. There was no significant publication bias (z=0.96, p=0.34) (online supplementary figure 2).

Exclusive breast feeding

Out of the 24 studies included, 11 studies[25 26 42–50] reported the association between EBF and gender of newborn in 6527 mothers (table 2A). The pooled OR of newborn gender was 1.08 (95% CI 0.86 to 1.36, p=0.49, I^2=71.7%) (figure 4). Since significant publication bias detected (z=−3.64, p<0.001), we did Duval and Tweedie trim-and-fill analysis and calculated a new effect size for gender of newborn (OR=1.31, 95% CI 1.01 to 1.68, p=0.04, I^2=81.7%) after including imputed studies (ie, estimated number of missing studies=4) (online supplementary figure 3). Therefore, mothers with male newborn had 31% significantly higher chance of exclusive breast feeding during the first 6 months compared with mothers with female newborn.

Twenty-one studies[35–37 42–49 51–60] reported the association between EBF and ANC in 16 052 mothers (table 2B). The pooled OR of ANC was 2.24 (95% CI 1.65 to 3.04, p<0.0001, I^2=90.9%) (figure 5). Mothers who had at least one ANC visit had 2.24 times significantly higher chance of exclusively breast feed compared with mothers who had no ANC visit. There was no significant publication bias (z=1.69, p=0.09) (online supplementary figure 4).

Table 1 Characteristics of included studies on TIBF

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	TIBF		
						Within 1 hour	After 1 hour	Total
A. Gender of newborn versus TIBF								
Regassa 2014[25]	SNNPR, Sidama zone	Cross-sectional study	Mothers with infants aged between 0 and 6 months old	1100/1094	Male	488	107	595
					Female	389	110	499
					Total	877	217	1094
Alemayehu 2014[26]	Tigray, Axum town	Cross-sectional study	Mothers who had children aged 6–12 months	418/418	Male	75	141	216
					Female	99	103	202
					Total	174	244	418
Berhe *et al* 2013[27]	Tigray, Mekelle town	Cross-sectional study	Mothers of children aged 0–24 months	361/361	Male	166	42	208
					Female	112	37	149
					Total	278	79	357
Beyene *et al* 2016[28]	SNNPR, Dale Woreda	Cross-sectional study	Mothers of children <24 months	634/634	Male	262	51	313
					Female	255	50	305
					Total	517	101	618
Lakew *et al* 2015[29]	National	Cross-sectional study*	Mothers who had children <5 years	11 654/11 553	Male	3124	2860	5984
					Female	3057	2511	5568
					Total	6181	5371	11552
Liben and Yesuf 2016[30]	Afar, Dubti town	Cross-sectional study	Mothers of infants aged <6 months	346/333	Male	81	122	203
					Female	70	130	200
					Total	151	252	403
Setegn *et al* 2011[31]	Oromia, Goba district	Cross-sectional study	Mothers with children (<12 months)	668/608	Male	164	152	316
					Female	150	133	283
					Total	314	285	599
Wolde *et al* 2014[32]	Oromia, Nekemte town	Cross-sectional study	Mothers who had a child less <24 months	182/174	Male	70	10	80
					Female	84	10	94
					Total	154	20	174
Woldemichael 2016[33]	Oromia, Tiyo Woreda	Cross-sectional study	Mothers who have children <1 year age	386/373	Male	153	60	213
					Female	98	62	160
					Total	251	122	373

Continued

Table 1 Continued

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	TIBF		
						Within 1 hour	After 1 hour	Total
Mekonen *et al* 2018[34]	Amhara, South Gondar	Cross-sectional study	Mothers of infants <12 months	845/823	Male	214	229	443
					Female	187	193	380
					Total	401	422	823
B. **Antenatal care versus TIBF**								
Gultie and Sebsibie2016[35]	Amhara, Debre Berhan town	Cross-sectional study	Mothers having children aged <23 months old	548/548	ANC	482	88	570
					No ANC	16	15	31
					Total	498	103	601
Tamiru *et al* 2012[36]	Oromia, Jimma Arjo Woreda	Cross-sectional study	Mothers of index children aged 0–6 months	384/382	ANC	115	69	184
					No ANC	120	71	191
					Total	235	140	375
Tamiru and Tamrat2015[37]	SNNPR, Arba Minch Zuria Woreda	Cross-sectional study	Mothers of infants aged ≤2 years	384/384	ANC	179	140	319
					No ANC	40	24	64
					Total	219	164	383
Berhe *et al* 2013[27]	Tigray, Mekelle town	Cross-sectional study	Mothers of children aged 0–24 months	361/361	ANC	263	66	329
					No ANC	15	13	28
					Total	278	79	357
Adugna 2014[38]	SNNPR, Arba Minch Zuria	Cross-sectional study	Women who had children <2 years	384/383	ANC	179	140	319
					No ANC	40	24	64
					Total	219	164	383
Beyene *et al* 2016[28]	SNNPR, Dale Woreda	Cross-sectional study	Mothers of children <24 months	634/634	ANC	206	58	264
					No ANC	311	43	354
					Total	517	101	618
Derso *et al* 2017[39]	Amhara, Dabat district	Cross-sectional study*	Mothers with children <5 years of age	6761/6761	ANC	2135	2220	4355
					No ANC	670	1364	2034
					Total	2805	3584	6389
Liben and Yesuf 2016[30]	Afar, Dubti town	Cross-sectional study	Mothers of infants aged <6 months	346/333	ANC	110	196	306
					No ANC	41	56	97
					Total	151	252	403

