

Prevalence and associated factors of cervical cancer among women in Ethiopia: A systematic review and meta-analysis

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Abstract

Background: cervical cancer is the second commonest disease of women in Ethiopia. Even though, some studies were conducted to assess the prevalence and associated factors of cervical cancer among women in Ethiopia, a variation in reported prevalence across the studies were observed. The aim of this study was to determine the pooled prevalence estimate and associated factors of cervical cancer among women in Ethiopia. **Methodology:** A systematic review and meta-analysis was performed based on published and gray literatures between 2010 and 2019. Articles were evaluated using Joanna Briggs Institute database guidelines by two independent authors. The pooled prevalence estimate was calculated using MedCalc software-version 19.0.7 and the pooled odd ratios for predictors was calculated using RevMan software version 5.3. A meta-analysis using a mantel Hansen variance random-effects model was performed to assess the amount of variation in between studies. The report was depicted descriptively using pooled estimated prevalence and odd ratios using tables and plots. **Result:** From 124 retrieved data, 10 full text articles were eligible for the review. The pooled prevalence estimates of cervical cancer among women in Ethiopia using random-effect model was 15.7%, 95%CI (10.8, 21.3%). Statistically significant heterogeneity between studies was detected ($I^2 = 94.35\%$ ($p < 0.0001$)). Among all associated factors measured: numbers of life time sexual partners >1 , OR=0.40, 95% CI (0.21,0.27), being HIV positive, OR=0.41,95%CI(0.21,0.75), having history of STI,OR=1.99,95% CI (1.02,3.87), women getting widowed, separated or divorced), OR=0.32, 95% CI(0.14,0.75),income <1000 birr, OR=1.78, 95% CI (1.19,2.65) and women had experience of contraceptive use, OR=2.32, 95% CI (1.75,3.43) were had statistical significant association with cervical cancer among women in Ethiopia **Conclusion:** The pooled prevalence estimate of cervical cancer among women in Ethiopia was high. There was a variation of cervical cancer reports across studies. Reporting of this information in a consistent manner is important for researchers to enhance future studies and also useful for policymakers and practitioners for better understanding of the burden of cervical cancer in Ethiopia for prevention, diagnosis, and early treatment of the disease. **Trial registration:** This systematic review for registration in PROSPERO was retrospectively registered on June 20,2019.

1. Introduction

1.1 Background

Cervical cancer is stated as a major public health problem worldwide. Cervical cancer is a sexually transmitted disease caused by Human papillomavirus (HPV) commonly type 16 and 18 which cause 70% of cervical cancers and pre-cancerous cervical lesions (1).

Cervical pre-cancer goes through many stages and takes many years to develop into cervical cancer. It becomes cancer when the abnormal cells spread below the epithelial layer down into the deeper tissues of the cervix. In 2018 cervical cancer is estimated as the fourth most frequent cancer among leading causes of death for women worldwide. It represented 7.5% of all female cancers. More than 85% of these occur in less developed countries (1).

According to the latest WHO data published in 2017, cervical cancer accounts 0.78% of total deaths in Ethiopia. That is about 1 death due to cervical cancer of every 128 deaths, 14 people die of Cervical Cancer each day and an average of 1 death occurs every 2 hours(2).

Cervical cancer is preventable disease through periodic screening and early detection of lesions before progress to cancer. Precancerous lesions can be treated easily by cryotherapy using freezing gas (liquid nitrogen) to destroy precancerous cells on the cervix.

The most frequent method for cervical cancer screening is cytology, and there are alternative methods such as Human Papilloma Virus (HPV) Deoxyribonucleic Acid (DNA) tests and Visual Inspection with Acetic Acid (VIA). VIA is an alternative to cytology-based screenings in low resource settings. It is the 'see and treat' approach.

Low level of awareness, lack of effective screening programs, and lack of attention to women's health are the possible factors that leads to higher the prevalence rate of cervical cancers (13.4%) in the Ethiopia. As a result, more than 80% of cervical cancer cases are detected at a late stage due to lack of information and weak preparedness to provide services(3).

Vaccines against HPV 16 and 18 are recommended by WHO and have been approved for use in many countries including Ethiopia(1).

The vaccine is widely administered in rich countries. While countries with the highest burden of cervical cancer in Africa and Asia are covering late (4).

