Effect of gender of new-born, antenatal care and postnatal care on breastfeeding practices in Ethiopia: Evidence from systematic review and meta-analysis of national studies

Tesfa Dejenie Habtewold[1,2*], Nigussie Tadesse Sharew[1], Sisay Mulugeta Alemu[2]

[1]Department of Nursing, College of Medicine and Health Science, Debre Berhan University, Debre Berhan, Ethiopia.

[2]Department of Epidemiology, University Medical Centre Groningen, University of Groningen, Groningen, the Netherlands.

* = Corresponding author
Tesfa Dejenie Habtewold
Email: tesfadej2003@gmail.com
Phone: +251910025860
P.O.BOX: 445
Fax: +251118697157

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Abstract

Objective: The aim of this systematic review and meta-analysis was to investigate the association of gender of new-born, antenatal care (ANC) and postnatal care (PNC) with timely initiation of breastfeeding (TIBF) and exclusive breastfeeding (EBF) practice in Ethiopia.

Design: Systematic review and meta-analysis

Methods: PubMed, EMBASE, CINAHL, WHO Global Health Library, Web of Science and SCOPUS databases systematically searched and complemented by manual searches to retrieve all available literature. Newcastle-Ottawa Scale (NOS) was used for quality assessment of included studies. Egger's regression test at p-value threshold ≤ 0.01 was used to examine 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. A meta-analysis using a weighted inverse variance random-effects model was performed. The trend of evidence over time was evaluated by performing a cumulative meta-analysis. Furthermore, mixed-effects meta-regression analysis was done to identify possible sources of heterogeneity.

Results: Of 523 articles retrieved, 17 studies (N = 26,146 mothers) on TIBF and 27 studies (N = 17,819 mothers) on EBF were included in the final analysis. ANC (OR = 2.24, 95% CI 1.65 - 3.04, p <0.001, I^2 = 90.9%), PNC (OR = 1.86, 95% CI 1.41 - 2.47, p <0.001, I^2 = 63.4%) and gender of new-born (OR = 1.31, 95% CI 1.01 - 1.68, p = 0.04, I^2 = 81.7%) significantly associated with EBF. In addition, ANC (OR = 1.70, 95% CI 1.10 - 2.65, p = 0.02, I^2 = 93.1%) was significantly associated with TIBF but not gender of new-born (OR = 1.02, 95% CI 0.86 - 1.21, p = 0.82, I^2 = 66.2%).

Conclusions: In line with our hypothesis, gender of new-born, ANC and PNC significantly associated with EBF. Likewise, ANC significantly associated with TIBF. Optimal care during pregnancy and after birth is important to ensure adequate breastfeeding. This meta-analysis study provided evidence on breastfeeding practices and its associated factors in Ethiopian context,

which can be useful for cross-country and cross-cultural comparison and for breastfeeding improvement initiative in Ethiopia.

Protocol registration and publication: CRD42017056768 and 10.1136/BMJOPEN-2017-017437

Strengths and limitations of this study

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

Introduction

For maintaining maternal and new-born health[1], World Health Organization (WHO) and United Nations Children's Fund (UNICEF) recommends timely initiation of breastfeeding (TIBF) (i.e. initiating breastfeeding within one hour of birth) and exclusive breastfeeding (EBF) (i.e. feeding only human milk during the first six months).[2] Breastfeeding provides optimal nutrition for the new-born, increase cognitive development, reduce morbidity and mortality, and preventing new-born and maternal long-term chronic diseases; 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.[2,4]

According to a new 2017 global report[5] from the UNICEF and the WHO, only 42%, the majority born in low- and middle-income countries, start breastfeeding within an hour of birth, leaving an estimated 78 million newborns to wait over 1 hour to be put to the breast. 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. A similar report[6] also shows that only two in five infants less than 6 months of age are exclusively breastfed. The prevalence rate of EBF ranges from 22% in East Asia and Pacific to 56% in Eastern and Southern Africa.[6] In 2018, based on our current meta-analysis[7], the prevalence of TIBF and EBF in Ethiopia is 66.5% and 60.1% respectively. To date, globally, only 22 nations have achieved WHO goal of 70% coverage in TIBF and 23 countries have achieved at least 60% coverage in EBF.[1]

WHO and UNICEF have been working in developing countries for the actualization of optimal breastfeeding and several studies have been conducted on breastfeeding advantages. However, it is challenging to achieve the standard and attributed to several factors including antenatal (ANC), post-natal care (PNC), and gender of new-born[8,9] and breastfeeding coverage

continued to be sub-optimal as a result. In Ethiopia, two meta-analyses studies were conducted.[10,11] In our previous meta-analysis, we investigated the association between maternal employment, lactation counseling, mode of delivery, place of delivery, maternal age, new-born age and discarding colostrum and, TIBF and EBF.[7,12] We also investigated whether TIBF associated with EBF.[7] However, none of these meta-analyses fully studied the effect of gender of new-born, ANC, and PNC. Therefore, we aimed to investigate whether TIBF and EBF in Ethiopia influenced by gender of new-born, ANC and PNC. We hypothesized at least one ANC or PNC visit significantly increase the odds of TIBF and EBF practices. Additionally, mothers with male new-born have higher odds of TIBF and EBF compared to mothers of female new-born.

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) (CRD42017056768) and published.[13]

Search strategy and databases

PubMed, EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), WHO Global Health Library, Web of Science and SCOPUS electronic databases were explored 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 (Supplementary file 1). Searches began 01 August 2017, and the last search was 16 September 2018. Gray literature and cross-references of identified articles and previous meta-analysis were also hand searched.

PECO guide

Population: All mothers with new-born up to 23 months of age.

Exposure: Gender of the new-born, ANC and PNC visit (at least one).

Controls: Female new-born, no ANC visit, and no PNC visit.

Outcome: TIBF and EBF practice.

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) study population with HIV/AIDS, preterm new-born and new-born in

intensive care unit (ICU); (2) publishing language other than English; (3) abstracts without full-text; and (4) qualitative studies, symposium/conference proceedings, essays, commentaries, editorials 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 canceled. Next, a pair of independent reviewers identified articles by analyzing the abstract and title for relevance and its compliance with the proposed review topic. Agreement between the two reviewers, as measured by Cohen's Kappa,[14] 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.[15] In line with the WHO standard definition, outcome measurements were TIBF (the percentage of new-born who breastfeed within the first hour of birth) and EBF (the percentage of infants who exclusively breastfed up to 6 months since birth). Finally, Joanna Briggs Institute (JBI) tool[16] 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 (i.e. 2 x 2 table). Geographic regions were categorized based on the current Federal Democratic Republic of Ethiopia administrative structure.[17] 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 odds ratio (OR). In addition, to illustrate the trend of evidence regarding the effect of gender of new-born, ANC and PNC on breastfeeding practices, a cumulative meta-

analysis was done. Publication bias was assessed by visual inspection of a funnel plot and Egger's regression test for funnel plot asymmetry using standard error as a predictor in mixed-effects meta-regression model at p-value threshold ≤ 0.01.[18] Duval and Tweedie trim-and-fill method[19] was used in case of asymmetric funnel which indicates 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;[20] for this meta-analysis, we used a reference value of $I^2 > 80\%$ indicating substantial variability related to heterogeneity.[13] Mixed-effects meta-regression analysis was done to identify possible sources of between-study heterogeneity. The data were analyzed using "metafor" packages in R software version 3.2.1 for Windows.[21]

Data synthesis and reporting

We analyzed the data in two groups based on TIBF and EBF outcome measurements. Results for each variable were shown using forest plots. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for literature review was strictly followed to report our results.[22]

Minor post hoc protocol changes

Based on the authors' decision and reviewers recommendation, the following changes were made to our published protocol methods.[13] We added the Joanna Briggs Institute (JBI) tool[16] 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 trend of evidence on each association factor and identify possible sources of between-study heterogeneity respectively.