Continued

Table 1 Continued

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	TIBF		
						Within 1 hour	After 1 hour	Total
Seid *et al* 2013[51]	Amhara, Bahir Dar city	Cross-sectional study	Mothers who delivered in the last 12 months	819/819	ANC	680	94	774
					No ANC	29	12	41
					Total	709	106	815
Setegn *et al* 2011[31]	Oromia, Goba district	Cross-sectional study	Mothers with children (<12 months)	668/608	ANC	270	238	508
					No ANC	37	19	56
					Total	307	257	564
Tewabe 2016[40]	Amhara, Motta town	Cross-sectional study	Mothers with infant <6 months-old	423/405	ANC	282	41	323
					No ANC	37	45	82
					Total	319	86	405
Woldemichael 2016[33]	Oromia, Tiyo Woreda	Cross-sectional study	Mothers who have children <1 year age	386/373	ANC	194	41	235
					No ANC	57	81	138
					Total	251	122	373
Mekonen *et al* 2018[34]	Amhara, South Gondar	Cross-sectional study	Mothers of infants <12 months	845/823	ANC	370	332	702
					No ANC	31	90	121
					Total	401	422	823

*Used nationally representative EDHS data.
ANC, antenatal care; EDHS, Ethiopian Demographic Health Survey; SNNPR, Southern Nations, Nationalities and Peoples' Region ; TIBF, timely initiation of breast feeding.

Table 2 Characteristics of included studies on EBF

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	EBF		
						Yes	No	Total
A. Gender of newborn versus EBF								
Asemahagn 2016[42]	Amhara, Azezo district	Cross-sectional study	Women having children aged from 0 to 6 months	346/332	Male	95	38	133
					Female	167	32	199
					Total	262	70	332
Setegn *et al* 2012[43]	Oromia, Bale Zone, Goba district	Cross-sectional study	Mothers–infant pairs	668/608	Male	107	43	150
					Female	92	37	129
					Total	199	80	279
Sonko and Worku 2015[44]	SNNPR, Halaba special woreda	Cross-sectional study	Mothers with children <6 months of age	422/420	Male	145	60	205
					Female	151	64	215
					Total	296	124	420
Regassa 2014[25]	SNNPR, Sidama zone	Cross-sectional study	With infants aged between 0 and 6 months old	1100/1094	Male	109	19	128
					Female	89	17	106
					Total	198	36	234
Alemayehu 2014[26]	Tigray, Axum town	Cross-sectional study	Mothers who had children aged 6–12 months	418/418	Male	97	119	216
					Female	77	128	205
					Total	174	247	421
Biks *et al* 2015[45]	Amhara, Dabat district	Nested case–control study*	All pregnant women in the second/third trimester	1769/1769	Male	271	619	890
					Female	727	1148	1875
					Total	998	1767	2765
Arage and Gedamu 2016[46]	Amhara, Debre Tabor Town	Cross-sectional study	Mothers of infants <6 months of age	470/453	Male	119	40	159
					Female	227	67	294
					Total	346	107	453
Adugna *et al* 2017[47]	SNNPR, Hawassa city	Cross-sectional study	Mothers with infants aged 0–6 months	541/529	Male	169	88	257
					Female	153	119	272
					Total	322	207	529
Egata *et al* 2013[48]	Oromia, Kersa district	Cross-sectional study*	Mothers of children <2 years of age	881/860	Male	323	124	447
					Female	294	119	413
					Total	617	243	860
Teka *et al* 2015[49]	Tigray, Enderta Woreda	Cross-sectional study	Mothers having children aged <24 months	541/530	Male	158	60	218
					Female	214	98	312
					Total	372	158	530