Ethiopia launched Human Papilloma Virus (HPV) vaccination pilot project in December 2015 targeting adolescent girls in the 9-13 year age groups in Oromia and Tigray regions(3).

Cervical cancer can be cured if the infection is diagnosed and treated at an early stage (girls between the ages of 9 and 14 years) with the alignment of good life styles(4).

Some epidemiological studies are available to assess cervical cancer distribution and associated factors among women in Ethiopia. But individual studies show a wide variation of cervical cancer distribution over time and across geographical areas in the country. Therefore, the main objective of this systematic review and meta-analysis is to provide a pooled prevalence estimate and to assess associated factors of cervical cancer among women in Ethiopia in 2019 to answering the following research questions:

1. To what extent cervical cancer is distributed among women in Ethiopia?
2. What are the associated factors of cervical cancer among women in Ethiopia?
3. To what extent in-between variance among study reports on cervical cancer among women is observed in Ethiopia?

1.2. Conceptual framework

(Figure 1)

2. Methods

2.1. Study settings

Facility based studies done on cervical cancer among women in Ethiopian from 2010-2019 were used for this systemic review and meta-analysis project work. Ethiopia is one of the east African countries situated in the horn of Africa having a total population of 109,616,652 and 50.2% of female population, 56.2 years (53.6-men, 58.8-women) of Life expectancy and 49.1 % of Literacy. The land mark of Ethiopia covers an area of 1,104,300KM²(36). The country has a federal system of governance with nine regional states and two chartered cities (32).

2.2. Population, Intervention, comparator and Outcomes (PICOs)

(Table 1)

2.3. Searching strategy

The presence of systemic review and meta-analysis on prevalence and associated factors of cervical cancer among women in Ethiopia was checked by searching different databases like: PubMed, Google scholar, Joanna Briggs Institute database (JBI), the national health center review and dissemination databases, and Prospero. There was no systematic review conducted on our topic of interest. Thus, to proceed this project work, the actual search was conducted from August 1 to 30, 2019 by using different electronic databases like PubMed, Congress library, Medline(TR), Web science core collection for the published work and Google scholar for gray literature using Mesh terms “Prevalence OR Frequency OR Occurrence AND Risk Factors AND Cancer of Cervix OR Cancer of the Cervix OR Cervical OR Cancer of the Uterine Cervix OR Uterine Cervical Cancer OR Cervical Intraepithelial Neoplasia OR Cervical Cancer OR Cervix Cancer OR Cervical Neoplasms OR Uterine Cervical Neoplasms OR Cervix Neoplasms OR Neoplasms OR Cervix OR Uterine Cervical Cancer OR Tumor of the Uterine Cervix OR Uterine Cervical Dysplasia AND Girls OR Woman OR Women's Groups AND Human Papilloma Virus AND Ethiopia”.

2.4. Inclusion criteria

The inclusion criteria for this study was

- Published and gray literatures with appropriate observational study designs conducted at health facility level on the prevalence and associated factors of cervical cancer among women in Ethiopia.
- Articles reported with English language, Odds Ratios (OR) and corresponding 95% confidence intervals (CI). (Figure 2)

2.5. Data extraction (selection and coding)

This systemic review and meta-analysis were performed based on published and gray literatures between 2010 and 2019. The retrieved data was screened independently by two reviewer authors (DZ and BE) to verify studies that possibly meet inclusion criteria. Any disagreement was resolved through discussion with a third reviewer (KM.). The third reviewer mediated any issues that remained unresolved. Data were extracted based on standardize data extraction tool adapted from JBI Meta-Analysis of Statistics Assessment and Review Instruments (MASARI)(37). Appropriate critical appraisal checklist of Observational Studies in Epidemiology (MOOSE) for systematic reviews (38)and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for reporting systematic reviews and meta-analyses were used to assess the overall methodological quality of included studies(39). Each study data was extracted following year of publication, women demographics and baseline characteristics, study setting, number of cases enrolled, study population, study designs, prevalence and associated factors of cervical cancer. The two authors were extract the data from included studies independently and checked the retrieved data together. (Table 2& Table 3)

2.6. Risk of bias (quality) assessment

Two review authors (DZ & BE) were assessing the risk of bias independently before the retrieved articles were included using appropriate critical appraisal checklist of Observational Studies in Epidemiology (MOOSE). Moreover, the completeness of outcome data and other sources of bias were effectively assessed by the review authors (DZ& BE) using Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) detailed guidance to make domain-level judgements about risk of bias (40). Any disagreements between two review authors (DZ & BE) were resolved by discussion and involvement of a third review author as mediator (KM). To minimize time-lag bias, the search was updated on August 30, 2019. Moreover, funnel plot was used to assess publication bias. During our study methodological quality assessment and scoring, one disagreement (1/10) was happened between the primary (DZ) and secondary (BE) review authors. But the difference was resolved after discussion and involvement of the third researcher. Moreover, each study level cannot be considered comparable to a well-performed randomized trial. Therefore, there was a moderate risk of bias in this study.