Patient and public involvement

The research question and outcome measures were developed by the authors (TD and NT) 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 breastfeeding and disseminating the key findings using brochure in the local language.

Results

Search results

In total, we obtained 523 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. Forty-three articles were excluded due to several reasons: 19 studies on complementary feeding, 3 studies on pre-lacteal feeding, 3 studies on malnutrition, 17 studies with different variables of interest and one 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 new-born 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.

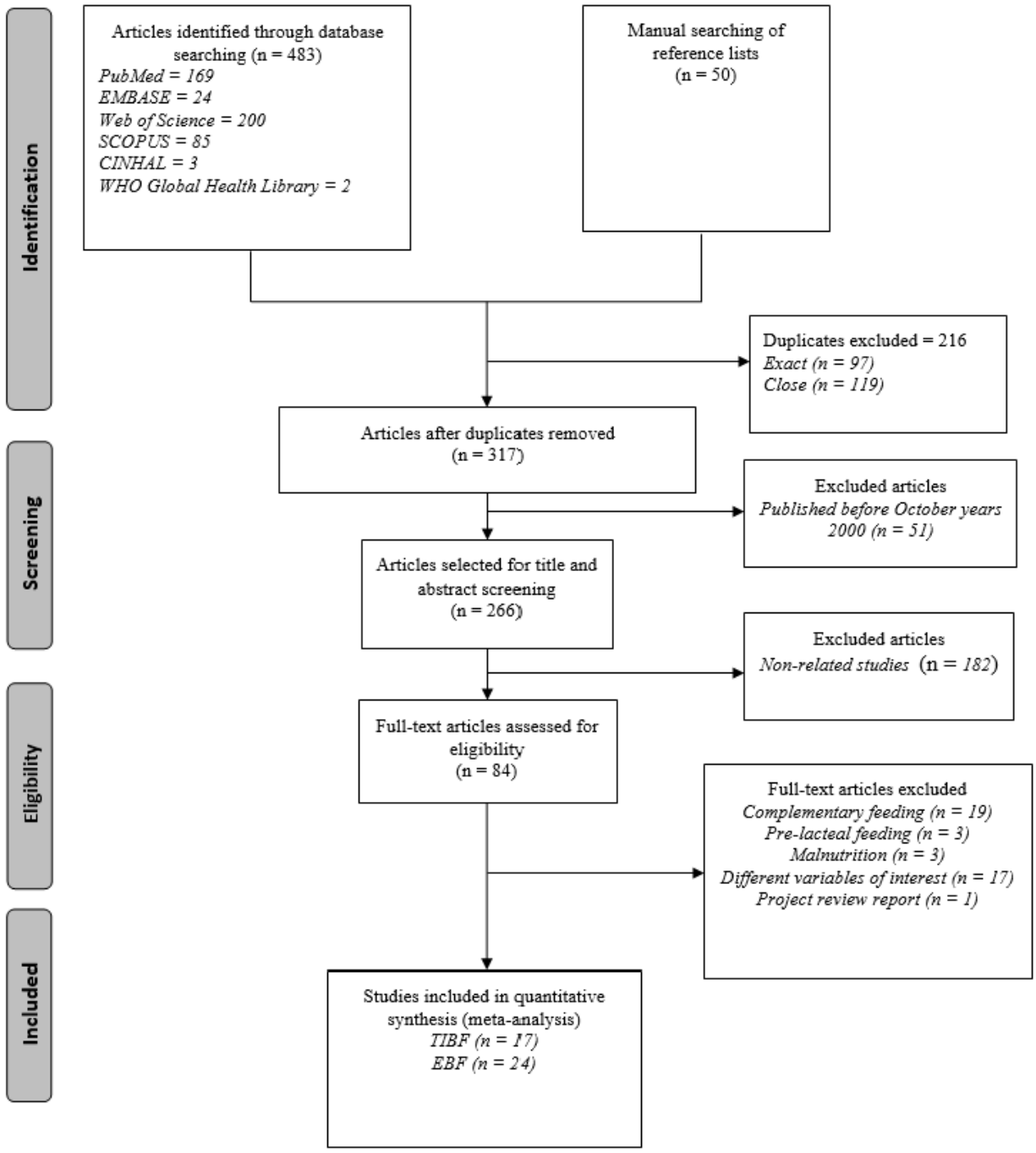

***Figure 1**: PRISMA flow diagram of literature screening and selection process; "n" in each stage represents the total number of studies that fulfilled particular criteria.*

Study characteristics

As presented in table 1, 17 studies reported the association of TIBF and gender of new-born 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 residence status of women, eight studies were conducted in both urban and rural whereas six studies in urban dwellers.

Table 1: Characteristics of included studies on TIBF

Author/publication year	Study area	Study design	Study population	Sample size/ Participated	Factors	TIBF (outcome)		
						Within 1 hour	After 1 hour	Total
A. Gender of newborn versus TIBF								
Regassa, 2014[23]	SNNPR, Sidama zone	Cross-sectional study	mothers with infants aged between 0 and 6 months old	1100/ 1094	Male	488	107	595
					Femal	389	110	499
					Total	877	217	1094
Alemayehu et.al. 2014[24]	Tigray, Axum town	Cross-sectional study	mothers who had children aged 6-12 months	418/418	Male	75	141	216
					Femal	99	103	202
					Total	174	244	418
Berhe et.al. 2013[25]	Tigray, Mekelle town	Cross-sectional study	mothers of children aged 0 to 24 months	361/361	Male	166	42	208
					Femal	112	37	149
					Total	278	79	357
Beyene et.al. 2017[26]	SNNPR, Dale Woreda	Cross-sectional study	mothers of children under 24 months	634/ 634	Male	262	51	313
					Femal	255	50	305
					Total	517	101	618
Lakew et.al. 2015[27]	National	Cross-sectional study *	mothers who had children less than 5 years	11,654/11,553	Male	3124	2860	5984
					Femal	3057	2511	5568
					Total	6181	5371	11552
Liben et.al. 2016[28]	Afar, Dubti town	Cross-sectional study	mothers of infants aged less than 6 months	346/333	Male	81	122	203
					Femal	70	130	200
					Total	151	252	403
Setegn et.al. 2011[29]	Oromia, Goba district	cross sectional study	mothers with children (< 12 months	668/ 608	Male	164	152	316
					Femal	150	133	283
					Total	314	285	599
Wolde et.al. 2014[30]	Oromia, Nekemte town	Cross-sectional study	mothers who had a child less than 24 month	182/174	Male	70	10	80
					Femal	84	10	94
					Total	154	20	174
Woldemichael et.al. 2016[31]	Oromia, Tiyo Woreda	Cross-sectional study	mothers who have children less than one year age	386/373	Male	153	60	213
					Femal	98	62	160
					Total	251	122	373
Mekonen et.al.	Amhara,	Cross-	mothers of infants	845/823	Male	214	229	443