Continued

Table 2 Continued

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	EBF		
						Yes	No	Total
Sefene 2013[50]	Amhara, Bahir Dar city	Cross-sectional study	Mothers who had a child aged <6 months	170/159	Male	36	47	83
					Female	42	34	76
					Total	78	81	159
B. Antenatal care versus EBF								
Asemahagn 2016[42]	Amhara, Azezo district	Cross-sectional study	Women having children aged from 0 to 6 months	346/332	ANC	243	57	300
					No ANC	19	13	32
					Total	262	70	332
Gultie and Sebsibie 2016[35]	Amhara, Debre Berhan town	Cross-sectional study	Mothers having children aged <23 months old	548/548	ANC	263	253	516
					No ANC	10	21	31
					Total	273	274	547
Hunegnaw *et al* 2017[52]	Amhara, Gozamin district	Cross-sectional study	Mothers who had infants aged between 6 and 12 months	506/478	ANC	341	109	450
					No ANC	17	11	28
					Total	358	120	478
Lenja *et al* 2016[53]	SNNPR, Offa district	Cross-sectional study	Mothers of infants <6 months	403/396	ANC	233	43	276
					No ANC	44	88	132
					Total	277	131	408
Seid *et al* 2013[51]	Amhara, Bahir Dar city	Cross-sectional study	Mothers who delivered in the last 12 months	819/819	ANC	405	372	777
					No ANC	7	35	42
					Total	412	407	819
Setegn *et al* 2011[31]	Oromia, Goba district	Cross-sectional study	Mothers with children (<12 months)	668/608	ANC	166	65	231
					No ANC	27	10	37
					Total	193	75	268
Sonko and Worku 2015[44]	SNNPR, Halaba special woreda	Cross-sectional study	Mothers with children <6 months of age	422/420	ANC	258	88	346
					No ANC	38	36	74
					Total	296	124	420
Tadesse *et al* 2016[54]	SNNPR, Sorro District	Cross-sectional Study	Mothers with infants aged 0–5 months	602/579	ANC	211	121	332
					No ANC	59	123	182
					Total	270	244	514
Tariku *et al* 2017[55]	Amhara, Dabat District	Cross-sectional study *	Mothers with children aged <59 months	5227/5227	ANC	1979	1353	3332
					No ANC	713	876	1589
					Total	2692	2229	4921

Continued

Table 2 Continued

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	EBF		
						Yes	No	Total
Tewabe 2016[40]	Amhara, Motta town, East Gojjam zone	Cross-sectional study	Mothers with an infant <6 months old	423/405	ANC	185	164	349
					No ANC	18	38	56
					Total	203	202	405
Tamiru *et al* 2012[36]	Oromia, Jimma Arjo Woreda	Cross-sectional study	Mothers of index children aged 0–6 months	384/382	ANC	87	103	190
					No ANC	96	96	192
					Total	183	199	382
Tamiru and Tamrat 2015[37]	SNNPR, Arba Minch Zuria Woreda	Cross-sectional study	Mothers of infants aged ≤2 years	384/384	ANC	228	92	320
					No ANC	27	37	64
					Total	255	129	384
Biks *et al* 2015[45]	Amhara, Dabat district	Nested case–control study*	All pregnant women in the second/third trimester	1769/1769	ANC	180	277	457
					No ANC	363	949	1312
					Total	543	1226	1769
Abera 2012[56]	Harari, Harar town	Cross-sectional study	Mothers of children aged <2 years	604/583	ANC	194	163	357
					No ANC	13	29	42
					Total	207	192	399
Arage and Gedamu 2016[46]	Amhara, Debre Tabor Town	Cross-sectional study	Mothers of infants <6 months of age	470/453	ANC	384	39	423
					No ANC	18	12	30
					Total	402	51	453
Adugna *et al* 2017[47]	SNNPR, Hawassa city	Cross-sectional study	Mothers with infants aged 0–6 months	541/529	ANC	221	111	332
					No ANC	101	96	197
					Total	322	207	529
Egata *et al* 2013[48]	Oromia, Kersa district	Cross-sectional study*	Mothers of children <2 years of age	881/860	ANC	233	135	368
					No ANC	384	108	492
					Total	617	243	860
Taddele 2014[57]	Amhara, Injibara Town	Comparative cross-sectional study	Employed and unemployed mothers of children aged ≤1 year	524/473	ANC	90	98	188
					No ANC	6	23	29
					Total	96	121	217
Echamo 2012[58]	SNNPR, Arbaminch town	Cross-sectional study	Mothers of infants within the age of 6–12 months	768/768	ANC	332	360	692
					No ANC	25	51	76
					Total	357	411	768

Continued

Table 2 Continued

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	EBF		
						Yes	No	Total
Teka *et al* 2015[49]	Tigray, Enderta Woreda	Cross-sectional study	Mothers having children aged <24 months	541/530	ANC	325	134	459
					No ANC	47	24	71
					Total	372	158	530
Chekol *et al* 2017[59]	Amhara, Gondar town	Cross-sectional study	Mothers with children aged 7–12 months	333/333	ANC	131	117	248
					No ANC	29	56	85
					Total	160	173	333
C. Postnatal care versus EBF								
Asemahagn 2016[42]	Amhara, Azezo district	Cross-sectional study	Women having children aged from 0 to 6 months	346/332	PNC	137	25	162
					No PNC	125	45	170
					Total	262	70	332
Lenja *et al* 2016[53]	SNNPR, Offa district	Cross-sectional study	Mothers of infants <6 months	403/396	PNC	188	33	221
					No PNC	121	54	175
					Total	309	87	396
Sonko and Worku 2015[44]	SNNPR, Halaba special woreda	Cross-sectional study	Mothers with children <6 months of age	422/420	PNC	98	25	123
					No PNC	197	99	296
					Total	295	124	419
Tadesse *et al* 2016[54]	SNNPR, Sorro District	Cross-sectional Study	Mothers with infants aged 0–5 months	602/579	PNC	204	127	331
					No PNC	66	117	183
					Total	270	244	514
Tewabe *et al* 2016[60]	Amhara, Motta town, East Gojjam zone	Cross-sectional Study	Mothers with an infant <6 months old	423/405	PNC	116	81	197
					No PNC	87	121	208
					Total	203	202	405
Abera 2012[56]	Harari, Harar town	Cross-sectional study	Mothers of children aged <2 years	604/583	PNC	29	31	60
					No PNC	178	161	339
					Total	207	192	399
Teka *et al* 2015[49]	Tigray, Enderta woreda	Cross-sectional study	Mothers having children aged <24 months	541/530	PNC	167	86	253
					No PNC	205	72	277
					Total	372	158	530