2.7. Strategy for data synthesis

In total, 10 studies were eligible to conduct this study, but not all researchers had used the same classification for each predictor at their study level. When this kind of event happened, a better inclusive classification system or category was selected. But for age categories, midpoint calculation was employed to fit it in the best placement. If all these efforts did not work, studies containing unfitted categories for predictors would not be included in the study. Therefore, 6 full text cross-sectional studies, 1 comparative cross- sectional study and 3 case control studies conducted at health facility level among women in Ethiopia reported from 2010 to 2019 were used. Only 7 studies were used to measure the prevalence of cervical cancer screened by any methods whereas all eligible studies (10 full text articles) were chosen to measure associated factors of cervical cancer among women in Ethiopia.

2.8. Data analysis

For this study, 2×2 tables summarizing was computed for each outcome measure. We also calculated a weighted study effect using a random effects model in case of heterogeneity at $P \leq 0.10$ for χ^2 test during meta-analysis. The pooled prevalence estimate was calculated using MedCalc software-version 19.0.7 whereas the overall effects estimate of odd ratios for associated factors were calculated using RevMan software version 5.3.(41). The variance of the study was stabilized with Mantel Hensel before pooling the data within a random-effects or fixed effect meta-analysis model (42). In addition to these, Funnel plot was used to assess the presence of publication bias (43). Moreover, heterogeneity was evaluated by using the χ^2 test and I^2 value(44).

3. Result

3.1. The pooled prevalence estimate of cervical cancer among women in Ethiopia

Seven studies conducted at health facility level with a total simple size of 3951 were included to compute the pooled prevalence estimate of cervical cancer among women in Ethiopia. The highest prevalence was observed in a study done in gynecology referral Clinics in 2018 (39.5%) (45) whereas the lowest point estimate was observed at a study conducted in North Ethiopia in 2017(6.7%)(25). A Statistically significant heterogeneity between studies was also detected ($I^2=94.35\%$ ($p<0.0001$)) (Table 4).

This study based meta-analysis forest plot with random effects model discovered that more weight was given for a study conducted in Yirgalem General Hospital in 2017(19) (i.e. the bigger the box, the more participants in the study, the smaller 95% confidence intervals and the higher the precision to predict the pooled estimate).As a result, studies given the higher weights were had the more influence on the pooled effect estimate. Therefore; the combined point estimate of cervical cancer was found to be 15.7%, 95%CI (10.78%, 21.31%) (Figure 3)

In figure 4, publication bias had been indicated by funnel plot symmetry or asymmetry. This visual inspection of the funnel plot confirmed that the plot was somewhat symmetrical. This indicates that there was no possible publication bias up on discovering the prevalence of cervical cancer among women in Ethiopia.

3.2. Factors associated with cervical cancer among women in Ethiopia

(Table 5 & Table 6)

At a meta-analysis level, each study was not given equal weighting in the comparison. Those studies with wider confidence intervals were given a lower weighting than those studies having narrow confidence intervals or those studies with a larger square were showing a higher weighting and vice versa. As a rule of thumb studies with a greater number of participants have a narrower confidence interval and a smaller horizontal line. That means the bigger the study, the smaller the horizontal line and the bigger the square

of the point estimate or the smaller the study, the wider the horizontal line and smaller the square of the point estimate

A study conducted in gynecology clinics of Addis Ababa in 2019 (22) had more effect to pull the overall effect estimate to the left (favours to the bad event /cervical cancer). The 95% CI of this study did not overlap 1 (the no effect). So, there was statistical significance association with cervical cancer at the study level like a study conducted in Addis Ababa (46) and in Jimma (47). Both had the lowest effect on the overall effect estimate (OR=1.34, 95% CI (0.56, 3.12) respectively. More weight (19.2%) was given for studies conducted in Addis Ababa (46) and in the Gurage zone (48). This tells us the weight was given based on the size of the sample they used for their studies.