2018[32]	South Gondar	sectional study	under 12 months		Female	187	193	380
					Total	401	422	823
B. **Antenatal care versus TIBF**								
Gultie et.al 2016[33]	Amhara, Debre Berhan town	Cross-sectional study	mothers having children aged less than 23 months old	548/548	ANC	482	88	570
					No ANC	16	15	31
					Total	498	103	601
Tamiru et.al 2012[34]	Oromia, Jimma Arjo Woreda	Cross-sectional study	mothers of index children aged 0 to 6 months	384/ 382	ANC	115	69	184
					No ANC	120	71	191
					Total	235	140	375
Tamiru et.al 2015[35]	SNNPR, Arba Minch Zuria Woreda	cross-sectional study	mothers of infants aged two years and younger	384/384	ANC	179	140	319
					No ANC	40	24	64
					Total	219	164	383
Berhe et.al 2013[25]	Tigray, Mekelle town	Cross-sectional study	mothers of children aged 0 to 24 months	361/361	ANC	263	66	329
					No ANC	15	13	28
					Total	278	79	357
Adugna et.al 2014[36]	SNNPR, Arba Minch Zuria	cross-sectional study	women who had children under two years	384/383	ANC	179	140	319
					No ANC	40	24	64
					Total	219	164	383
Beyene et.al 2017[26]	SNNPR, Dale Woreda	Cross-sectional study	mothers of children under 24 months	634/ 634	ANC	206	58	264
					No ANC	311	43	354
					Total	517	101	618
Derso et.al 2017[37]	Amhara, Dabat district	Cross-sectional study *	mothers with children under five years of age	6,761/ 6,761	ANC	2135	2220	4355
					No ANC	670	1364	2034
					Total	2805	3584	6389
Liben et.al 2016[28]	Afar, Dubti town	Cross-sectional study	mothers of infants aged less than 6 months	346/333	ANC	110	196	306
					No ANC	41	56	97
					Total	151	252	403
Seid et.al 2013[38]	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[29]	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[39]	Amhara, Motta town	cross-sectional study	mothers with infant less than six month old	423/405	ANC	282	41	323
					No ANC	37	45	82
					Total	319	86	405
Woldemichael et.al 2016[31]	Oromia, Tiyo Woreda	Cross-sectional study	mothers who have children Less Than One Year Age	386/373	ANC	194	41	235
					No ANC	57	81	138
					Total	251	122	373
Mekonen et.al. 2018[32]	Amhara, South Gondar	Cross-sectional study	mothers of infants under 12 months	845/823	ANC	370	332	702
					No ANC	31	90	121
					Total	401	422	823

*= *Used nationally representative Ethiopian Demographic Health Survey (EDHS) data*

Twenty-four studies reported the association of EBF with gender of new-born, 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 of women, 10 studies were conducted in urban, eight in urban and rural, and six in rural dwellers. Even though almost all studies were cross-sectional, five studies have used a nationally representative data of the Ethiopian Demographic Health Survey (EDHS) [19-23]. Detailed study characteristics have shown in Table 2.

Table 2: Characteristics of included studies on EBF

Author/publication year	Study area	Study design	Study population	Sample size/Participated	Factors	EBF (outcome)		
						Yes	No	Total
A. Gender of newborn versus EBF								
Asemahagn 2016[40]	Amhara, Azezo district	Cross-sectional study	Women having children aged from 0–6 months	346/ 332	Male	95	38	133
					Femal	167	32	199
					Total	262	70	332
Setegn et.al. 2012[41]	Oromia, Bale Zone, Goba district	Cross-sectional study	Mothers-infant pairs	668/608	Male	107	43	150
					Femal	92	37	129
					Total	199	80	279
Sonko et.al. 2015[42]	SNNPR, Halaba special woreda	Cross-sectional study	Mothers With children less than six months of age	422/420	Male	145	60	205
					Femal	151	64	215
					Total	296	124	420
Regassa 2014[23]	SNNPR, Sidama zone	Cross-sectional study	with infants aged between 0 and 6 months old	1100/ 1094	Male	109	19	128
					Femal	89	17	106
					Total	198	36	234
Alemayehu et.al. 2014[24]	Tigray, Axum town	Cross-sectional study	mothers who had children aged 6-12 months	418/418	Male	97	119	216
					Femal	77	128	205
					Total	174	247	421
Biks et.al. 2015[43]	Amhara, Dabat district	Nested case–control study *	All pregnant women in the second/third trimester	1,769/1,769	Male	271	619	890
					Femal	727	1148	1875
					Total	998	1767	2765
Arage et.al. 2016[44]	Amhara, Debre Tabor Town	Cross-sectional study	Mothers of Infants Less Than Six Months of Age	470/453	Male	119	40	159
					Femal	227	67	294
					Total	346	107	453
Adugna et.al. 2017[45]	SNNPR, Hawassa city	Cross-sectional study	Mothers with infants aged 0–6 months	541/529	Male	169	88	257
					Femal	153	119	272
					Total	322	207	529
Egata et.al. 2013[46]	Oromia, Kersa district	Cross-sectional study*	Mothers of children under-two years of age	881/860	Male	323	124	447
					Femal	294	119	413
					Total	617	243	860
Teka et al. 2015[47]	Tigray,	Cross-	Mothers having	541/530	Male	158	60	218