*Used nationally representative EDHS data.
ANC, antenatal care; EBF, exclusive breast feeding; EDHS, Ethiopian Demographic Health Survey; PNC, postnatal care; SNNPR, Southern Nations, Nationalities and Peoples' Region.

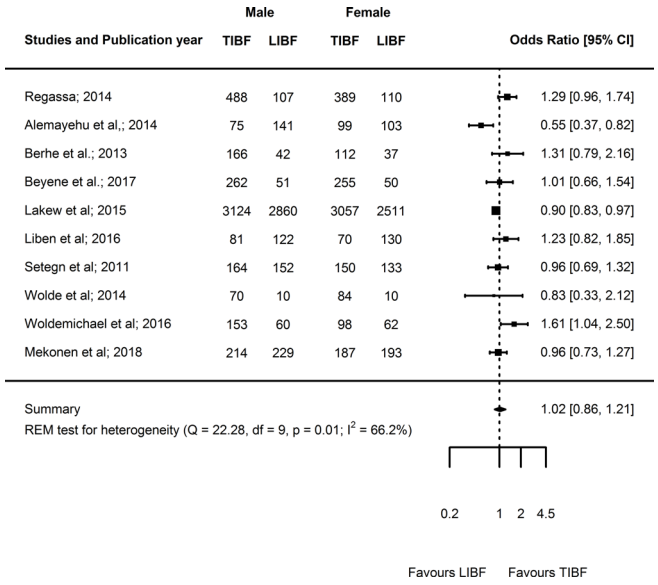

Figure 2 Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 10 studies on the association of gender of newborn and TIBF. The horizontal line represents the CI, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled OR. The reference category is 'Female'. LIBF, late initiation of breast feeding; REM, random-effects model; TIBF, timely initiation of breast feeding.

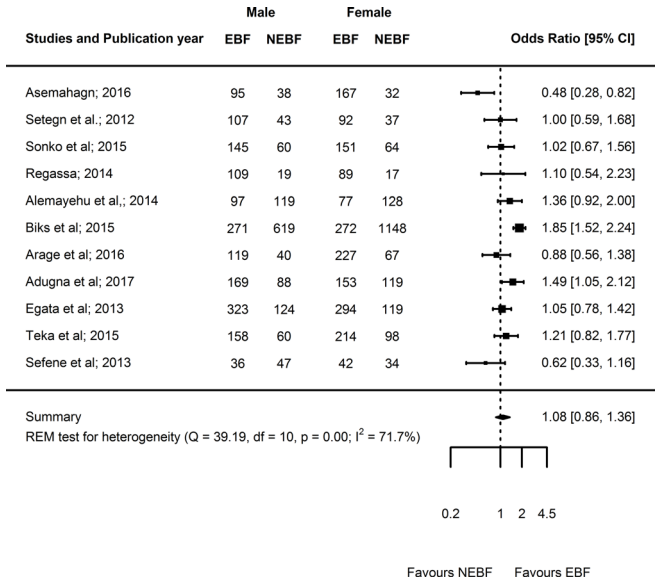

Figure 4 Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 11 studies on the association of newborn gender and EBF. The horizontal line represents the CI, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled OR. The reference category is 'Female'. EBF, exclusive breast feeding; NEBF, non exclusive of breast feeding; REM, random-effects model.

Furthermore, seven studies[42 44 49 53 54 56 60] reported the association between EBF and PNC in 2995 mothers (table 2C). The pooled OR of PNC was 1.86 (95% CI 1.41 to 2.47, p<0.0001, I^2=63.4%) (figure 6). Mothers who had at least one PNC visit had 86% significantly higher chance of exclusively breast feed during the first 6 months compared with mothers who had no PNC