Therefore, the overall effect estimates of women's age (OR=1.43, 95 %CI (0.65, 3.12) was slightly associated with cervical cancer but it is not statistically supported (Figure 5).

From this sub group meta-analysis, the study done at Yirgalem General Hospital in 2017 had more effect size and weight on the combined effect estimate (19). Its 95% confidence interval did not overlap 1 (the no effect). The 95% confidence intervals of all other the studies overlap 1. But the overall effect estimate 95% CI did not the no effect line That means marital status had statistically significant association with cervical cancer (Figure 6).

Except one study(19), all other studies did not show a statistically significant association with cervical cancer at a study level (22, 46, 49). As a result, the overall effect estimate touches the line of no effect (Figure 7).

The study conducted at Yirgalem General Hospital in 2017 had more effect, high precision and statistically significant (19). But a study conducted in Addis Ababa in 2018 had low precision and statistically significant at a study level (22). Due to the higher weight (35.8%) and more effect was given for a study done at Yirgalem General Hospital, it pulls the overall effect estimate towards to the better event (favours to Negative)(19). Moreover, studies were had higher heterogeneity ($I^2=96%$) at ($p<0001$). The 95%CI of the overall effect estimate did overlap the no effect line. That means there was no statistical significance (Figure 8).

In this analysis more effect was observed at a study conducted in Jimma University Specialized Hospital in 2015(47) where as more weight (52.7%) was given for a study conducted at Yirgalem General Hospital in,2017 due to its larger simple size (19). Higher heterogeneity was also observed ($I^2=92%$) between these studies. However, the combined effect estimate, OR=1.44, 95%CI (0.37, 5.58) did not show statistical significance (Figure 9).

Income was another important variable to predict cervical cancer distribution among women in Ethiopia. The 95% confidence intervals of all the studies did not overlap 1 and the 95% confidence intervals of the overall effect estimate did not overlap 1. This indicates that there was statistical significance at the study level (Figure 10).

As the forest plot indicates that the combined point estimate did not touch the null value. Therefore, there was statistically significant effect difference on cervical cancer between women of modern contraceptive users and non-users (Figure 11).

All studies except a study done at Family Guidance Association of Ethiopia in Jimma in 2015(50), the 95% confidence intervals did not touch the line of no effect(46, 47, 49). As a result, their effect pulled the overall effect estimate towards the left (bad event/cervical cancer episode). Thus, there was a statistically significant effect difference on cervical cancer prevalence between women having >1 life time sexual partners and women had 1 life time sexual partner (OR=0.40, 95%CI (0.21, 0.75) (Figure 12).

Like other variables history of STI predicted the prevalence of cervical cancer among women in Ethiopia. The overall effect estimate, OR=1.99, 95%CI (1.02, 3.87) showed that there was statistical significance effect difference between women having a history of STI and women did not have a history of STI (Figure 13).

This forest plot shows that the highest effect but the least weight (7.4%) was given for a study done in North Ethiopia in 2016 even though it did not show statistical significance(25). The 95% confidence intervals of studies conducted at Debre Markos referral hospital, Addis Ababa and Yirgalem General Hospital did not overlap 1(19, 46, 51). But there was statistical significance effect difference at the meta-analysis level (Figure 14).

All studies(22, 46, 47, 50) except studies done in the Gurage zone(48) and Adama town(49), the 95% CIs cross the no effect line (1). Similarly, the combined effect estimate (the diamond) also overlaps on the no effect line (Figure 15).

This forest plot shows that the 95% confidence intervals of both studies(46, 47) overlap 1 as a result the 95% confidence intervals of the overall effect estimate also overlaps 1 (Figure 16).

4. Discussion

Cervical cancer is a major problem that threaten the developing countries which in fact the second commonest disease of women in Ethiopia (2). As a result, it remains a central issue for most researchers

Our study was the first systemic review aimed to combine the findings of primary studies to generate better estimated evidences on the prevalence and associated factors of cervical cancer among women in Ethiopia. To conduct this study a total of 10 eligible studies were included.

It was performed based on the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (annex 9.5). Two investigators were verifying studies that possibly meet inclusion criteria and assessing the risk of bias for each eligible study independently. Any disagreement was resolved through discussion with a third reviewer author.