	Enderta Woreda	sectional study	children aged less than 24 months		Femal	214	98	312
					Total	372	158	530
Sefene et al. 2013[48]	Amhara, Bahir Dar city	Cross-sectional study	Mothers who had a child age less than 6 months	170/159	Male	36	47	83
					Femal	42	34	76
					Total	78	81	159
B. Antenatal care versus EBF								
Asemahagn 2016[40]	Amhara, Azezo district	Cross-sectional study	Women having children aged from 0–6 months	346/ 332	ANC	243	57	300
					No ANC	19	13	32
					Total	262	70	332
Gultie et.al 2016[33]	Amhara, Debre Berhan town	Cross-sectional study	mothers having children aged less than 23 months old	548/548	ANC	263	253	516
					No ANC	10	21	31
					Total	273	274	547
Hunegnaw et.al. 2017[49]	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[50]	SNNPR, Offa district	Cross-sectional study	Mothers of infants younger than 6 months	403/396	ANC	233	43	276
					No ANC	44	88	132
					Total	277	131	408
Seid et.al 2013[38]	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[29]	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 et.al. 2015[42]	SNNPR, Halaba special woreda	Cross-sectional study	Mothers With children less than six months of age	422/420	ANC	258	88	346
					No ANC	38	36	74
					Total	296	124	420
Tadesse et.al. 2016[51]	SNNPR, Sorro District	Cross-sectional Study	Mothers With infants aged of 0–5 months	602/ 579	ANC	211	121	332
					No ANC	59	123	182
					Total	270	244	514
Tariku et.al. 2017[52]	Amhara, Dabat District	Cross-sectional study *	Mothers with children aged less than 59 months	5,227/ 5,227	ANC	1979	1353	3332
					No ANC	713	876	1589
					Total	2692	2229	4921
Tewabe et.al. 2017[39]	Amhara, Motta town, East Gojjam zone	Cross-sectional Study	Mothers with infant less than six months old	423/405	ANC	185	164	349
					No ANC	18	38	56
					Total	203	202	405
Tamiru et.al 2012[34]	Oromia, Jimma Arjo Woreda	Cross-sectional study	Mothers of index children aged 0 to 6 months	384/ 382	ANC	87	103	190
					No ANC	96	96	192
					Total	183	199	382
Tamiru et.al 2015[35]	SNNPR, Arba Minch Zuria Woreda	cross-sectional study	Mothers of infants aged two years and younger	384/384	ANC	228	92	320
					No ANC	27	37	64
					Total	255	129	384
Biks et.al. 2015[43]	Amhara, Dabat	Nested case–control study	All pregnant women in the	1,769/1,769	ANC	180	277	457
					No ANC	363	949	1312

	district	*	second/third trimester		Total	543	1226	1769
Abera 2012[53]	Harari, Harar town	Cross-sectional study	Mothers of children aged less than two years	604/583	ANC	194	163	357
					No ANC	13	29	42
					Total	207	192	399
Arage et.al. 2016[44]	Amhara, Debre Tabor Town	Cross-sectional study	Mothers of Infants Less Than Six Months of Age	470/453	ANC	384	39	423
					No ANC	18	12	30
					Total	402	51	453
Adugna et.al. 2017[45]	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[46]	Oromia, Kersa district	Cross-sectional study *	Mothers of children under two years of age	881/860	ANC	233	135	368
					No ANC	384	108	492
					Total	617	243	860
Taddele et.al. 2014[54]	Amhara, Injibara Town	Comparative cross-sectional study	Employed and unemployed mothers of children age ≤ 1 year	524/473	ANC	90	98	188
					No ANC	6	23	29
					Total	96	121	217
Echamo. 2012[55]	SNNPR, Arbaminch town	Cross-sectional study	Mothers of infants within the age of six to twelve months	768/768	ANC	332	360	692
					No ANC	25	51	76
					Total	357	411	768
Teka et al. 2015[47]	Tigray, Enderta Woreda	Cross-sectional study	Mothers having children aged less than 24 months	541/530	ANC	325	134	459
					No ANC	47	24	71
					Total	372	158	530
Chekol et al. 2017[56]	Amhara, Gondar town	Cross-sectional study	Mothers with children age 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[40]	Amhara, Azezo district	Cross-sectional study	Women having children aged from 0–6 months	346/ 332	PNC	137	25	162
					No PNC	125	45	170
					Total	262	70	332
Lenja et.al. 2016[50]	SNNPR, Offa district	Cross-sectional study	Mothers of infants younger than 6 months	403/396	PNC	188	33	221
					No PNC	121	54	175
					Total	309	87	396
Sonko et.al. 2015[42]	SNNPR, Halaba special woreda	Cross-sectional study	Mothers with children less than six months of age	422/420	PNC	98	25	123
					No PNC	197	99	296
					Total	295	124	419
Tadesse et.al. 2016[51]	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. 2017[57]	Amhara, Motta town, East Gojjam zone	Cross-sectional Study	Mothers with infant less than six Months old	423/405	PNC	116	81	197
					No PNC	87	121	208
					Total	203	202	405
Abera 2012[53]	Harari, Harar town	Cross-sectional	Mothers of children aged less	604/583	PNC	29	31	60
					No PNC	178	161	339

		study	than two years		Total	207	192	399
Teka et al. 2015[47]	Tigray, Enderta woreda	Cross-sectional study	Mothers having children aged less than 24 months	541/530	PNC	167	86	253
					No PNC	205	72	277
					Total	372	158	530

*= *Used nationally representative Ethiopian Demographic Health Survey (EDHS) data*

Meta-analysis

TIBF

Among the 17 selected studies, 10 studies[23–32] reported the association between TIBF and gender of new-born in 16,411 mothers (Table 1A). The pooled odds ratio (OR) of gender of new-born was 1.02 (95% CI 0.86 - 1.21, p = 0.82, I^2 = 66.2%) (figure 2). Mothers with male new-born had 2% higher chance of initiating breastfeeding within one hour of birth compared with female new-born although not statistically significant. Egger's regression test for funnel plot asymmetry was not significant (z = 0.41, p = 0.68) (Supplementary figure 1).

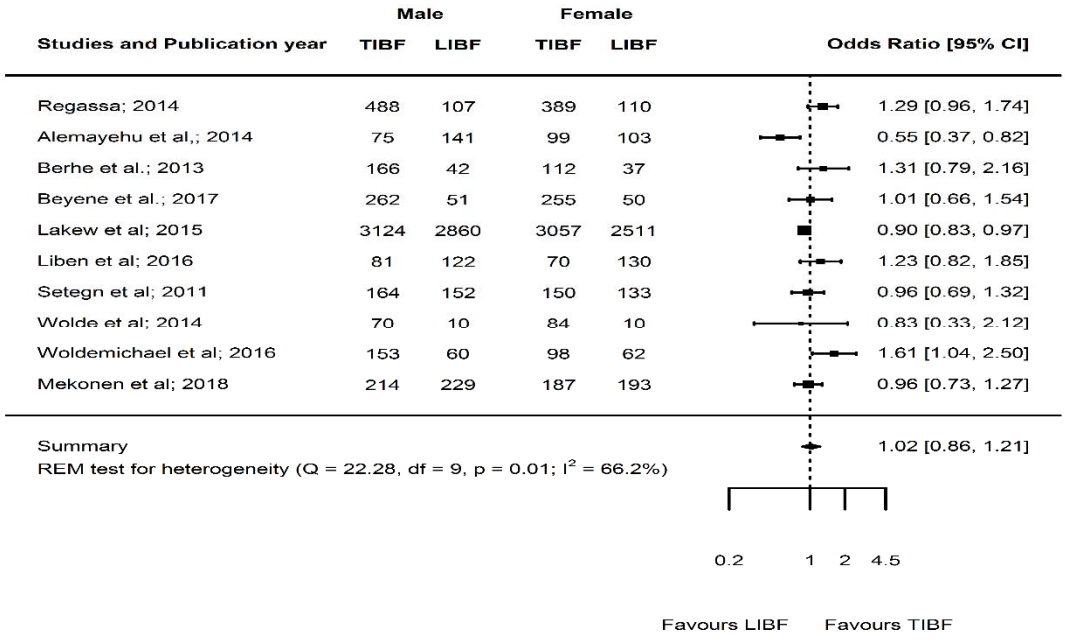

Figure 2*: Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 10 studies on the association of gender of new-born and TIBF. The horizontal line represents the confidence*

interval, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled odds ratio. The reference category is 'Female'. TIBF = timely initiation of breastfeeding; LIBF = late initiation of breastfeeding; REM = random-effects model.

