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 from 2000 to 2018 were included. Newcastle-Ottawa Scale was used for quality assessment of included studies.

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, I²=90.9%), PNC (OR=1.86, 95% CI 1.41 to 2.47, p<0.001, I²=63.4%) and gender of newborn (OR=1.31, 95% CI 1.01 to 1.68, p=0.04, I²=81.7%) was significantly associated with EBF. ANC (OR=1.70, 95% CI 1.10 to 2.65, p=0.02, I²=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, I²=66.2%).

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 due to residual heterogeneity and measure variability attributed to heterogeneity, respectively.
- The trend of evidence over time was examined by performing a cumulative meta-analysis.

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

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) for maintaining maternal and newborn health. Breast feeding provides optimal nutrition, increase cognitive development, reduce morbidity and mortality for the newborn; for...
example, TIBF prevents 22% of neonatal deaths. 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. Breast feeding also prevents maternal long-term chronic diseases, such as diabetes mellitus.

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. 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. The prevalence rate of EBF ranges from 22% in East Asia and Pacific to 56% in Eastern and Southern Africa. Based on our meta-analysis in 2018, the prevalence of TIBF and EBF in Ethiopia is 66.5% and 60.1% respectively. 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.

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, and breastfeeding coverage continued to be suboptimal as a result. In Ethiopia, several meta-analyses studies were done on infant and young child feeding. 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). We also separately studied the association between TIBF and EBF. 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.

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, 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. 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 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. 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. Duval and Tweedie trim-and-fill method was used to manage publication bias. Cochrane’s Q X2 test, τ2 and I2 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 examine the effect of variation in study area (region), residence of women, sample size and publication year on between-study heterogeneity. The total amount of heterogeneity (R2) 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.

**Data synthesis and reporting**

We analysed the data in two groups based on outcome measures (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.