Determining of the pooled prevalence estimate, the overall effect estimates for associated factors, assessment of heterogeneity between studies and the presence of publication bias were our central focus for this study

Therefore, the pooled prevalence estimate of cervical cancer among women in Ethiopia was (15.7%). The highest prevalence was observed in a study done in gynecology referral Clinics in 2018 (39.5%) (45) whereas the lowest point estimate was observed at a study conducted in North Ethiopia in 2017(6.7%) (25). This pooled prevalence estimate was comparable with the pooled prevalence estimate conducted in china (15.54%)(10)and Latin America (16.1%)(7). But it was lower than the study conducted in Sudan (24%)(15) and higher than studies conducted in Egypt (10.4%)(13) and Qatari (8.1%)(11). These differences might be due to socio-economic and cultural variations.

A Statistically significant heterogeneity between studies was also detected ($I^2=94.35\%$ ($p<0.0001$)). This might show that studies were inconsistent due to a reason other than chance (Table 4).

There was a variation of evidences reported on the effect of associated factors on cervical cancer like: women's age, education, occupation, residence and age at first sexual intercourse. Some studies revealed that they had a statistically significant association with cervical cancer while others did not show at their study levels (Figure 6,8,9,10,16 & 17). This might be due to difference in sample size, variance, methodology, study populations and reliability of the outcome measures at each study level.

The overall effect estimates of women's age (OR=1.43, 95 %CI (0.65, 3.12) was slightly associated with cervical cancer but it is not statistically supported. This indicate that we did not have enough evidence to say women of ≥ 40 years were 1.34 times to have an effect of getting cervical cancer than women < 40 years of age (Figure 5).

The odd of cervical cancer was 68 % lower among married, widowed and divorced women than single women. It might be that all single women were not protected them from the risk of cervical cancer infection (Figure 6).

There was no overall effect difference association with cervical cancer between non formal educated and literate women (Figure 7) as women residing Urban and rural (Figure 9), women had first sexual intercourse at < 15 years and ≥ 15 years (Figure 15) and women ever had cervical cancer screening and women did not ever have cervical cancer screening (Figure 16).

Being unemployed women did not have clear difference effect on cervical cancer as compared to employed women (Figure 8).

Less episodes of cervical cancer were observed among women who did not have an experience of using modern contraceptives than users (Figure11). But more episode of cervical cancer was observed among women having >1 life time sexual partners than women had 1 life time sexual partner (Figure 12)

The better outcome of cervical cancer was observed among women who did not have a history of STI than women having a history of STI (Figure 13).

Moreover, cervical cancer occurred less frequently among HIV negative women than HIV positive women (OR<1) (Figure 14).

5. Limitation Of The Study

This study was not done without limitations. When we describe some limitations, we hope that no one be considered them as inherently bad rather, they are good for readers, researchers and others to understand where new efforts need to be made or researchers may be inspired by these limitations and consider them as the foundation for their future studies. Therefore, some of the limitations of this study are failure to show sub group analysis due to small number of studies were included. Even if our study has strong design and estimable statistics, it may not be able to collect the most important missing data at a study level that might produce limitations in terms of interpreting the findings.

6. Conclusion:

The pooled prevalence estimate of cervical cancer among women in Ethiopia was high. The pooled prevalence estimate was had a statistical significance association with some variables like income, being HIV positive, previous STI history, more than one numbers of life time sexual partners and prolonged uses of modern contraceptives. There was also a variation of cervical cancer reports across studies. Reporting of this information in a consistent manner is important for researchers to enhance future studies and also useful for policymakers and practitioners for better understanding of the burden of cervical cancer in Ethiopia for prevention, diagnosis, and treatment of the disease.

7. List Of Abbreviations

AJOL——African Journal Online

BMC——BioMed Central

DNA——Deoxyribonucleic Acid

HIV——Human Immunodeficiency Virus

HPV——Human Papilloma Virus

JBI——Joanna Briggs Institute database

MASARI——Meta-Analysis of Statistics Assessment and Review Instruments

MEDLINE——Medical Literature Analysis and Retrieval System Online

MOOSE—Methods of Observational Studies in Epidemiology

Popline—Population Information Online

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

PubMed—Public Medicine

RevMan—Review Manager

ROBINS-I—Risk Of Bias In Non-randomized Studies of Interventions

SNNPR—Southern Nations Nationalities and People Region

SSA—Sub-Saharan Africa

STI—Sexual Transmitted Infection

VIA—Visual Inspection with Acetic acid

WHO—World Health Organization

WWW—World Wide Web

Declarations

Ethics approval and consent to participate

Ethical clearance and permission were obtained from Bahir Dar University through a formal Letter.