Likewise, 13 studies[25,26,28,29,31–37,39,58] 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 - 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 breastfeeding within one hour of birth compared with mothers who had no ANC visit. Egger's regression test for funnel plot asymmetry was not significant (z = 0.96, p = 0.34) (Supplementary figure 2).

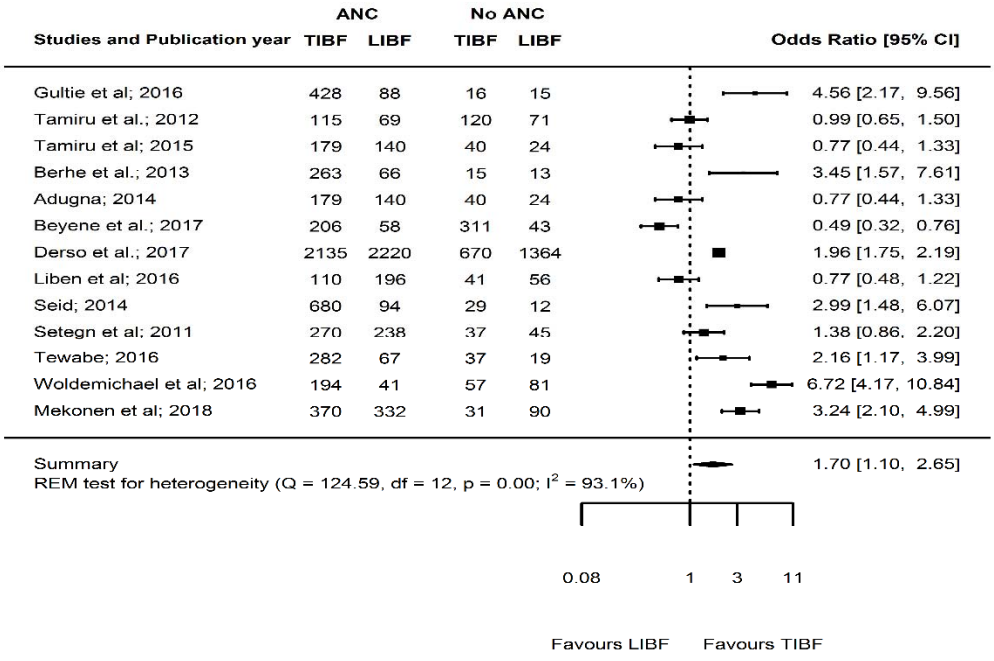

Figure 3*: Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 13 studies on the association of ANC and TIBF. The horizontal line represents the confidence interval, the box*

and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled odds ratio. The reference category is 'No ANC follow-up'. TIBF = timely initiation of breastfeeding; LIBF = late initiation of breastfeeding; REM = random-effects model; ANC=Antenatal care.

EBF

Out of the 24 studies included, 11 studies[23,24,40–48] reported the association between EBF and gender of new-born in 6,527 mothers (Table 2A). The pooled OR of new-born gender was 1.08 (95% CI 0.86 - 1.36, p = 0.49, I^2 = 71.7%) (figure 4). Mothers with male new-born had 8% higher chance of exclusively breastfeeding during the first six months compared with mothers with female new-born although not statistically significant. Egger's regression test for funnel plot asymmetry was significant (z = -3.64, p < 0.001). Since significant publication bias detected, we did Duval and Tweedie trim-and-fill analysis and calculated a new effect size for gender of new-born (OR = 1.31, 95% CI 1.01 - 1.68, p = 0.04, I^2 = 81.7%) after including imputed studies (i.e. estimated number of missing studies = 4) (Supplementary figure 3). Therefore, based on the new estimate, mothers with male new-born had 31% significantly higher chance of exclusive breastfeeding during the first six months compared with mothers with female new-born.

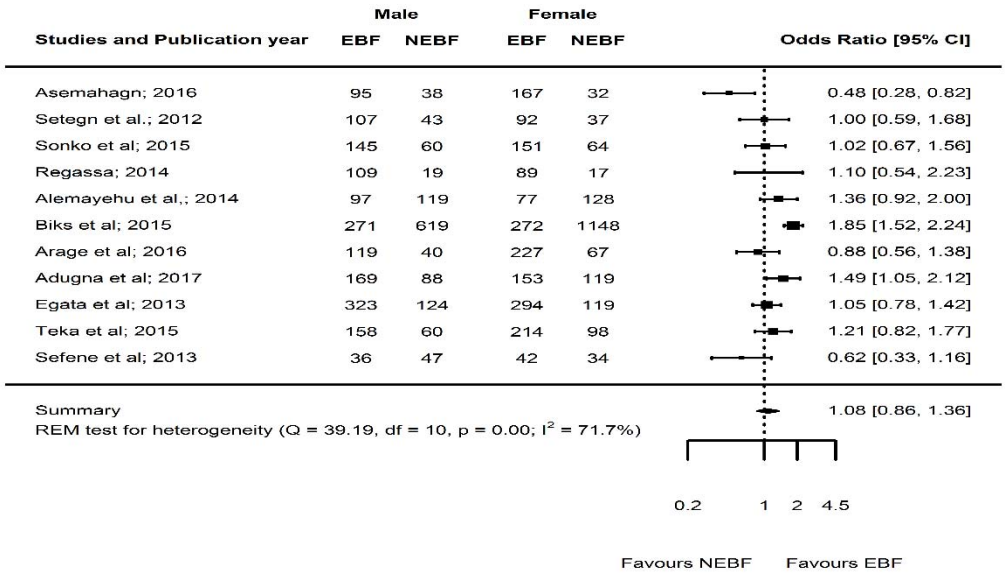

Figure 4*: Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 11 studies on the association of new-born gender and EBF. The horizontal line represents the confidence interval, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled odds ratio. The reference category is 'Female'. EBF = Exclusive breastfeeding; NEBF = Non-exclusive of breastfeeding; REM = random-effects model.*

Twenty-one studies[33–35,38,40–47,49–57] 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 - 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 breastfeed compared with mothers who had no ANC visit. Egger's regression test for funnel plot asymmetry was not significant (z = 1.69, p = 0.09) (Supplementary figure 4).

