Incidence of uterine rupture and associated factors in Ethiopia: A systematic review and Meta-analysis

Asteray Assmie Ayenew (amanuelbiruk0077@gmail.com)
Bahir Dar University

Azezu Asres Nigussie
Bahir Dar University

Biruk Ferede Zewdu
Bahir Dar University

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Abstract

Background: Globally, maternal morbidity and mortality a major public health challenge. Uterine rupture is a life-threatening obstetrical emergency with life-threatening complications for both the mother and her infant. In developing countries, it is the leading cause of maternal and fetal morbidity and mortality. Therefore, this systematic review and meta-analysis aimed to assess the incidence of uterine rupture and its associated factors among mothers managed for obstetric cases in Ethiopia.

Method: for this review, we used the standard PRISMA checklist guideline. Different online databases were used for the review: PubMed, Google Scholar, EMBASE, Cochrane Library, HINARI, WHO Afro Library Databases, and African Online Journals. Based on the adapted PICO principles, different search terms were applied to achieve and access all the essential articles. This search included all published and unpublished observational studies written only in English language and conducted in Ethiopia. Microsoft Excel 16 was used for data entrance, and Stata version 11.0 (Stata Corporation, College Station, Texas, USA) used for data analysis.

Result: A total of 21 studies with 33,303 mothers managed for obstetric cases were included. The pooled incidence of uterine rupture among mothers managed for obstetric cases in Ethiopia was 3.25% (95%CI: 2.6–3.89, I^2=97.4%, P<0.001). Rural residency (adjusted odds ratio (AOR):5.44; 95% confidence interval (CI): 95%CI: 3.17–9.34, I^2 =59.5%, P=0.03), grand multiparty (AOR = 2.38; 95%CI: 1.32–4.29, I^2=0.0%, p=0.002), not having antenatal care (AOR =4.05(; 95% CI: 1.90–8.64 I^2=89.4%, P<0.001), having previous cesarean section scar (AOR =7.10; 95% CI: 5.40–9.34, I^2=26.3%, P=0.254), having Prolonged labour (AOR=6.71; 95%CI: 4.04–11.15, I^2=84.6%, P<0.001), having obstructed labour (AOR=7.22; 95%CI: 2.86–18.28, I^2=97.4%, P<0.001), no partograph utilization for labour monitoring (AOR=3.43; 95%CI: 1.62–7.29, I^2=66.6%, P=0.05) were the determinant factors for the incidence of uterine rupture in Ethiopia.

Conclusion: This systematic review and meta-analysis showed that the incidence of uterine rupture was high in Ethiopia. Being from the rural area, prolonged labour, having cesarean section scar, not using partograph for labour monitoring, not having ante natal care, and obstructed labour increased the risk of uterine rupture.

Background

Maternal and neonatal morbidity and mortality are among the standing challenges in the arena of reproductive health. Uterine rupture is one of the contributors to obstetric morbidity and mortality in developing countries [1]. It is a life-threatening tearing of the uterus either partially or completely during pregnancy or delivery. This usually results in extrusion of the product of conception into the abdominal cavity, extensive damage to the uterus, and deadly bleeding in the mother and death of the baby [2, 3].

Globally, around 303,000 to half a million women die per annum due to complications of pregnancy and childbirth. The global Maternal Mortality Rate is 216 per 100,000 live births. Sub-Sahara Africa alone

bears over 90% of the burden of these maternal deaths. Among these deaths, uterine rupture accounts for about 8% of all maternal deaths [4].

In developing countries uterine rupture is an important cause of maternal mortality and morbidity, with the overall incidence of around 74 in 10,000 [5, 6]. Ethiopia is one of the Sub-Saharan African countries where maternal, and perinatal mortality rates are still very high, with maternal mortality ratio of 412 maternal deaths per 100,000 live births [7]. Uterine rupture with or without obstructed labor is the leading cause of maternal mortality accounting for 36% of the total maternal mortality [8]. This may be a reflection of high prevalence of home delivery [8, 9], especially in rural areas. The majority of pregnant women in Ethiopia stay at home laboring for 2–3 days and come to health facility when they are seriously ill [8].

Uterine rupture is associated with a number of acute and long term complications. These include anemia, need for transfusion, bladder injury, wound infection, sepsis, and death [10]. Complications like obstetric fistula, foot drop, psychological trauma, permanent loss of fertility are some of the long term outcomes [11, 12]. Acute renal failure from pre renal azotemia is also possible following massive hemorrhage [13, 14]. Among these, the most commonly encountered complication is hemorrhage leading to anemia [9, 10, 12, 15]. Not only this, loss of fertility in communities where reproduction is considered the very essence of womanhood has grave socio cultural implications like divorce, and loss of economic support [16, 17].

Patients with fistula are living leaking urine or feces through the vagina. They have to continue living thereafter unclean, outcast, smelling of urine, and faces. This is a cause for separate from their families, worsening poverty, malnutrition, and almost unendurable suffering [18]. Maternal death as a consequence of uterine rupture occurs at a rate of 0–1% in modern developed nations, but the mortality rates in developing countries are 5–10% [11].

Uterine rupture could be prevented by initiation of labor at health institutions, early referral [3], and treatment of hypovolumia, and prevention of postoperative anemia is recommended to decrease maternal death secondary to uterine rupture [9]. In addition proper monitoring of labour, and improvement of comprehensive emergence obstetric care at all levels of health care are recommended to avoid unnecessary delays in care [17]. Early diagnosis, and active surgical management will go a long way in reducing maternal, and fetal mortality [14]. Even though indicators for emergency obstetric care dictate that the fatality of any obstetric condition should not exceed 1%, the burden of death due to uterine rupture is still higher in Ethiopia indicating that need for attention is still required for this obstetric sequel [19]. The prevalence ranges from 0.9% in Tigray region [8] to 16.68% in Amhara region [20]. Therefore, this systematic review and meta-analysis aimed to estimate the incidence of uterine rupture and its associated factors among mothers managed for obstetrics care in Ethiopia.

Methods

This systematic review and meta-analysis were conducted to estimate the incidence of uterine rupture and associated factors among mothers managed for obstetrics care in Ethiopia. We used the Preferred

Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist guideline [21].

Searching strategy

First, the PROSPERO database and database of abstracts of reviews of effects (DARE) (http://www.library.UCSF.edu) were searched to check whether published and/or ongoing projects exist related to the topic. The literature search strategy, selection of studies, data extraction, and result reporting were done in accordance with (PRISMA) guidelines [22]. We searched PubMed, Google Scholar, EMBASE, Cochrane Library, HINARI, WHO Afro Library Databases, and African Online Journal databases for all available studies using the following terms:“incidence”, “prevalence” “outcome”, “determinants”, ‘uterine rupture”, “obstructed labour”“classical cesarean section”, “factors”, “vaginal birth after cesarean/caesarean section”, “trial of labour”, “outcome”, AND Ethiopia.

Searching terms were based on adapted PICO principles to search through the above-listed databases to access all the relevant articles. Moreover, the search string was developed using "AND" and "OR" Boolean operators. For unpublished studies, the official websites of Ethiopian's University research repository online library (University of Gondar and Addis Ababa University) was used.

Eligibility Criteria

Inclusion Criteria

Study Design: All observational studies reported the incidence of uterine rupture and/or associated factors were included.

Language: English language literature and research articles were included.

Publication: Both unpublished and published research articles were considered.

Searching date: Articles searched from January 1-30, 2020 were included.

Participants: mothers who managed for obstetric cases in Ethiopia

Exclusion Criteria

Duplicated studies, articles without full text and abstract, anonymous reports, qualitative studies, and case reports were excluded.

Quality assessment

After collecting the findings from all databases, the articles were exported to Microsoft Excel spreadsheet. Two authors independently extracted the data and reviewed the screened and eligible articles. Any disagreement was handled by the third reviewer. Finally, a consensus was reached between the authors through discussion. The methodological quality of each study (sampling strategy, response rate, and representativeness of the study), comparability, and outcome were checked using the NOS tool.