**Minor post hoc protocol changes**

Based on the authors’ decision and reviewers’ recommendation, the following changes were made to our published protocol methods. We added the JBI tool 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 breastfeeding 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 prelactal feeding, 3 studies on malnutrition, 17 studies with different variables of interest and 1 project 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 26146 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 17819 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. 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 reported the association between TIBF and gender of newborn in 16411 mothers (table 1A). The pooled OR of gender of newborn was 1.02 (95% CI 0.86 to 1.21, p=0.82, I2=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).
Likewise, 13 studies 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, I²=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 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, I²=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, I²=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 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, I²=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 | TIBF Within 1 hour | TIBF After 1 hour | TIBF Total |
|-------------------------|---------------------|--------------------|----------------------------------------------------------------------------------|---------------------------|--------------------|------------------|------------|
| **A. Gender of newborn versus TIBF** |                     |                    |                                                                                  |                           |                    |                  |            |
| Regassa 2014            | SNNPR, Sidama zone | Cross-sectional   | Mothers with infants aged between 0 and 6 months old                             | 1100/1094 Male           | 488                | 107              | 595        |
|                         |                     | study              |                                                                                  | Female                    | 389                | 110              | 499        |
|                         |                     |                    |                                                                                  | Total                     | 877                | 217              | 1094       |
| Alemayehu 2014          | Tigray, Axum town  | Cross-sectional   | Mothers who had children aged 6–12 months                                        | 418/418 Male             | 75                 | 141              | 216        |
|                         |                     | study              |                                                                                  | Female                    | 99                 | 103              | 202        |
|                         |                     |                    |                                                                                  | Total                     | 174                | 244              | 418        |
| Berhe et al 2013        | Tigray, Mekelle town| Cross-sectional   | Mothers of children aged 0–24 months                                            | 361/361 Male             | 166                | 42               | 208        |
|                         |                     | study              |                                                                                  | Female                    | 112                | 37               | 149        |
|                         |                     |                    |                                                                                  | Total                     | 278                | 79               | 357        |
| Beyene et al 2016       | SNNPR, Dale Woreda | Cross-sectional   | Mothers of children <24 months                                                  | 634/634 Male             | 262                | 51               | 313        |
|                         |                     | study              |                                                                                  | Female                    | 255                | 50               | 305        |
|                         |                     |                    |                                                                                  | Total                     | 517                | 101              | 618        |
| Lakew et al 2015        | National            | Cross-sectional   | Mothers who had children <5 years                                               | 11 654/11 553 Male       | 3124               | 2860             | 5984       |
|                         |                     | study*             |                                                                                  | Female                    | 3057               | 2511             | 5568       |
|                         |                     |                    |                                                                                  | Total                     | 6181               | 5371             | 11 552     |
| Liben and Yesuf 2016    | Afar, Dubti town   | Cross-sectional   | Mothers of infants aged <6 months                                               | 346/333 Male             | 81                 | 122              | 203        |
|                         |                     | study              |                                                                                  | Female                    | 70                 | 130              | 200        |
|                         |                     |                    |                                                                                  | Total                     | 151                | 252              | 403        |
| Setegn et al 2011       | Oromia, Goba district| Cross-sectional | Mothers with children (<12 months)                                              | 668/608 Male             | 164                | 152              | 316        |
|                         |                     | study              |                                                                                  | Female                    | 150                | 133              | 283        |
|                         |                     |                    |                                                                                  | Total                     | 314                | 285              | 599        |
| Wolde et al 2014        | Oromia, Nekemte town| Cross-sectional   | Mothers who had a child less <24 months                                         | 182/174 Male             | 70                 | 10               | 80         |
|                         |                     | study              |                                                                                  | Female                    | 84                 | 10               | 94         |
|                         |                     |                    |                                                                                  | Total                     | 154                | 20               | 174        |
| Woldemichael 2016       | Oromia, Tiyo Woreda| Cross-sectional   | Mothers who have children <1 year age                                            | 386/373 Male             | 153                | 60               | 213        |
|                         |                     | study              |                                                                                  | 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      | Amhara, South Gondar | Cross-sectional    | Mothers of infants <12 months                       | 845/823                  | Male       | 214           | 229          | 443     |
|                         |                   | study             |                                                      |                          | Female     | 187           | 193          | 380     |
|                         |                   |                    |                                                      |                          | Total      | 401           | 422          | 823     |
| B. Antenatal care versus TIBF
| Gultie and Sebsibie 2016 | 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       | 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 Tamrat 2015  | 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        | 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             | 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       | 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 2017              | 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 2015    | 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
| Author/Publication year | Study Area                  | Study Design             | Study Population                                         | Sample size/Participated | Factors          | TIBF Within 1 hour | TIBF After 1 hour | TIBF Total |
|-------------------------|-----------------------------|--------------------------|----------------------------------------------------------|--------------------------|------------------|-------------------|-------------------|-----------|
| Seid et al. 2013         | 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       | 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              | 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        | 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      | 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          | 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      | 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   | 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           | 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         | 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        | 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  | 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      | 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       | 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        | 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
| Author/publication year | Study area | Study design | Study population | Sample size/Participated | Factors | EBF |
|-------------------------|------------|--------------|------------------|--------------------------|---------|-----|
| Sefene 2013\(^{50}\)   | Amhara, Bahir Dar city | Cross-sectional study | Mothers who had a child aged <6 months | 170/159 | Male 36 | Yes 83 |
|                         |            |              |                  |                          | Female 42 | No 76 |
|                         |            |              |                  |                          | Total 78 | Total 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 | Yes 300 |
|                         |            |              |                  |                          | No ANC 19 | No 32 |
|                         |            |              |                  |                          | Total 262 | Total 332 |
| Gultie and Sebsibie 2016\(^{35}\) | Amhara, Debre Berhan town | Cross-sectional study | Mothers having children aged <23 months old | 548/548 | ANC 263 | Yes 516 |
|                         |            |              |                  |                          | No ANC 10 | No 31 |
|                         |            |              |                  |                          | Total 273 | Total 547 |
| Hunegnaw et al 2017\(^{50}\) | Amhara, Gozamin district | Cross-sectional study | Mothers who had infants aged between 6 and 12 months | 506/478 | ANC 341 | Yes 450 |
|                         |            |              |                  |                          | No ANC 17 | No 28 |
|                         |            |              |                  |                          | Total 358 | Total 478 |
| Lenja et al 2016\(^{53}\) | SNNPR, Offa district | Cross-sectional study | Mothers of infants <6 months | 403/396 | ANC 233 | Yes 276 |
|                         |            |              |                  |                          | No ANC 44 | No 132 |
|                         |            |              |                  |                          | Total 277 | Total 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 | Yes 777 |
|                         |            |              |                  |                          | No ANC 7 | No 42 |
|                         |            |              |                  |                          | Total 412 | Total 819 |
| Setegn et al 2011\(^{31}\) | Oromia, Goba district | Cross-sectional study | Mothers with children (<12 months) | 668/608 | ANC 166 | Yes 231 |
|                         |            |              |                  |                          | No ANC 27 | No 37 |
|                         |            |              |                  |                          | Total 193 | Total 268 |
| Sonko and Worku 2015\(^{44}\) | SNNPR, Halaba special woreda | Cross-sectional study | Mothers with children <6 months of age | 422/420 | ANC 258 | Yes 346 |
|                         |            |              |                  |                          | No ANC 38 | No 74 |
|                         |            |              |                  |                          | Total 296 | Total 420 |
| Tadesse et al 2016\(^{54}\) | SNNPR, Sorro District | Cross-sectional Study | Mothers with infants aged 0–5 months | 602/579 | ANC 211 | Yes 332 |
|                         |            |              |                  |                          | No ANC 59 | No 182 |
|                         |            |              |                  |                          | Total 270 | Total 514 |
| Tariku et al 2017\(^{55}\) | Amhara, Dabat District | Cross-sectional study * | Mothers with children aged <59 months | 5227/5227 | ANC 1979 | Yes 3332 |
|                         |            |              |                  |                          | No ANC 713 | No 1589 |
|                         |            |              |                  |                          | Total 2692 | Total 4921 |