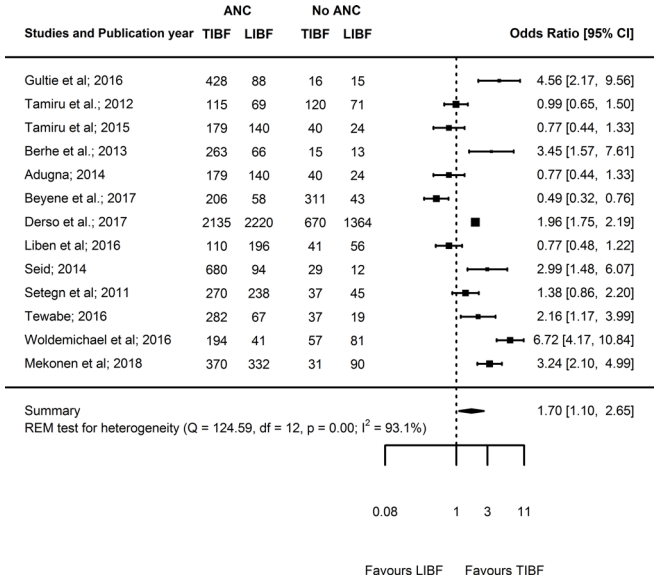

Figure 3 Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 13 studies on the association of ANC and TIBF. The horizontal line represents the CI, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled OR. The reference category is 'No ANC follow-up'. ANC, antenatal care; LIBF, late initiation of breast feeding; REM, random-effects model; TIBF, timely initiation of breast feeding.

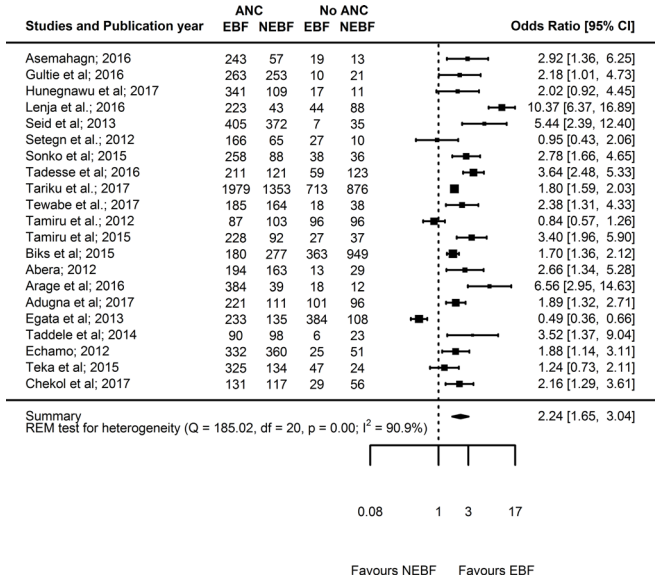

Figure 5 Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 21 studies on the association of ANC and EBF. The horizontal line represents the CI, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled OR. The reference category is 'No ANC follow-up'. ANC, antenatal care; EBF, exclusive breast feeding; NEBF, non-exclusive of breast feeding; REM, random-effects model.

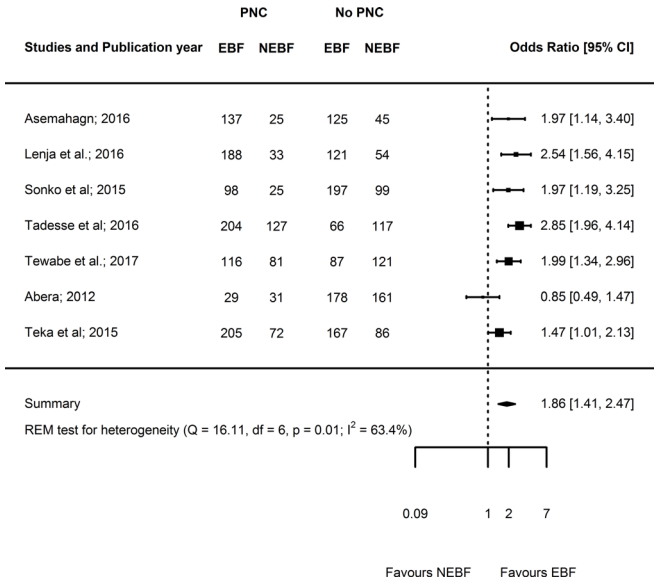

Figure 6 Forest plot of the unadjusted odds ratios with corresponding 95% CIs of seven studies on the association of PNC and EBF. The horizontal line represents the CI, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled OR. The reference category is 'No PNC follow-up'. EBF, exclusive breast feeding; NEBF, non-exclusive breast feeding; PNC, postnatal care; REM, random-effects model.

follow-up. There was no significant publication bias (z=−0.91, p=0.36) (online supplementary figure 5).

Cumulative meta-analysis

As illustrated in figure 7, the effect of gender of newborn (figure 7) has not been changed whereas the effect of ANC on TIBF (figure 8) has been increasing over time.