Newcastle-Ottawa Quality Assessment Scale (NOS) for cross-sectional, cohort, and case-control studies was used to assess the methodological quality of a study and to determine the extent to which a study has addressed the possibility of bias in its design, conduct and analysis[23]. All the included articles scored (NOS) 7 and more can be considered as “good” studies with low risk.

Outcome of measurement

This review has two main outcomes. The primary outcome of this review was the incidence of uterine rupture among mothers admitted for obstetrics care in Ethiopia, whereas associated factors for the incidence of uterine rupture among mothers admitted for obstetrics care were the second outcome variable. The odds ratio was calculated for the common risk factors of the reported studies. The most common associated factors included in this systematic review and meta-analysis were rural residency, grand multiparity, having previous cesarean section scar, having Prolonged labour, not having antenatal care during pregnancy, having obstructed labour, and no partograph utilization for labour monitoring.

Operational definitions

Uterine rupture: defined as complete or incomplete nonsurgical disruption of uterine layers (endometrium, myometrium, and serosa) diagnosed and confirmed after laparotomy [24].

Prolonged labour: occurs when labour lasts for approximately 20 hours or more if you are a first-time mother, and 14 hours or more if you have previously given birth [25].

Obstructed labour : is defined as failure of the fetal presenting part to descent in the birth canal due to mechanical reasons, adequate, and strong uterine contraction it leads to various maternal and fetal outcomes [26].

Grand multiparity : is defined as giving birth five times or higher [27].

Statistical analysis

To obtain the pooled incidence of uterine rupture, a meta-analysis using random effects DerSimonian and Laird model was performed due to anticipated heterogeneity [28]. Cochran’s Q chi-square statistics and I^2 statistical test was conducted to assess the random variations between primary studies [29]. In this study, heterogeneity was interpreted as an I^2 value of 0% = no heterogeneity, 25% = low, 50% = moderate, and 75% = high [30]. In case of high heterogeneity, subgroup analysis and sensitivity analyses were run to identify possible moderators of this heterogeneity. Potential publication bias was assessed by visually inspecting funnel plots and objectively using the Egger’s test (i.e. $p<0.05$) [31]. To account for any publication bias, we used the trim-and-fill method, based on the assumption that the effect sizes of all the studies are normally distributed around the center of a funnel plot. The meta-analysis was performed using the Stata version 11.0 (Stata Corporation, College Station, Texas, USA) software. Finally, for all analyses, $P < 0.05$ was considered statistically significant.

Results

The search strategy identified 90 articles from PubMed, 110 articles from Google Scholar, 45 articles from Cochrane Library, 10 articles from African Journals Online, 2 articles from Ethiopian's University online library, and 3 articles by manual search. Of which, 117 were excluded due to duplication, 75 through review of titles and abstracts. Additionally, 52 full-text articles were excluded for not reporting the outcome variable and other reasons. Finally, 21 were included to the incidence and/ or associated factor analysis on uterine rupture among among mothers managed for obstetric cases in Ethiopia [Fig.1].

Characteristics of included studies

In this review, 21 relevant studies were included with a sample size of 33,303. Among twenty one studies, thirteen were cross sectional, seven case-controls, and one cohort in study design. Regarding the geographical area, seven studies were from Amhara region, five from Oromia, five from Southern Nation Nationalities and People (SNNPR), and four from Tigray region. Among the included studies the largest sample size was 14,152, where as the smallest was 115 (Table 1).

Table 1: Descriptive summary of included studies on uterine rupture based on year of study, study design, sample size, region of study, response rate, and prevalence *(n=21).*

Author (year)	study design(setting)	Sample size	Study area	Prevalence (%)
Dawud A.et al(2017)[52]	Cross-sectional	376	Amhara	0.9
Fikru A.et al(2017)[53]	Case control	432	Oromia	N/A
Worku T.et al(2017)[20]	Cross-sectional	750	Amhara	16.68
Akine Eshete .et al(2017) [54]	Cohort	2498	Oromia	1.8
Tefera M.et al(2015)[55]	Case control	336	Tigray	N/A
Tegene L.et al(2016)[56]	Cross-sectional	9789	SNNP	1.24
Geremew A.et al(2014)[9]	Cross-sectional	254	Amhara	2.44
Temesgen T. et al(2015)[57]	Case control	172	Oromia	N/A
Amare W.et al(2018[58])	Case control	210	Amhara	N/A
Amanuel G.et al(2001)[59]	Cross-sectional	2000	Tigray	0.9
Yayehyirad Y.et al e (2016) [60]	Case control	352	SNNP	N/A
A. ADMASSU.et al(2004)[61]	cross-sectional	1200	Amhara	3.8
Samuel A.et al(2016)[62]	Cross-sectional	880	Amhara	9.5
Chamiso B.et al(1995)[63]	Cross-sectional	2185	Oromia	2.6
Habtamu M.et al(2015)[64]	Cross-sectional	115	SNNP	1.6
Solomon G.et al(2013)[65]	Case control	560	Tigray	N/A
Yibrah B. et al[8]	Cross-sectional	5185	Tigray	0.9
Goitom G. et al(2019)[66]	Case control	560	SNNP	N/A
Tigist G.et al(2018)[67]	Cross-sectional	14,152	Oromia	1.07
Mekuanint T. et al(2020)[68]	Cross-sectional	378	Amhara	8.7
Achamyelesh G.et *al(2020) [69]*	Cross-sectional	13,500	SNNPR	2.55

Meta-analysis

Publication bias

Three studies were excluded from prevalence estimation after checking funnel plot and the significance of Egger's regression test. However, they were not excluded from meta-analysis for risk factors. Significant publication bias with an Egger's regression *p*-value< 0.001 was seen when all studies considered. Thus, after adjustment Egger's regression p-value was 0.215, indicated a reduced publication bias (Fig. 2).

Incidence of uterine rupture in Ethiopia

Primarily, all seven case-control studies were not considered in the incidence estimation. The pooled incidence of uterine rupture is presented with a forest plot (Fig. 3). Therefore, the estimated incidence of uterine rupture among mothers managed for obstetric cases in Ethiopia was 3.25% (95%CI: 2.6-3.89, I^2=97.4%, P<0.001).

Subgroup analysis

Subgroup analysis was employed with the evidence of heterogeneity. In this study, the Cochrane I^2 statistic was 97.4%, $P < 0.001$, which showed the evidence of marked heterogeneity. Therefore,

subgroup analysis was done using the study region and year of study. As a result, uterine rupture was high in North Western Ethiopia 8.08% (95%CI: 3.97-12.18), regarding year of study the highest incidence was in the study conducted between 2014-2017 (5.03% (95%CI: 3.54-6.52)) (Fig 4&5).

Risk factors for incidence of uterine rupture

The association between prolonged labour, being grand multi para, rural residency, having cesarean section scar, not using partograph for labour monitoring, not having antenatal care during pregnancy, and obstructed labour with uterine rupture was carried out.

A total of six articles were included to identify the association between rural residency and uterine rupture. Mother's residency (as defined as rural and urban) was significantly associated with uterine rupture. Mother's from rural areas were more likely to have uterine rupture than those (women) from urban areas (AOR=5.44, 95% CI: 3.17–9.34, I^2 =59.5%, P=0.03) (Fig. 6).

Seven studies showed a significant association between grand multiparity and uterine rupture. Mother's of grand multipara were 2.38 times more likely to develop uterine rupture (AOR = 2.38; 95%CI: 1.32–4.29, I^2=0.0%, p=0.002) compared to mothers who are primi gravida (Fig.7).

Four studies showed a significant association between previous cesarean section scar and uterine rupture. Mother's who had previous cesarean section scar were 7.10 times more likely to develop uterine rupture (AOR =7.10; 95% CI: 5.40–9.34, I^2=26.3%, P=0.254) than mother' who had no cesarean section scar (Fig.8).

Seven studies showed a significant association between prolonged labour and uterine rupture. Mother's with prolonged labour were 6.71 times more likely to develop uterine rupture than mother's who had normal labour (AOR=6.71; 95%CI: 4.04–11.15, I^2=84.6%, P<0.001) (Fig.9).

Five studies showed a significant association between obstructed labour and uterine rupture. Mother's who had obstructed labour were 7.22 times more likely to develop uterine rupture (AOR=7.22; 95%CI: 2.86–18.28, I^2=97.4%, P<0.001) as compared to their counter parts (Fig.10).