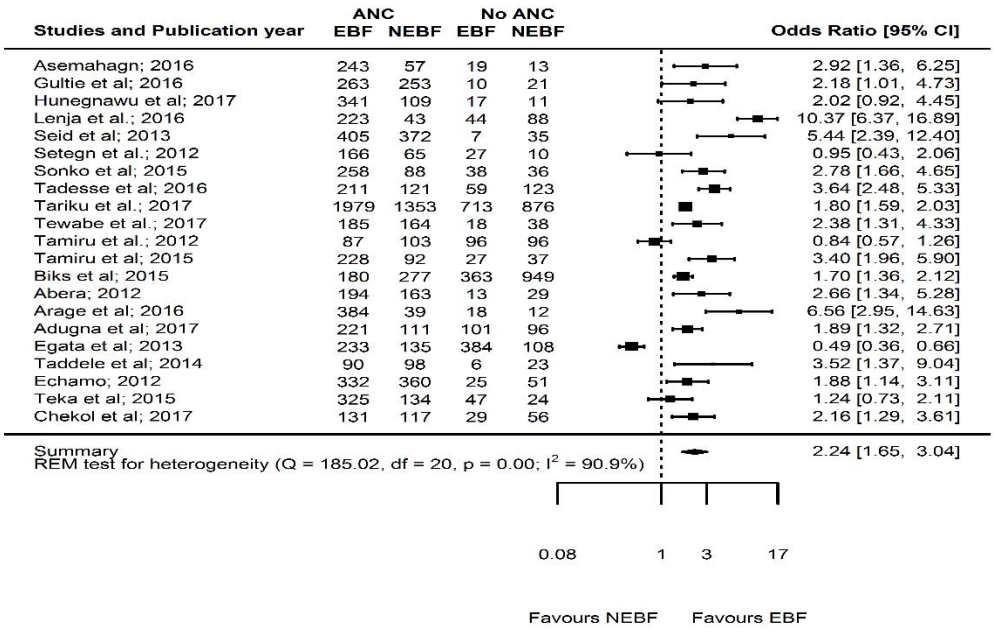

Figure 5: *Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 21 studies on the association of ANC and EBF. The horizontal line represents the confidence interval, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled odds ratio. The reference category is 'No ANC follow-up'. EBF = Exclusive breastfeeding; NEBF = Non-exclusive of breastfeeding; ANC = Antenatal care; REM = random effects model.*

Furthermore, seven studies[40,42,47,50,51,53,57] reported the association between EBF and PNC in 2,995 mothers (Table 2C). The pooled OR of PNC was 1.86 (95% CI 1.41 - 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 breastfeed during the first six months compared with mothers who had no PNC follow-up. Egger's regression test for funnel plot asymmetry was not significant (z = -0.91, p = 0.36) (Supplementary figure 5).

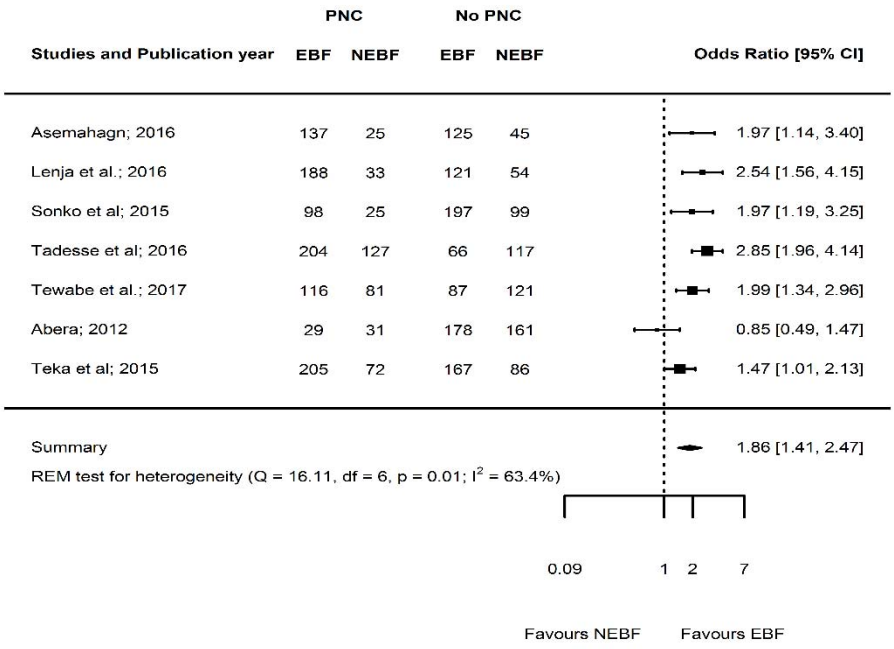

Figure 6*: Forest plot of the unadjusted odds ratios with corresponding 95% CIs of seven studies on the association of PNC and EBF. The horizontal line represents the confidence interval, the box and its size in the middle of the horizontal line represents the weight of sample size. The polygon represents the pooled odds ratio. The reference category is 'No PNC follow-up'. EBF = Exclusive breastfeeding; NEBF = Non-exclusive breastfeeding; PNC = Postnatal care; REM = random-effects model.*

Cumulative meta-analysis

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

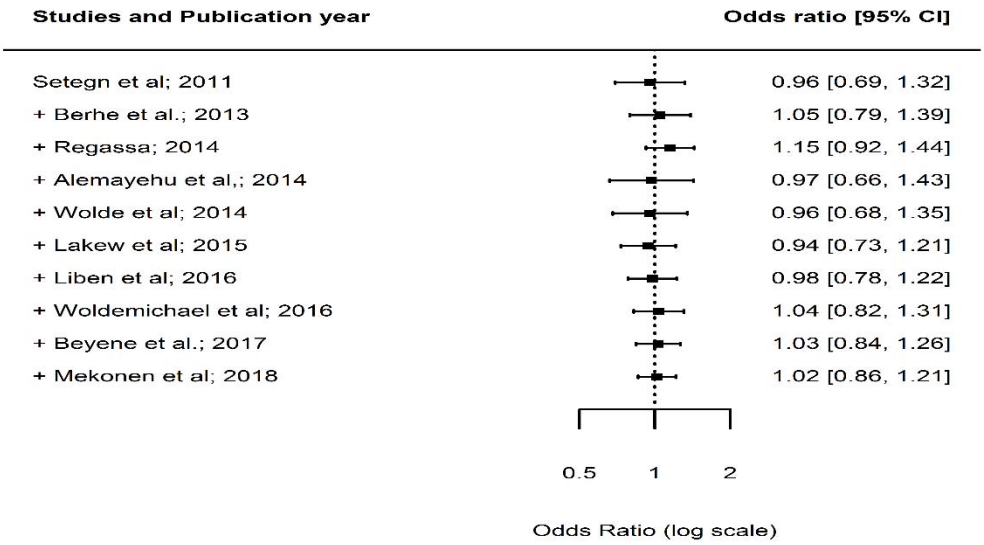

Figure 7*: Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of gender of new-born on TIBF.*