Continued
| Author/publication year | Study area | Study design | Study population | Sample size/ Participated | Factors | EBF | Yes | No | Total |
|-------------------------|------------|--------------|------------------|--------------------------|---------|-----|-----|----|------|
| Tewabe 2016            | 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      | 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 | 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        | 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             | 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  | 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      | 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       | 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           | 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            | 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
| Author/publication year | Study area | Study design       | Study population                                                                 | Sample size/Participated | Factors | EBF |
|-------------------------|------------|--------------------|-----------------------------------------------------------------------------------|--------------------------|---------|-----|
| Teka et al 2015<sup>49</sup> | Tigray, Enderta Woreda | Cross-sectional study | Mothers having children aged <24 months                                           | 541/530                  | ANC     | 325 |
|                          |            |                    |                                                                                    |                          | No ANC  | 47  |
|                          |            |                    |                                                                                    |                          | Total    | 372 |
| Chekol et al 2017<sup>59</sup> | Amhara, Gondar town | Cross-sectional study | Mothers with children aged 7–12 months                                           | 333/333                  | ANC     | 131 |
|                          |            |                    |                                                                                    |                          | No ANC  | 29  |
|                          |            |                    |                                                                                    |                          | Total    | 160 |
| C. Postnatal care versus EBF |
| Asemahagn 2016<sup>42</sup> | Amhara, Azezo district | Cross-sectional study | Women having children aged from 0 to 6 months                                     | 346/332                  | PNC     | 137 |
|                          |            |                    |                                                                                    |                          | No PNC  | 125 |
|                          |            |                    |                                                                                    |                          | Total    | 262 |
| Lenja et al 2016<sup>53</sup> | SNNPR, Offa district | Cross-sectional study | Mothers of infants <6 months                                                     | 403/396                  | PNC     | 188 |
|                          |            |                    |                                                                                    |                          | No PNC  | 121 |
|                          |            |                    |                                                                                    |                          | Total    | 309 |
| Sonko and Worku 2015<sup>44</sup> | SNNPR, Halaba special woreda | Cross-sectional study | Mothers with children <6 months of age                                           | 422/420                  | PNC     | 98  |
|                          |            |                    |                                                                                    |                          | No PNC  | 197 |
|                          |            |                    |                                                                                    |                          | Total    | 295 |
| Tadesse et al 2016<sup>54</sup> | SNNPR, Sorro District | Cross-sectional Study | Mothers with infants aged 0–5 months                                             | 602/579                  | PNC     | 204 |
|                          |            |                    |                                                                                    |                          | No PNC  | 66  |
|                          |            |                    |                                                                                    |                          | Total    | 270 |
| Tewabe et al 2016<sup>60</sup> | Amhara, Motta town, East Gojam zone | Cross-sectional Study | Mothers with an infant <6 months old                                             | 423/405                  | PNC     | 116 |
|                          |            |                    |                                                                                    |                          | No PNC  | 87  |
|                          |            |                    |                                                                                    |                          | Total    | 203 |
| Abera 2012<sup>56</sup> | Harari, Harar town | Cross-sectional study | Mothers of children aged <2 years                                                | 604/583                  | PNC     | 29  |
|                          |            |                    |                                                                                    |                          | No PNC  | 178 |
|                          |            |                    |                                                                                    |                          | Total    | 207 |
| Teka et al 2015<sup>49</sup> | Tigray, Enderta woreda | Cross-sectional study | Mothers having children aged <24 months                                          | 541/530                  | PNC     | 167 |
|                          |            |                    |                                                                                    |                          | No PNC  | 205 |
|                          |            |                    |                                                                                    |                          | Total    | 372 |