Three studies showed a significant association between not utilizing partograph for labour monitoring and uterine rupture. Mother's who did not followed by partograph during active phase of labour were 3.43 times more likely to develop uterine rupture (AOR=3.43; 95%CI: 1.62–7.29, I^2=66.6%, P=0.05) than mother's followed by partograph (Fig.11).

Seven articles with were included to identify the association between not having antenatal care during pregnancy and uterine rupture. Mother's who have no antenatal care during pregnancy were 4.05 times more likely to develop uterine rupture (AOR =4.05; 95% CI: 1.90–8.64 I^2=89.4%, P<0.001) than mother's who had ANC (Fig. 12).

Discussion

In this meta-analysis, the pooled incidence of uterine rupture was 3.25% (95%CI: 2.6-3.890. The result is higher than a systematic review conducted in high income countries [32] 0.92%, a 7 year review in India [33] 0.061%, Uganda [34] 0.76%, Nigeria [35] 0.58%, Dar-es- Salaam, Tanzania [17] 0.22%, and Australian women attempting vaginal birth after one prior caesarean section [36] 0.01%. The possible reason might be poor ANC follow up, high home birth prevalence, teenage pregnancy, low socioeconomic status, poor infrastructure and poor referral system in Ethiopia[37-39].

The current study revealed that the chance of having uterine rupture is higher for mothers from rural residence compared to urban. Mother's from rural areas were 5.44 times were more likely to have uterine rupture as compared with mothers from urban areas. The is in line with prior studies done in Pakistan [40]. This could be due to lack of access to nearby health institution in rural residential areas. For women residing in rural area, health facilities are distant and accesses to information about institutional deliveries are limited in comparison to woman reside in urban. As a result the higher chance of uterine rupture for women from rural residents may be attributed to two delays in the process of getting obstetric cares. The first is delay to decide for seeking health care as early as possible and the second is delay in reaching health facility. Additionally, maybe there is a failure of early referral for any labour abnormality, thus resulting in delay in early intervention leading to ruptured uterus.

This study also showed that the chance of having uterine rupture was increased by increase in number of gravidity. Mother's of grand multipara were 2.38 times more likely to develop uterine rupture compared to mothers of primiparas. The result is supported by studies done in Yemen [41], western Uganda [34], and Nigeria [42, 43]. The possible explanation might be as the increment in parity ends up with the weakening of the uterine muscle, which could not be resistant to prolonged and powerful labour, especially in grand multipara women. Moreover, lax and weak muscle contributes for the head of fetus not to be engaged early that leads to different mal-presentations, which promotes uterine rupture. Additionally, as parity increase the risk of gestational diabetes, macrosomia, fetal anomalies, and Precipitated labour which in turn increase the risk of uterine rupture.

In the current study uterine rupture was found to be higher among women with a history of scarred uterus. Mother's who had previous cesarean section scar were 7.10 times more likely to develop uterine rupture than mother's who had no cesarean section scar. The result is supported by the studies done in United Kingdom [37], India [44] , Nigeria [43], and a systematic review in developing countries [24]. The reason behind could be mothers with previous CS delivery are highly likely to develop scar dehiscence especially when the incision of uterine wall is vertical and when the inter-pregnancy interval is short after a CS scar. Then these will lead women to develop rupture.

This study also elucidated that, mothers not having ANC care were 4.05 times more likely to have uterine rupture. The is in line with studies done in Nigeria [42, 45], Ugnda [46], and India [47]. This might be the fact that not having antenatal care during pregnancy decrease women knowledge about her health status likes multiple pregnancy, gestational diabitus, uterine and fetal anomaies, and other risk factors for

uterine rupture. Moreover, women who don't have antenatal care are prone to home childbirth, poor awareness about birth preparedness and complication readiness plan, danger sign of pregnancy which in turn increase the risk of rupture.

In this study, mothers who had prolonged labour were 6.1 times more likely to get uterine rupture compared to women who gave birth within normal range of time. This finding is in line with studies conducted in Angola [48], Nigeria [42] and Tanzania [15]. This could be due to prolonged labour causes increase the use of oxytocine, increases the risk of obstructed labour, and instrumental delivery which in turn increase uterine rupture. Moreover, as labour prolongs and not managed early the uterine muscle become exhausted and tend to rupture.

This review showed that mothers who had obstructed labour were 7.22 times more likely to develop uterine rupture as compared to their counter parts. This finding was similar to studies conducted in Uganda [49], Dar es Salaam, and USA [2]. The reason for this could be because during obstructed labour there is an impossible barrier (obstruction) preventing its descent despite strong uterine contractions, which increase risk of uterine rupture.

This study identified not using partograph during labour was as an important predictor of uterine rupture. Mother's who did not followed by partograph during labour were 3.43 times more likely to develop uterine rupture as compared to women who were followed by partograph during labour. Appropriate use of the partograph is an important tool for audit and monitoring progress of labour and a warning device to detect deviations from normal labour, preventing obstructed labour, uterine rupture, and thereby improving maternal and fetal outcome [50, 51]. Thus, not using a partograph increases the likely of uterine rupture among labouring mothers.

Limitation

Since it is the first systematic review and meta-analysis, it is taken as strength. The included articles were restricted to the English language only; this is a limitation of the study as it missed studies published in local languages. This review has not registered online.

Conclusion

The overall incidence of uterine rupture was high in Ethiopia. Being from the rural area, prolonged labour, having cesarean section scar, not using partograph for labour monitoring, not having ante natal care, and obstructed labour increased the risk of uterine rupture. Therefore to prevent the incidence of uterine rupture it is recommended to promote routine utilization of paragraph for labour monitoring, reducing the cesarean section delivery, and promoting ANC service utilization during pregnancy. Moreover, it is better to promote institutional service utilization for the prevention and early management of prolonged labour and obstructed labour.

Abbreviations

AA: Addis Ababa

CI: Confidence Interval

OR: Odds Ratio

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

SNNP: Southern Nation Nationality and Peoples

USA: United State of America

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable

Consent to publish

Not applicable

Availability of data and material

The data sets generated during the current study are available from corresponding author on reasonable request

Competing interests

All authors declare that they have no competing interests

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Authors' Contributions

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Author’s information

Affiliations

Department of Midwifery, College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia.

Asteray Assmie Ayenew , Azezu Asres Nigussie

Department of Orthopedics, College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia.