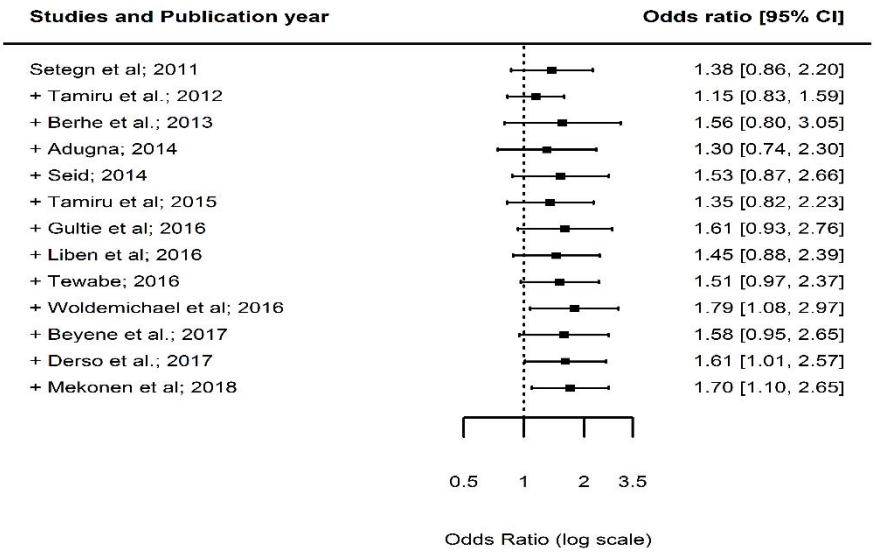

Figure 8*: Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of ANC on TIBF.*

Similarly, the effect of gender of new-born on EBF (figure 9) has not been changed. The effect of the effect of ANC (figure 10) and PNC (figure 11) have been increasing overtime.

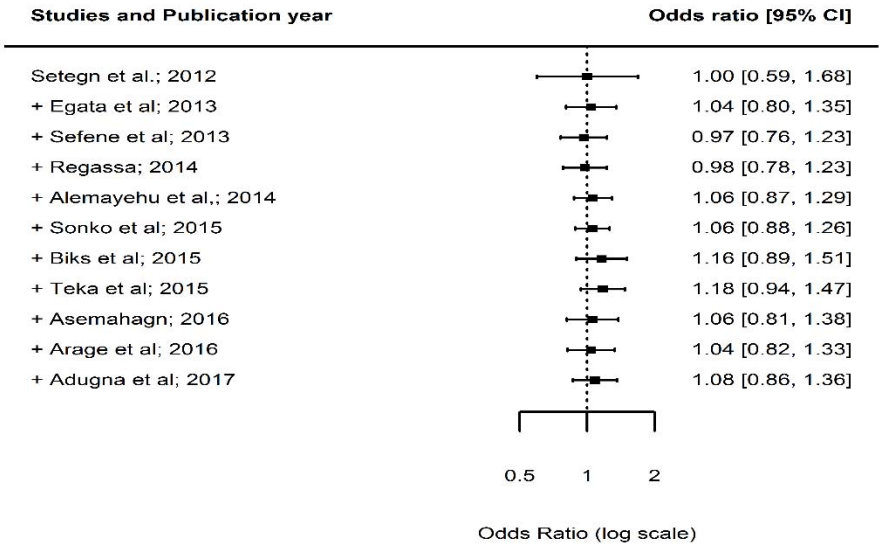

Figure 9*: Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of gender of new-born on EBF.*

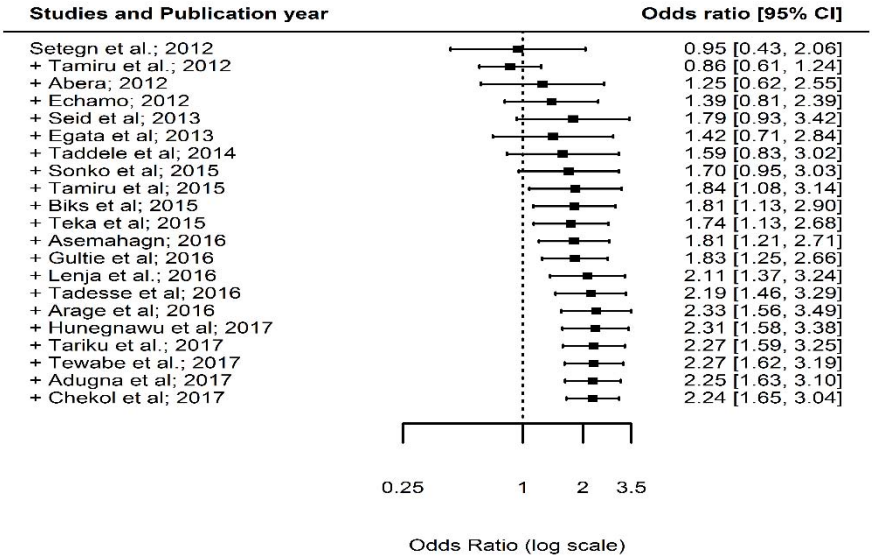

***Figure 10**: Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of ANC on EBF.*

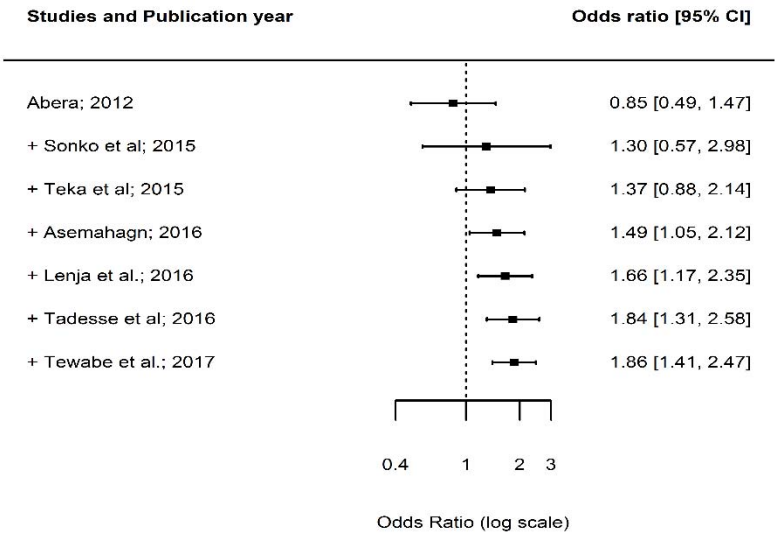

***Figure 11**: Forest plot showing the results from a cumulative meta-analysis of studies examining the effect of PNC on EBF.*

Meta-regression analysis

In studies reporting the association between TIBF and ANC, 40% of the heterogeneity was due to variation in study area (region), residence of mothers, sample size and publication year. Based on the omnibus test, however, none of these factors influenced their association ($Q_M = 14.72$, df = 8, p = 0.07). In studies reporting the association between TIBF and gender of new-born, the estimated amount of total heterogeneity was substantially low ($tau^2 = 5.4\%$); as a result, it is not relevant to investigate the possible reasons for heterogeneity.

In EBF, 100%, 57% and 100% of the heterogeneity among studies reporting gender of new-born, ANC and PNC were due to variation in study area (region), residence of mothers, sample size and publication year respectively. Based on the omnibus test, study area (region) and sample size positively influenced the association between gender of new-born and EBF practice ($Q_M = 36.95$, df = 7, $p < 0.001$). Study area (region) negatively influenced the association between ANC and EBF practice ($Q_M = 25.75$, df = 8, p = 0.001) (Table 3).

Table 3: Meta-regression analysis to identify possible reasons for between-study heterogeneity.