*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.
Furthermore, seven studies 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, I²=63.4%) (figure 6).

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 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 4 Forest plot of the unadjusted odds ratios with corresponding 95% CIs of 13 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.

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.
Habtewold TD, et al. BMJ Open 2019;9:e023956. doi:10.1136/bmjopen-2018-023956

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 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 ($\tau^2=4.28\%$);

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**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.

**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.

**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.

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**Table 1**

| Studies and Publication year | Odds ratio [95% CI] |
|-----------------------------|---------------------|
| Setegn et al: 2011          | 0.96 [0.69, 1.32]   |
| + Berhe et al: 2013         | 1.05 [0.79, 1.39]   |
| + Regassa: 2014             | 1.15 [0.92, 1.44]   |
| + Alemayehu et al: 2014     | 0.97 [0.66, 1.43]   |
| + Wolde et al: 2014         | 0.96 [0.68, 1.35]   |
| + Lakew et al: 2015         | 0.94 [0.73, 1.21]   |
| + Liben et al: 2016         | 0.98 [0.78, 1.22]   |
| + Woldemichael et al: 2016  | 1.04 [0.82, 1.31]   |
| + Beyene et al: 2017        | 1.03 [0.84, 1.26]   |
| + Mekonen et al: 2018       | 1.02 [0.86, 1.21]   |

**Table 2**

| Studies and Publication year | Odds ratio [95% CI] |
|-----------------------------|---------------------|
| Setegn et al: 2011          | 1.38 [0.86, 2.20]   |
| + Tamiru et al: 2012        | 1.15 [0.83, 1.59]   |
| + Berhe et al: 2013         | 1.56 [0.80, 3.05]   |
| + Adugna: 2014              | 1.30 [0.74, 2.30]   |
| + Sed: 2014                 | 1.53 [0.87, 2.66]   |
| + Tamiru et al: 2015        | 1.35 [0.82, 2.23]   |
| + Gutlie et al: 2016        | 1.61 [0.93, 2.76]   |
| + Liben et al: 2016         | 1.45 [0.88, 2.39]   |
| + Tewabe: 2016              | 1.51 [0.97, 2.37]   |
| + Woldemichael et al: 2016  | 1.79 [1.08, 2.97]   |
| + Beyene et al: 2017        | 1.56 [0.65, 2.65]   |
| + Derso et al: 2017         | 1.61 [0.81, 2.77]   |
| + Mekonen et al: 2018       | 1.70 [1.10, 2.65]   |

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**Figure 10** 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.

**Figure 11** 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.
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 (Qₐ=18.46, df=7, p=0.01). Study area (region) negatively influenced the association between ANC and EBF practice (Qₐ=27.55, df=8, p=0.001) (table 3).

### 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.

| Studies and Publication year | Odds ratio [95% CI] |
|-----------------------------|---------------------|
| Abers, 2012                 | 0.85 [0.49, 1.47]   |
| + Sonko et al; 2015         | 1.30 [0.57, 2.98]   |
| + Teko et al; 2015          | 1.37 [0.88, 2.14]   |
| + Asenmahgnis, 2016         | 1.49 [1.05, 2.12]   |
| + Lega et al; 2016          | 1.66 [1.17, 2.35]   |
| + Tadesse et al; 2016       | 1.84 [1.31, 2.58]   |
| + Teko et al; 2015          | 1.70 [0.95, 3.03]   |
| + Sonko et al; 2015         | 1.74 [1.13, 2.68]   |
| + Asemahgnis, 2016          | 1.81 [1.21, 2.71]   |
| + Gulte et al; 2016         | 1.83 [1.25, 2.66]   |
| + Lega et al; 2016          | 2.11 [1.37, 3.24]   |
| + Tadesse et al; 2016       | 2.19 [1.46, 3.29]   |
| + Arage et al; 2016         | 2.33 [1.56, 3.49]   |
| + Huneegruw et al; 2017     | 2.31 [1.58, 3.58]   |
| + Tadesse et al; 2016       | 2.27 [1.59, 3.25]   |
| + Tewabe et al; 2017        | 2.27 [1.62, 3.19]   |
| + Adugna et al; 2017        | 2.25 [1.63, 3.10]   |
| + Chekol et al; 2017        | 2.24 [1.65, 3.04]   |