Biruk Ferede Zewdu

Corresponding author

Correspondence to Asteray Assmie Ayenew

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Figures

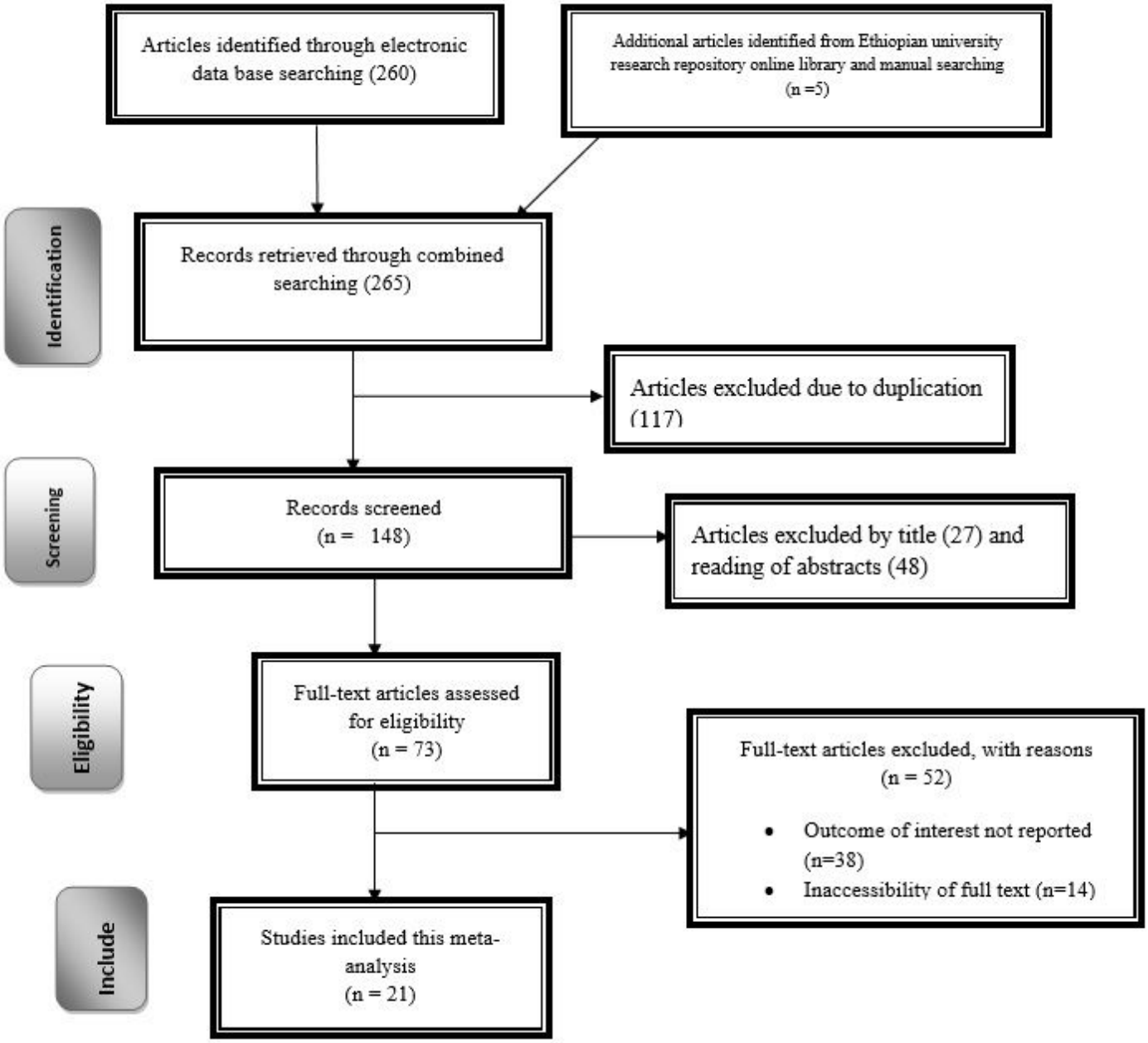

Figure 1

PRISMA 2009 Flow diagram for identification and selection of articles for inclusion in the review.

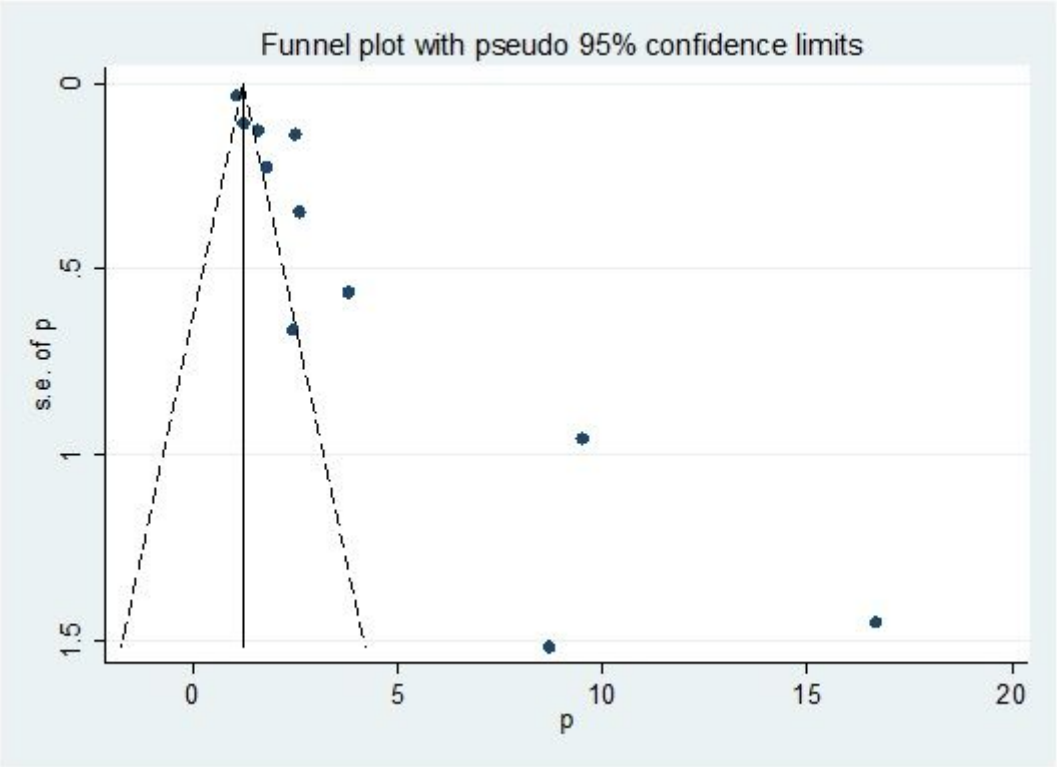

Figure 2

Funnel plot with 95% confidence limits of the pooled incidence of uterine rupture in Ethiopia

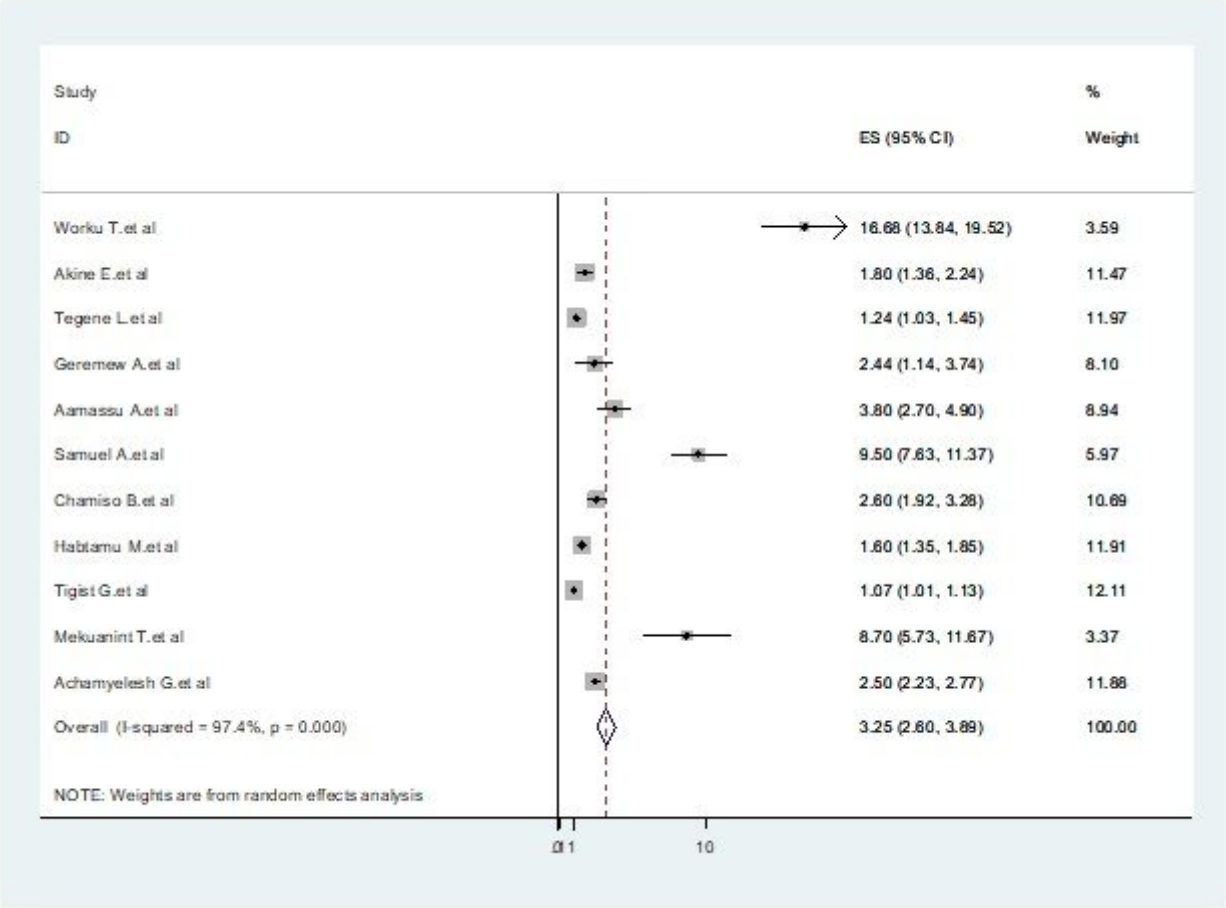

Figure 3

Forest Plot for the incidence of uterine rupture mothers managed for obstetric case in Ethiopia, 2020