Similarly, the effect of gender of newborn on EBF (figure 9) has not been changed over time. The effect

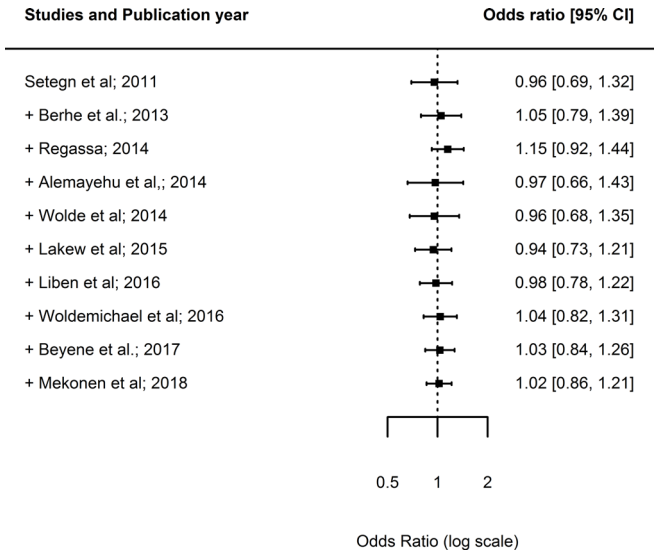

Figure 7 Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of gender of newborn on TIBF. TIBF, timely initiation of breast feeding.

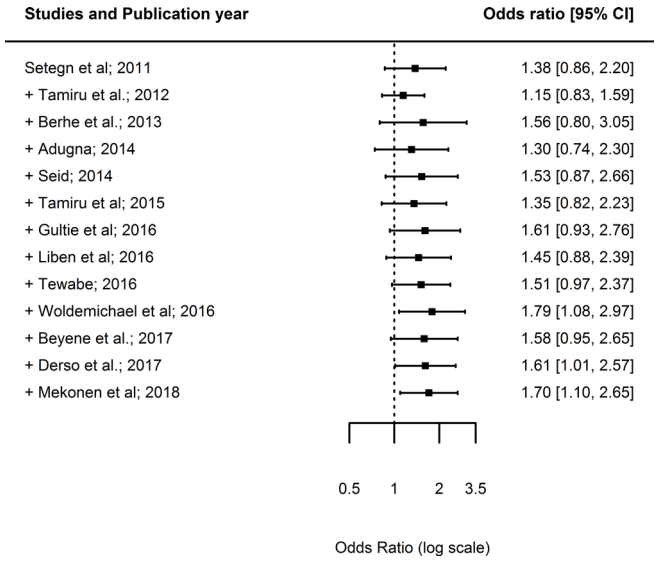

Figure 8 Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of ANC on TIBF. ANC, antenatal care; TIBF, timely initiation of breast feeding.

of ANC (figure 10) and PNC (figure 11) have been increasing.

Meta-regression analysis

In studies reporting the association between TIBF and ANC, 26.29% of the heterogeneity was accounted for the variation in study area (region), residence of mothers, sample size and publication year. Based on the omnibus test of moderators, however, none of these factors influenced association between TIBF and ANC (Q_M=11.57, df=8, p=0.17). In studies reporting the association between TIBF and gender of newborn, the estimated amount of total heterogeneity was substantially low (tau²=4.28%);

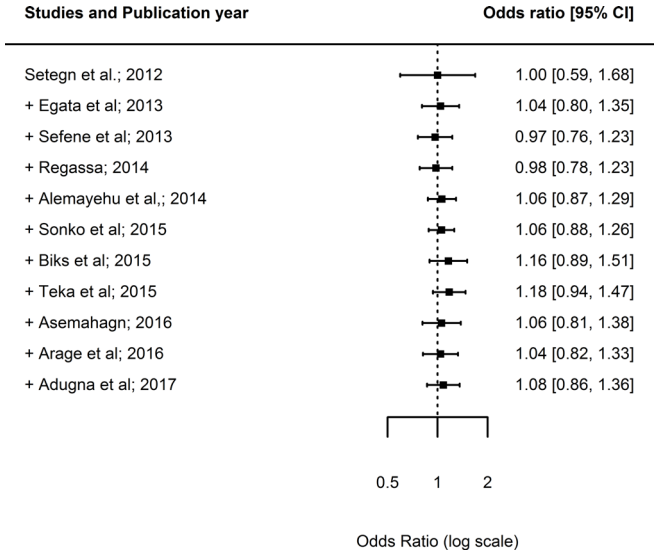

Figure 9 Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of gender of newborn on EBF. EBF, exclusive breast feeding.

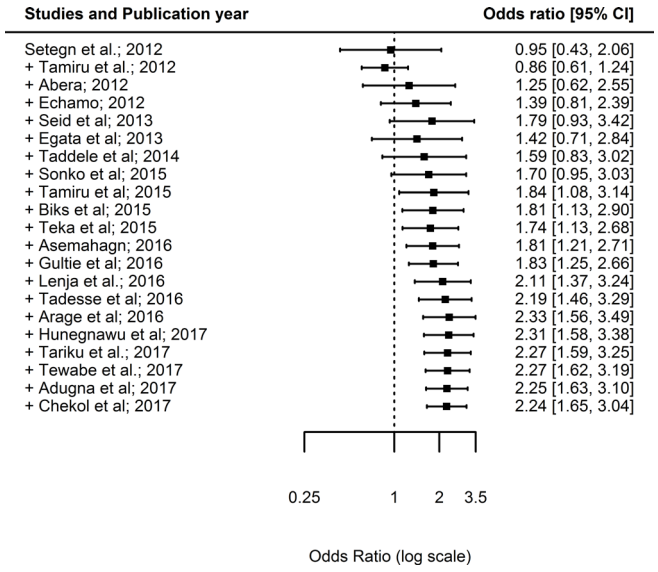

Figure 10 Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of ANC on EBF. ANC, antenatal care; EBF, exclusive breast feeding.

as a result, it is not relevant to investigate the possible reasons for heterogeneity.