### 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.

| Studies and Publication year | Odds ratio [95% CI] |
|-----------------------------|---------------------|
| Abers, 2012                 | 0.85 [0.49, 1.47]   |
| + Sonko et al; 2015         | 1.30 [0.57, 2.98]   |
| + Teko et al; 2015          | 1.37 [0.88, 2.14]   |
| + Asenmahgnis, 2016         | 1.49 [1.05, 2.12]   |
| + Lega et al; 2016          | 1.66 [1.17, 2.35]   |
| + Tadesse et al; 2016       | 1.84 [1.31, 2.58]   |
| + Teko et al; 2015          | 1.74 [1.13, 2.68]   |
| + Sonko et al; 2015         | 1.81 [1.21, 2.71]   |
| + Asemahgnis, 2016          | 1.83 [1.25, 2.66]   |
| + Gulte et al; 2016         | 2.11 [1.37, 3.24]   |
| + Tadesse et al; 2016       | 2.19 [1.46, 3.29]   |
| + Arage et al; 2016         | 2.33 [1.56, 3.49]   |
| + Huneegruw et al; 2017     | 2.31 [1.58, 3.58]   |
| + Tadesse et al; 2016       | 2.27 [1.59, 3.25]   |
| + Tewabe et al; 2017        | 2.27 [1.62, 3.19]   |
| + Adugna et al; 2017        | 2.25 [1.63, 3.10]   |
| + Chekol et al; 2017        | 2.24 [1.65, 3.04]   |

### 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 institution66 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 studies63 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
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 hinders 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

| 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.
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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Contributors NTS and TDH conceived and designed the study. TDH developed a syntax for searching databases, analysed the data and interpreted the results. TDH and SMA wrote and revised the manuscript. All authors read and approved the final manuscript.

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

Habtewold TD, Sharew NT, Alemu SM. 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. BMJ Open 2019;9:e023956. doi: 10.1136/bmjopen-2018-023956

The following amendments were considered to the original version of this article.

Reference 35: Gultie T, Sebsibie G. Determinants of suboptimal breastfeeding practice in Debre Berhan town, Ethiopia: a cross sectional study. Int Breastfeed J 2016;11 has been excluded from the published article.

Authors have found in their meta-analysis,1 that this study in reference 352 was retracted from the International Breastfeeding Journal in 2018 (online: 07 March 2018) because of significant overlap of both text and data with the Master’s Thesis of Hilina Ketma, “Assessment of prevalence and determinants of suboptimal breastfeeding among mothers of children aged less than two years in Dire Dawa City Administration, Ethiopia, June 2013”, which was defended at the School of Graduate Studies, Addis Ababa University, Addis Ababa, Ethiopia in June 2013.3

Therefore, authors have performed reanalysis by excluding Gultie and Sebsibie study (reference 35), and revised figure 3 and figure 5.

In conclusion, despite having excluded Gultie and Sebsibie study, the results show that antenatal care significantly associated with timely initiation of breastfeeding and exclusive breastfeeding. Therefore, the central findings of the original article remain unaffected.

Please, find the revised figures.

### 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 breastfeeding; REM, random-effects model; TIBF, timely initiation of breastfeeding.
Figure 5  Forest plot of the unadjusted odds ratios with corresponding 95% c.i.s of 21 studies on the association of ANC and EBF. The horizontal line represents the C.I, 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.

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2 Gultie T, Sebsibie G. Determinants of suboptimal breastfeeding practice in Debre Berhan town, Ethiopia: a cross sectional study. Int Breastfeed J 2016;11:5. eCollection 2016.

3 Gultie T, Sebsibie G. Retraction note: determinants of suboptimal breastfeeding practice in Debre Berhan town, Ethiopia: a cross sectional study. Int Breastfeed J 2018;13:13.

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