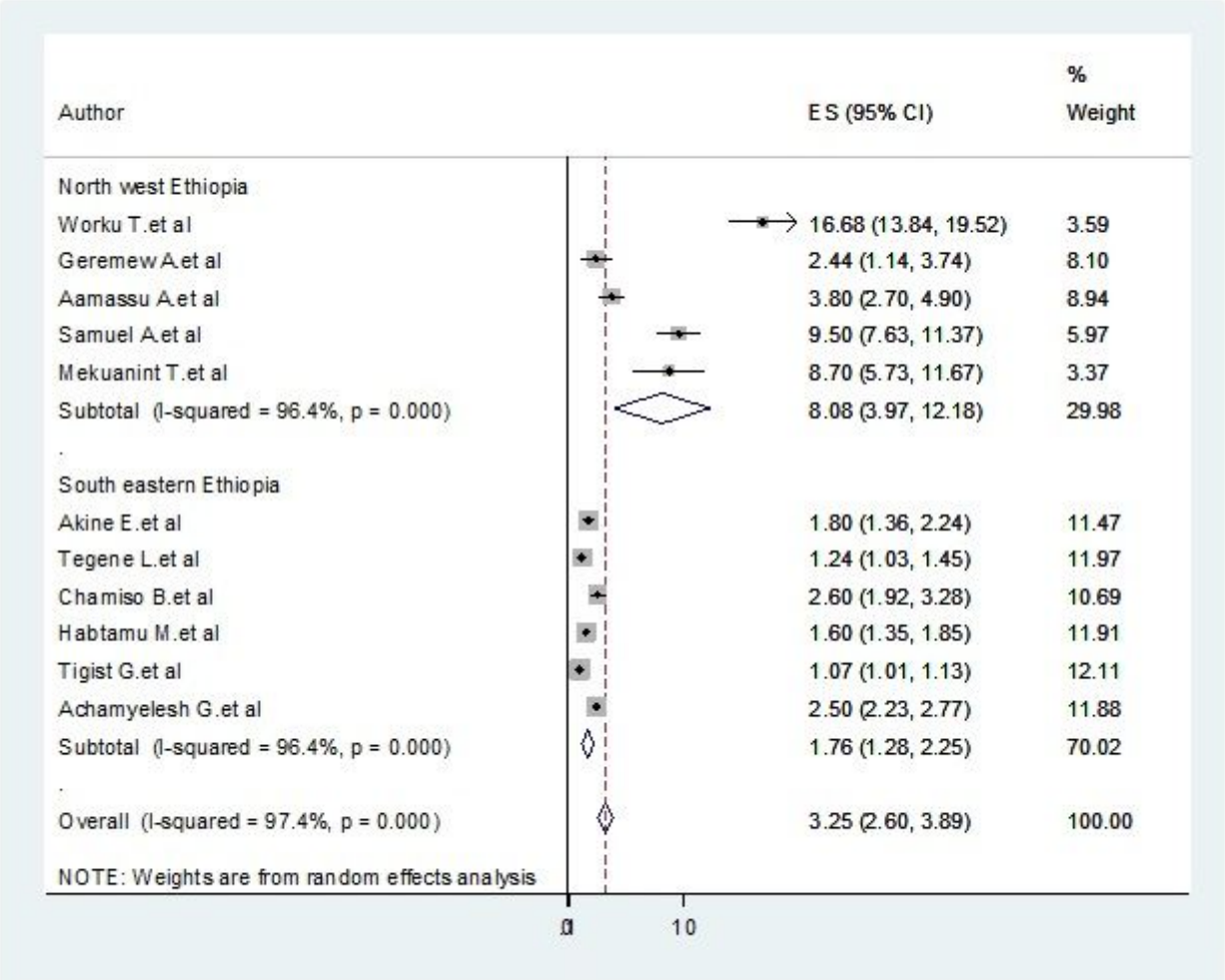

Figure 4

subgroup analysis of the pooled incidence of uterine rupture among mothers managed for obstetric cases based on the study region

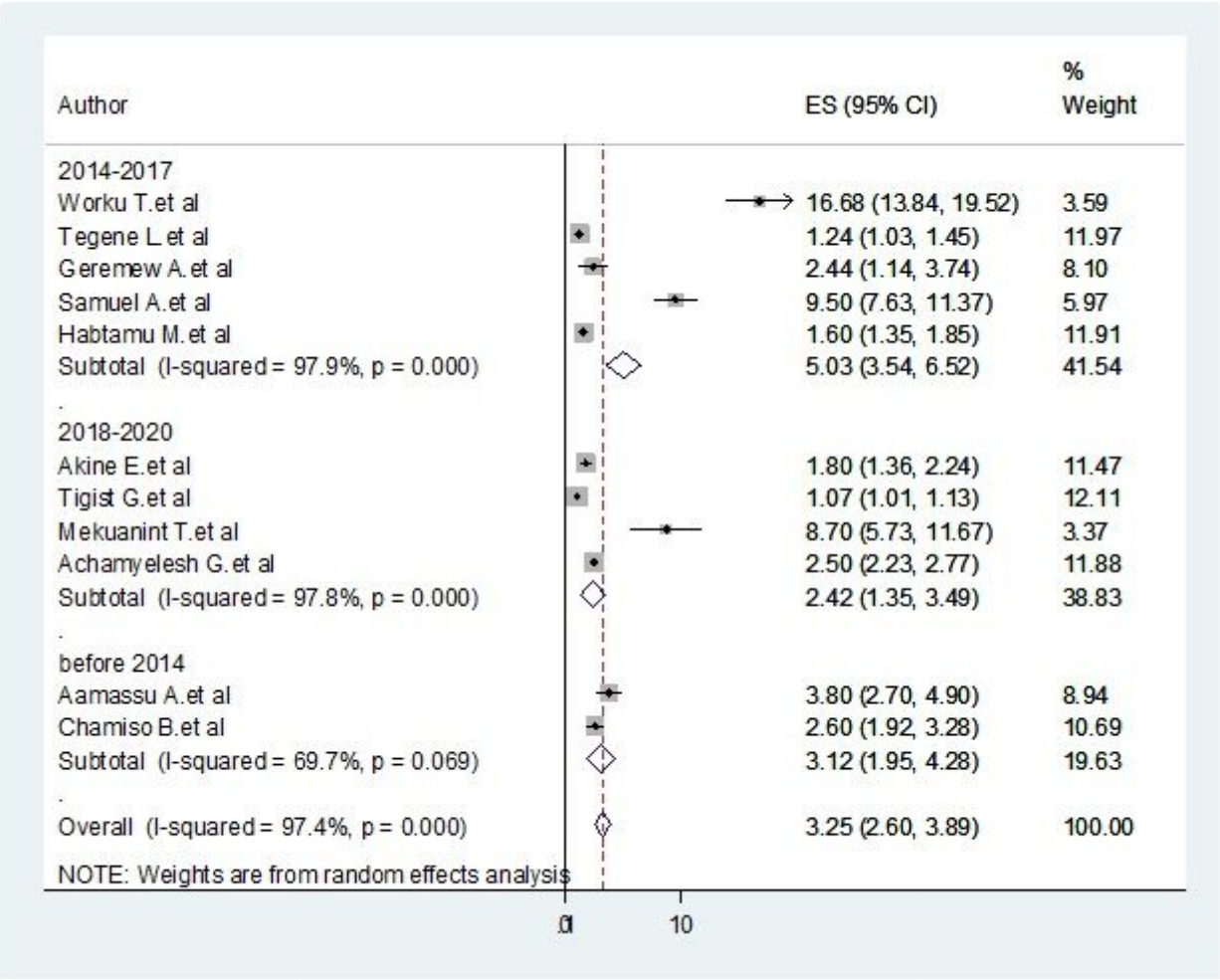

Figure 5

subgroup analysis of the pooled incidence of uterine rupture among mothers managed for obstetric cases based on year of study