Among studies reporting the association between EBF and gender of newborn, ANC and PNC, 77.66%, 60.29% and 100% of the heterogeneity were accounted for the variation in study area (region), residence of mothers, sample size and publication year, respectively. Based on the omnibus test of moderators, study area (region) and publication year negatively influenced the association between gender of newborn and EBF practice (Q_M=18.46, df=7, p=0.01). Study area (region) negatively influenced the association between ANC and EBF practice (Q_M=27.55, df=8, p=0.001) (table 3).

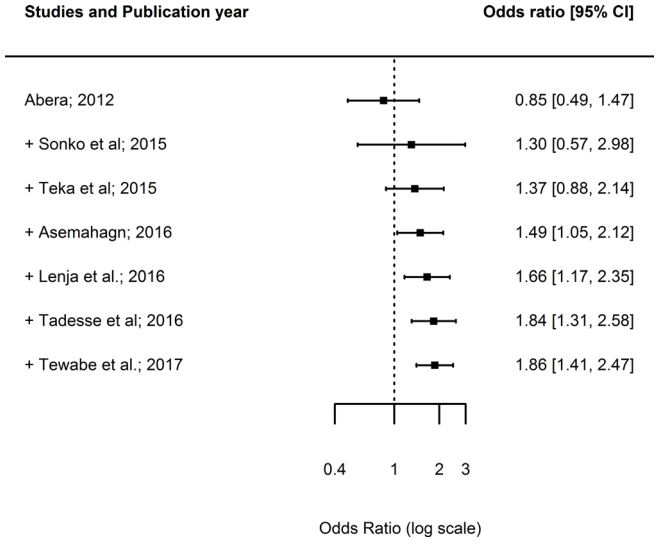

Figure 11 Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of PNC on EBF. EBF, exclusive breast feeding; PNC, postnatal care.

DISCUSSION

This meta-analysis assessed the association between breastfeeding practices (ie, TIBF and EBF) and gender of newborn, ANC and PNC. The key findings were EBF was significantly associated with ANC, PNC and gender of newborn whereas TIBF was significantly associated with ANC but not with gender of newborn.

In congruent with our hypothesis and the large body of global evidence,[61–66] our finding indicated that mothers who had at least one antenatal visit had a significantly higher chance of initiating breast feeding within 1 hour of birth and exclusively breast feed for the first 6 months compared with mothers who had no ANC visit. This may be because health professionals provide breastfeeding guidance and counselling during ANC visit.[7] The Ethiopian Ministry of Health has also adopted Baby-Friendly Hospital Initiative programme as part of the national nutrition programme and is now actively working to integrate to all public and private health facilities and improving breastfeeding practice as a result.

We also showed that mothers who had at least one PNC visit had nearly twice higher chance of exclusively breast feeding during the first 6 months compared with mothers who had no PNC follow-up. This result supported our hypothesis, and various studies have similarly reported a significantly high rate of EBF in mothers who had a postnatal visit at health institution[66] or postnatal home visit.[67] The possible justification could be that postnatal visit health education may positively influence the belief and decision of the mothers to exclusively breast feed. Previous studies have also shown that postnatal education and counselling are important to increase EBF practice.[68] In addition, in our previous meta-analyses, we showed that guidance and counselling during PNC was significantly associated with high-rate EBF.[7] Furthermore, PNC may ease breastfeeding difficulty, increase maternal confidence and encourage social/family support which lead the mother to continue EBF for 6 months.

Finally, in agreement with our hypothesis and previous studies,[69–71] we uncovered gender of newborn was significantly associated with EBF practice. Mothers with male newborn had a 31% significantly higher chance of exclusively breast feeding during the first 6 months compared with mothers of female newborn. This finding disproved the traditional perception and belief in Ethiopia that male newborn has prelacteal feeding to be strong and healthy compared with female newborn. On the other hand, several studies[63 66] depicted that gender of newborn is not significantly associated with breastfeeding practice, such as TIBF as we showed in our meta-analysis. This discrepancy might be due to the sociocultural difference and lack of adequate power given that we only found 10 studies to estimate the pooled effect size.