Variables (reference category)[¥]	**Estimate**	**SE**	**Z-value**	**P-value**	**CI.lb**	**CI.ub**
TIBF						
ANC						
Amhara region (Afar)	1.02	1.01	1.01	0.31	-0.96	2.99
Oromia region (Afar)	1.63	0.85	1.91	0.06	-0.04	3.30
SNNPR region (Afar)	-0.07	0.83	-0.08	0.94	-1.70	1.56
Tigray region (Afar)	1.65	1.23	1.33	0.18	-0.77	4.07
Urban residence (Rural)	0.43	0.95	0.46	0.65	-1.43	2.29
Urban and Rural residence (Rural)	-0.08	0.65	-0.12	0.90	-1.35	1.19
Sample size	-0.00	0.0002	-0.31	0.76	-0.0003	0.0002
Publication year	0.22	0.16	1.33	0.18	-0.10	0.54
EBF						

Gender of new-born						
Oromia region (Amhara)	0.05	0.26	0.19	0.85	-0.45	0.55
SNNPR region (Amhara)	0.72	0.24	2.96	0.003	0.24	1.19
Tigray region (Amhara)	0.55	0.20	2.71	0.01	0.15	0.94
Urban residence (Rural)	0.40	0.31	1.28	0.19	-0.21	1.02
Urban and Rural residence (Rural)	0.24	0.31	0.76	0.45	-0.37	0.85
Sample size	0.001	0.0002	4.77	<0.0001	0.0005	0.001
Publication year	-0.07	0.09	-0.68	0.49	-0.26	0.13
ANC						
Harari region (Amhara)	-0.21	0.69	-0.31	0.76	-1.58	1.15
Oromia region (Amhara)	-1.62	0.51	-3.18	0.002	-2.62	-0.62
SNNPR region (Amhara)	-0.12	0.33	-0.36	0.72	-0.77	0.53
Tigray region (Amhara)	-0.77	0.63	-1.21	0.23	-2.01	0.47
Urban residence (Rural)	-0.41	0.33	-1.25	0.21	-1.04	0.23
Urban and Rural residence (Rural)	-0.47	0.44	-1.05	0.29	-1.34	0.40
Sample size	-0.0001	0.0001	-0.66	0.51	-0.0004	0.0002
Publication year	-0.04	0.09	-0.47	0.64	-0.23	0.14
PNC*						
Harari region (Amhara)	-0.25	1.30	-0.19	0.85	-2.79	2.29
SNNPR region (Amhara)	0.28	0.44	0.65	0.52	-0.56	1.13
Tigray region (Amhara)	-0.19	0.67	-0.28	0.78	-1.49	1.12
Sample size	0.001	0.002	0.41	0.68	-0.003	0.004
Publication year	0.13	0.27	0.49	0.62	-0.39	0.66

¥ *= 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; CI.lb = Confidence interval, lower bound; CI.ub = Confidence interval, upper bound; SNNPR = Southern Nations, Nationalities and Peoples' Region.*

Discussion

This meta-analysis assessed the association of timely initiation of breastfeeding (TIBF) and exclusive breastfeeding (EBF) with gender of new-born, antenatal (ANC) and postnatal care (PNC). The key findings were (1) ANC, PNC and gender of new-born significantly associated with EBF and (2) ANC significantly associated with TIBF but not gender of new-born.

In congruent with our hypothesis and the large body of global evidence,[59–64] our finding indicated that mothers who had at least one antenatal visit had significantly higher chance of initiating breastfeeding within one hour of birth and exclusively breastfeed for the first six months compared with mothers who had no ANC visit. This may be due to the fact that health professionals provide breastfeeding guidance and counseling/health education during ANC visit. This justification is supported by our previous meta-analysis[7] and WHO/UNICEF presumption which emphasizes promoting breastfeeding during pregnancy through the Baby-Friendly Hospital Initiative (BFHI) program. Ethiopia has also adopted BFHI as part of the national nutrition program 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 breastfeeding during the first six months compared with mothers who had no PNC follow-up; this result supported our hypothesis. Similarly, several studies have reported a significantly high rate of EBF in mothers who had a postnatal visit at health institution[64] or postnatal home visit.[65] The possible justification could be that postnatal visit health education may positively influence the belief and decision of the mothers to exclusively breastfeed. Previous studies have also shown that postnatal education and counseling are important to increase EBF.[66] In addition, in our previous meta-analyses, we showed that guidance and

counseling during ANC or PNC significantly associated with high rate EBF.[7] Furthermore, postnatal care 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 previous studies[67–69] and our hypothesis, we uncovered gender of new-born significantly associated with EBF. Mothers with male new-born had 31% significantly higher chance of exclusively breastfeeding during the first six months compared with mothers with female new-born. This meta-analysis result disproved the traditional perception and believe in Ethiopia that male new-born have pre-lacteal feeding to be strong and healthy compared with female new-born; however, further investigation is required. On the other hand, we showed that gender of new-born not significantly associated with TIBF. Several studies[61,64] also showed that gender of new-born is not significantly associated with breastfeeding practice. This discrepancy across studies may be due to the socio-cultural difference. In addition, the non-significant association between gender of new-born and TIBF may be due to lack of adequate power given that only 10 studies were used for pooling the effect size.

This systematic review and meta-analysis was conducted based on the registered and published protocol,[13] and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for literature reviews. In addition, publication bias was quantified using Egger's regression statistical test and NOS was used to assess the quality of studies. Since it is the first study in Ethiopia, the information could be helpful for future researchers, public health practitioners, and healthcare policymakers. The inclusion of large sample size and recent studies are further strengths of this study. This study has limitations as well. Almost all included studies were observational which 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 methods of the 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 of 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/PNC visits and breastfeeding practices was not examined. Lastly, a significant publication bias was detected in studies reported the association between EBF and gender of new-born. We did Duval and Tweedie trim-and-fill analysis to adjust publication bias and to provide an unbiased estimate; however, the result should be interpreted cautiously.

Conclusions

We found, in line with our hypothesis, gender of new-born, ANC and PNC significantly associated with EBF. Likewise, ANC significantly associated with TIBF. This meta-analysis study provided evidence on breastfeeding practices and its associated factors in an Ethiopian context, which can be useful for cross-country and cross-cultural comparison and for breastfeeding improvement initiative in Ethiopia. Most importantly, this study provides an overview of up-to-date evidence for public nutrition professionals and policymakers. In addition, the result indicates that increasing the utilization of antenatal and postnatal care have a positive effect on breastfeeding practices. This signifies stakeholders would provide emphasis on ANC and PNC service to achieve WHO breastfeeding goal. From the research point of view, in general, intervention- and outcome-based studies of breastfeeding in Ethiopia are required.

Data sharing statement

All data generated or analysed in this study are included in the article and its supplementary files.

Competing interests

The authors declare that they have no competing interests.

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Authors Contribution

NT and TD conceived and designed the study. TD developed a syntax for searching databases, analyzed the data and interpreted the results. TD and SM wrote and revised the manuscript. All authors read and approved the final manuscript.

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