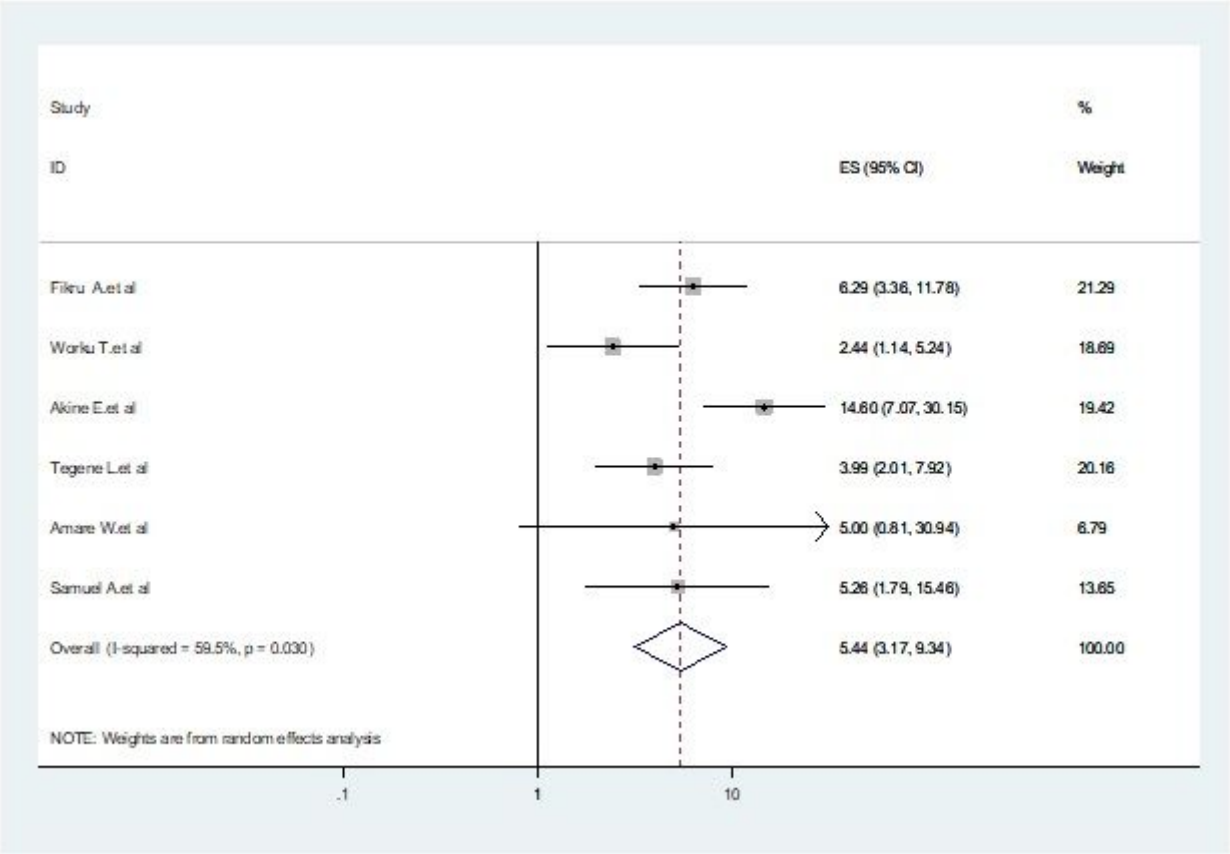

Figure 6

The pooled effects of rural residency on uterine rupture in Ethiopia.

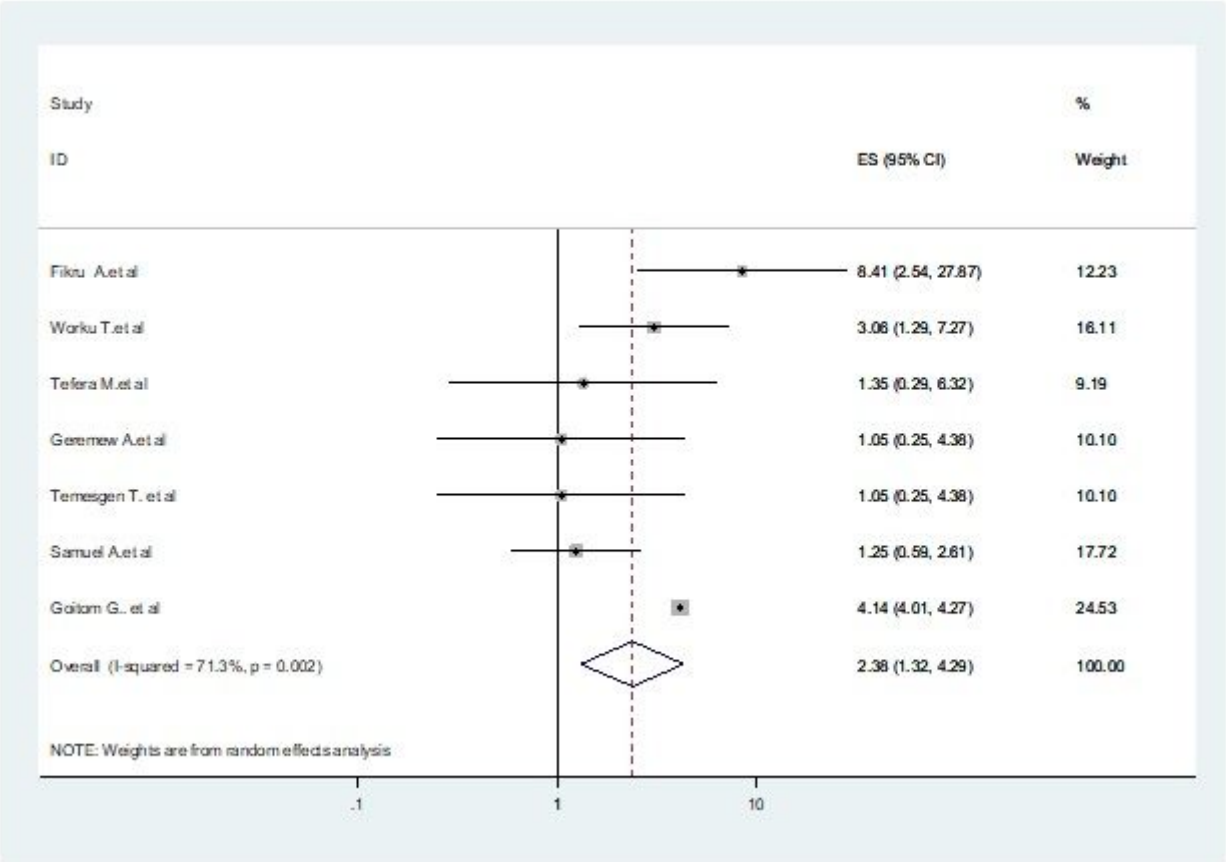

Figure 7

The pooled effects of grand multiparity on uterine rupture in Ethiopia.