This systematic review and meta-analysis was conducted based on published protocol,[15] and PRISMA guideline for literature reviews. In addition, publication bias was quantified using Egger's regression statistical test and NOS was used to assess the quality of included studies. Since it is

Table 3 Meta-regression analysis to identify possible factors of heterogeneity among the included studies

Variables (reference category)*	Estimate	SE	Z value	P value	CI.lb	CI.ub
TIBF						
ANC						
Amhara region (Afar)	1.71	1.17	1.46	0.15	−0.59	4.01
Oromia region (Afar)	1.48	0.91	1.62	0.10	−0.31	3.28
SNNPR region (Afar)	0.54	1.09	0.50	0.62	−1.58	2.67
Tigray region (Afar)	1.58	1.30	1.21	0.23	−0.97	4.12
Urban residence (Rural)	0.71	1.07	0.67	0.51	−1.38	2.80
Urban and rural residence (Rural)	0.65	1.25	0.52	0.61	−1.81	3.10
≥501 mothers (≤500 mothers)	−0.54	0.81	−0.66	0.51	−2.13	1.06
Published 2016–2018 (2011–2015)	0.14	0.82	0.17	0.87	−1.47	1.74
EBF						
Gender of newborn						
Oromia region (Amhara)	−0.54	0.24	−2.22	0.03	−1.02	−0.06
SNNPR region (Amhara)	0.12	0.26	0.46	0.64	−0.39	0.63
Tigray region (Amhara)	−0.39	0.30	−1.31	0.19	−0.98	0.19
Urban residence (Rural)	0.79	0.51	1.57	0.12	−0.20	1.78
Urban and rural residence (Rural)	−0.10	0.44	−0.24	0.81	−0.96	0.75
≥501 mothers (≤500 mothers)	0.78	0.23	3.34	<0.001	0.32	1.24
Published 2016–2018 (2011–2015)	−1.14	0.44	−2.59	0.01	−1.99	−0.28
ANC						
Harari region (Amhara)	−0.11	0.64	−0.17	0.87	−1.37	1.16
Oromia region (Amhara)	−1.27	0.39	−3.28	0.001	−2.03	−0.51
SNNPR region (Amhara)	0.09	0.35	0.27	0.78	−0.59	0.78
Tigray region (Amhara)	−0.49	0.57	−0.87	0.38	−1.60	0.62
Urban residence (Rural)	−0.18	0.38	−0.47	0.63	−0.92	0.56
Urban and rural residence (Rural)	−0.26	0.52	−0.49	0.62	−1.28	0.76
≥501 mothers (≤500 mothers)	−0.30	0.34	−0.87	0.38	−0.96	0.37
Published 2016–2018 (2011–2015)	0.08	0.28	0.29	0.77	−0.46	0.62
PNC†						
Harari region (Amhara)	−0.60	0.48	−1.24	0.22	−1.54	0.35
SNNPR region (Amhara)	0.25	0.30	0.82	0.41	−0.34	0.83
Tigray region (Amhara)	−0.16	0.64	−0.25	0.80	−1.42	1.10
≥501 mothers (≤500 mothers)	0.11	0.31	0.36	0.72	−0.50	0.73
Published 2016–2018 (2011–2015)	0.26	0.36	0.71	0.47	−0.45	0.96

*Since we do not have a specific hypothesis, the reference category is selected arbitrarily; †Residence is dropped from the model due to small sample size of included studies. Cut-off value for sample size and publication year was arbitrarily chosen.
ANC, antenatal care; CI.lb, CI interval, lower bound; CI.ub, CI interval, upper bound; EBF, exclusive breast feeding; PNC, postnatal care; SNNPR, Southern Nations, Nationalities and Peoples' Region; TIBF, timely initiation of breast feeding.

the first study in Ethiopia, the evidence could be helpful for future researchers, public health practitioners and healthcare policy-makers. The inclusion of all previously published studies is a further strength of this meta-analysis. This study has limitations as well. Almost all included studies were observational, which weakens the strength of evidence and hinder causality inference. Even though we have used broad search strategies, the possibility of missing relevant studies cannot be fully exempted and the finding may not be nationally representative. Based on the conventional method of heterogeneity test, a few analyses suffer from high between-study variation. The course of heterogeneity was carefully explored using meta-regression analysis, and this variation may be due to the difference in study area (region), residence of mothers, sample size, publication year or other residual

factors; therefore, the result should be interpreted with caution. Moreover, the dose–response relationship between the number of ANC or PNC visits and breastfeeding practices was not examined. Lastly, significant publication bias was detected in studies that reported the association between EBF and gender of newborn. We did Duval and Tweedie trim-and-fill analysis to adjust publication bias and to provide an unbiased estimate; however, the result should be cautiously interpreted.

CONCLUSIONS

In line with our hypothesis, we found that increasing the use of antenatal and PNC has a positive effect on breastfeeding practices (ie, TIBF and EBF), which signifies stakeholders would provide emphasis on ANC and PNC service to optimise breast feeding. This meta-analysis study provided an overview of up-to-date evidence for public nutrition professionals and policy-makers in Ethiopia. It could also be useful for breastfeeding improvement initiative in Ethiopia and cross-country and cross-cultural comparison. From the research point of view, in general, intervention and outcome based studies on breast feeding in Ethiopia are required.

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