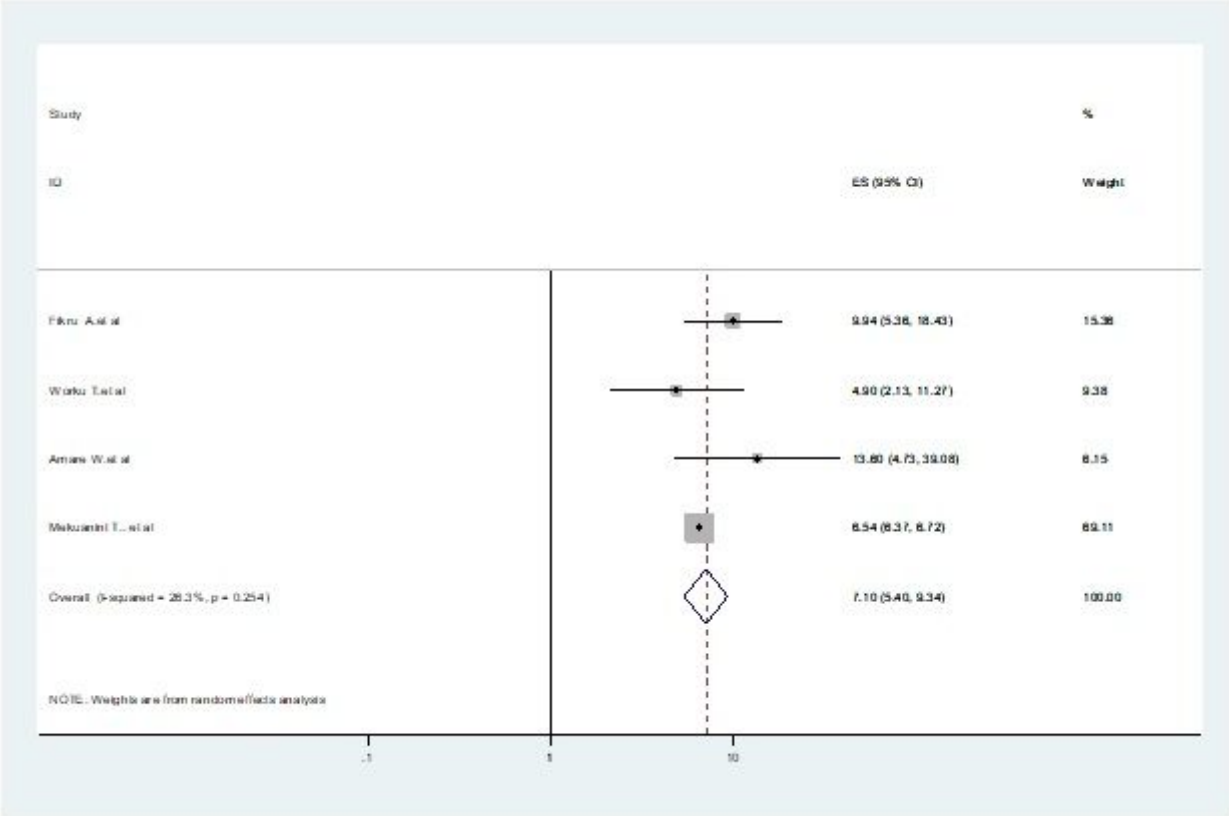

Figure 8

The pooled effects of previous cesarean section scar on uterine rupture in Ethiopia.

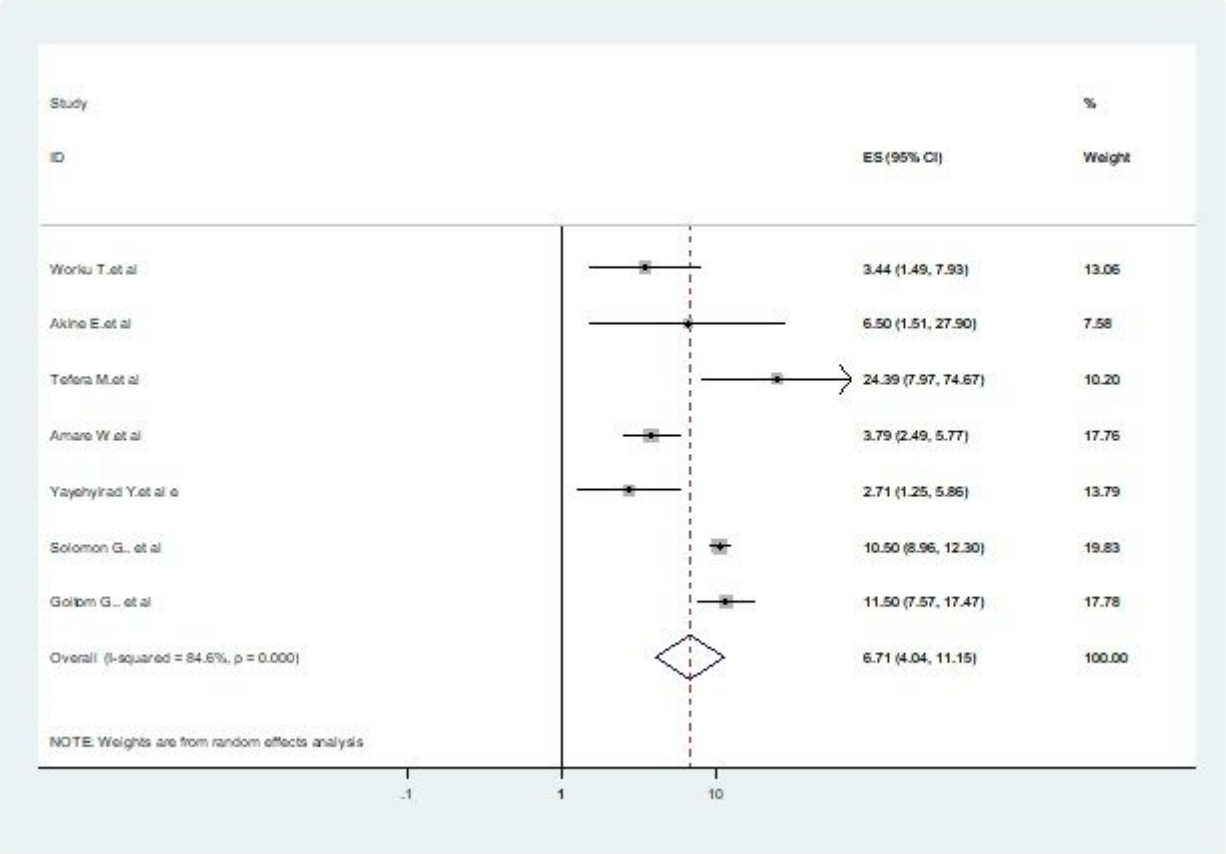

Figure 9

The pooled effects of Prolonged labour on uterine rupture in Ethiopia.

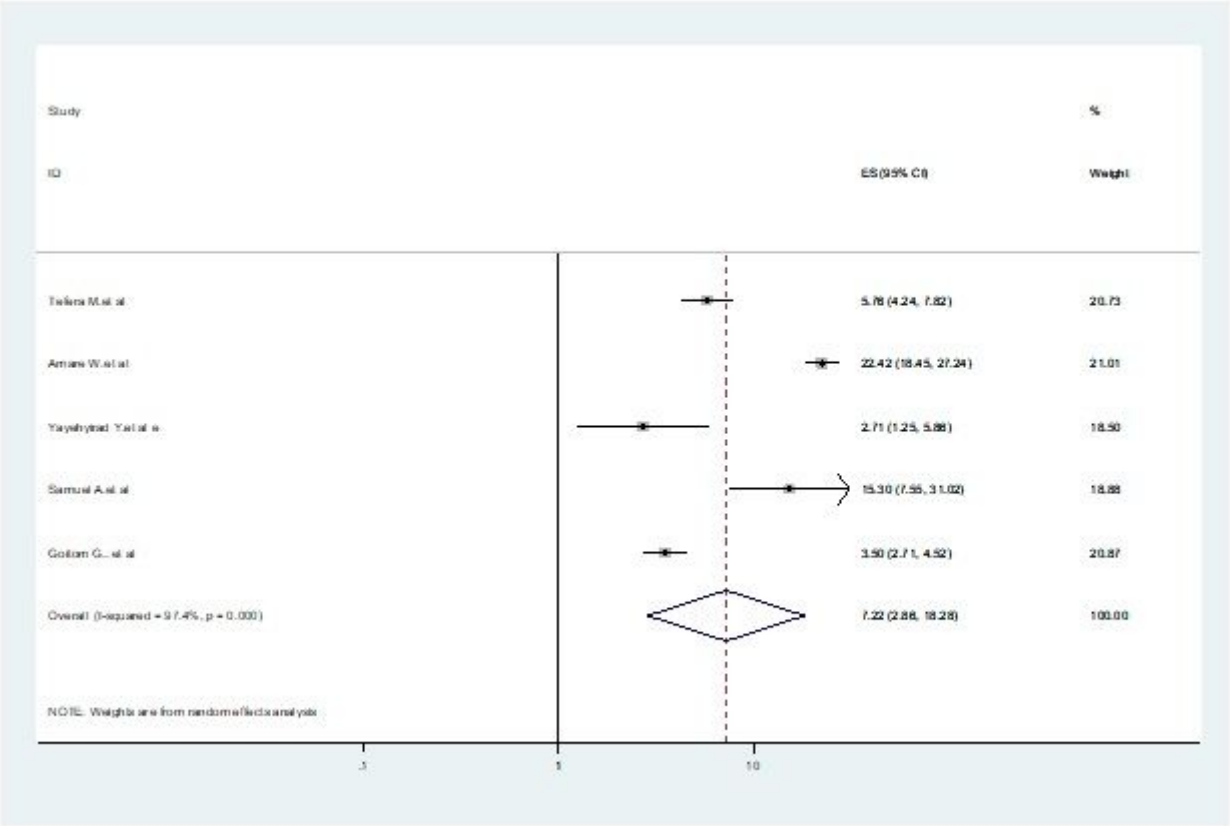

Figure 10

The pooled effects of obstructed labour on uterine rupture in Ethiopia.

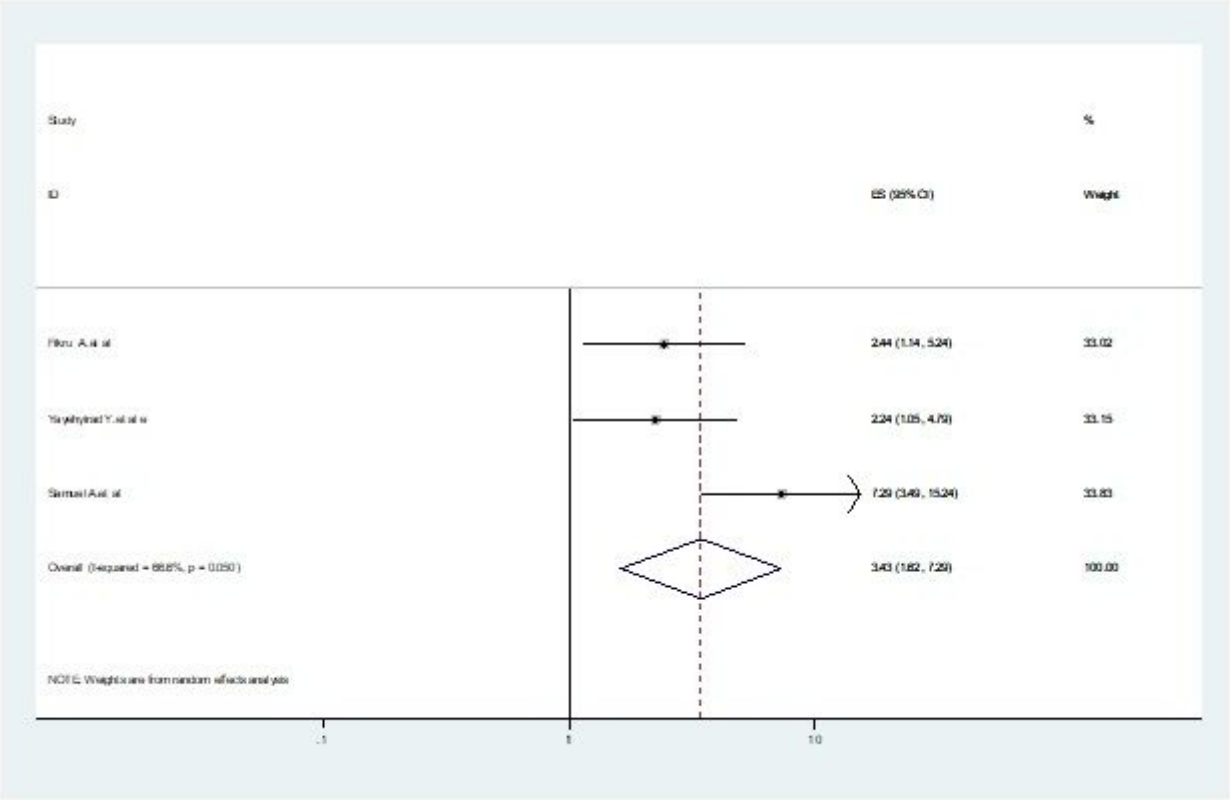

Figure 11

The pooled effects of no parthograh utilization for labour monitoring on uterine rupture in Ethiopia.

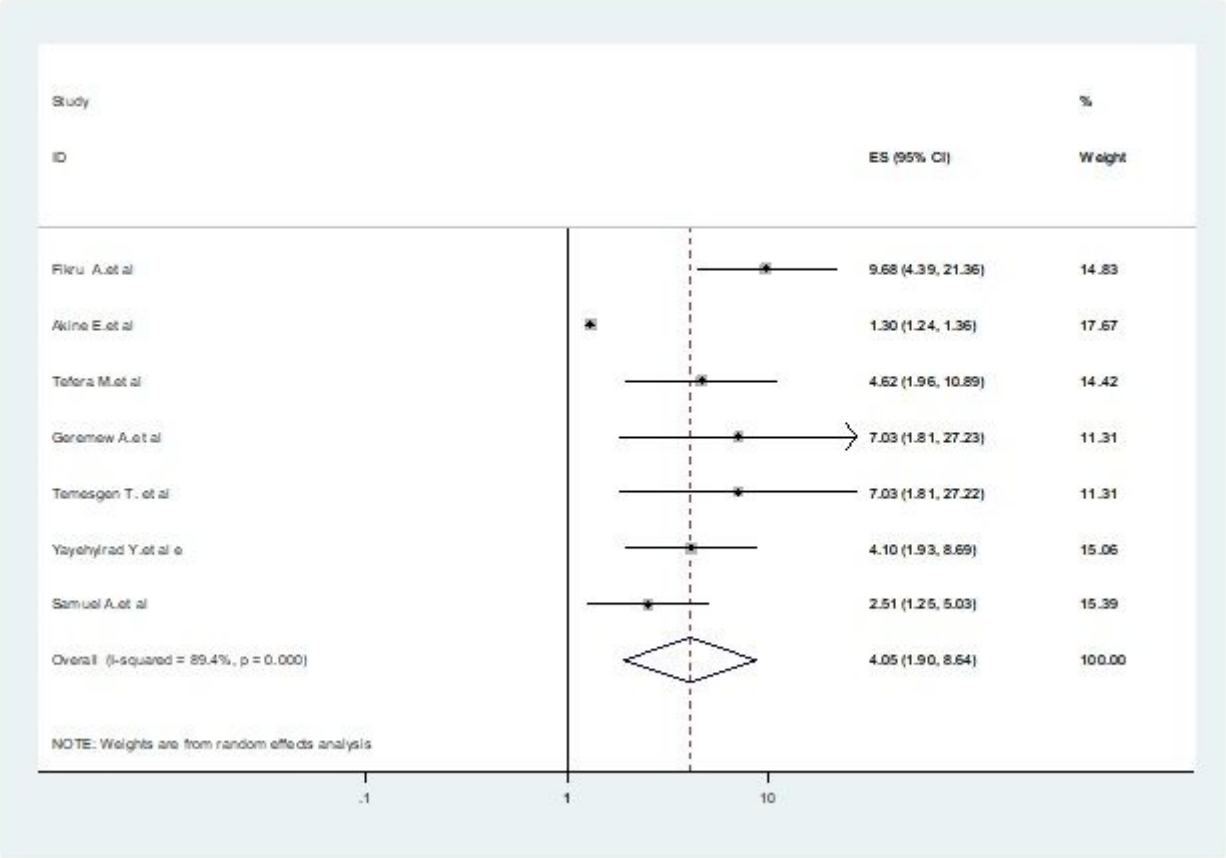

Figure 12

The pooled effects of no having ANC on uterine rupture in Ethiopia.