Consent for publication

Not applicable

Availability of data and materials

This research data is available at the hand of the corresponding Author.

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Competing interests

We declare that we have no competing interests.

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Authors' contributions

The corresponding author (DZ) was involved in the conception, design, drafted the manuscript and data analysis of the study. All authors (DZ, BE&KM) were involved in analysis and interpretation of data. All authors (DZ, BE&KM) have been involved in critically revising the article for important intellectual content and have given final approval to the version to be published. All authors (DZ, BE&KM) have read and approved the manuscript

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Tables

3.2. Population, Intervention, comparator and Outcomes (PICOs)

Table 1: The Population, Intervention, Comparator and Outcomes (PICOs) for associated factors of cervical cancer among women in Ethiopia from 2010 -2019

Intervention	comparator	Outcomes	Population
Education	Primarily and above education	Cervical cancer positive	Women in Ethiopia
Married, Divorced & Widowed	Single	Cervical cancer positive	Women in Ethiopia
Women having multiple sexual partners	Women did not have multiple sexual partners	Cervical cancer positive	Women in Ethiopia
first intercourse <15 years	first intercourse ≥15 years	Cervical cancer positive	Women in Ethiopia
Women having previous history of STI infection	Women did not have previous history of STI infection	Cervical cancer positive	Women in Ethiopia

Table 2: Summary of eligible articles included to review the prevalence and associated factors of cervical cancer among women in Ethiopia.

No	ID	Author name and publication	Title of the study	Study design	Overall quality
1	10	Mesele B. etal, 2015	Risk Factors Associated with Invasive Cervical Carcinoma among Women Attending Jimma University Specialized Hospital, Southwest Ethiopia	Case control	8/10
2	16	Deksissa etal, 2015	Prevalence and factors associated with VIA positive result among clients screened at Family Guidance Association of Ethiopia, south west area office, Jimma model clinic, Jimma, Ethiopia, 2012	Cross-sectional	7/9

			Office, Jimma Model Clinic, Jimma, Ethiopia 2015		
3	35	Getinet M. etal, 2015	Prevalence and predictors of Pap smear cervical epithelial cell abnormality among HIV-positive and negative women attending gynecological examination in cervical cancer screening center at Debre Markos referral hospital, East Gojjam, Northwest Ethiopia	Comparative Cross-sectional	6/8
4	47	Kassa R. 2018	Risk factors associated with precancerous cervical lesion among women screened at Marie Stops Ethiopia, Adama town, Ethiopia 2017	Case control	8/10
5	50	Leyh-B. etal, 2014	Cervical human papillomavirus prevalence and genotype distribution among hybrid capture 2 positive women 15 to 64 years of age in the Gurage zone, rural Ethiopia	Cross-sectional	7/8
6	61	Gebreheat G. etal, 2018	Factors associated with cervical precancerous lesions among women screened for cervical cancer in Addis Ababa, Ethiopia	Case control	8/10
7	64	Wolday D. etal, 2018	HPV genotype distribution among women with normal and abnormal cervical cytology presenting in a tertiary gynecology referral Clinic in Ethiopia	Cross-sectional	6/8
8	69	HailemariamT.etal,2017	Prevalence of Cervical Cancer and Associated Risk Factors among Women Attending Cervical Cancer Screening and Diagnosis Center at Yirgalem General Hospital, Southern Ethiopia	Cross-sectional	7/9
9	76	Misgina etal,2016	Prevalence of precancerous cervical lesion and associated factors among women in North Ethiopia	Cross-sectional	7/9
10	85	Ali etal, 2019	Burden and genotype distribution of high-risk Human Papillomavirus infection and cervical cytology abnormalities at selected obstetrics and gynaecology clinics of Addis Ababa, Ethiopia	Cross-sectional	7/9

Table 3: Summary of eligible articles included to review the prevalence and associated factors of cervical cancer among women in in Ethiopia.

No	ID	Author name and publication	Total sample size	Prevalence	Statistically significant associated factors
1	10	Mesele B. etal, 2015	180 (60:120)	NA	Women: <ul style="list-style-type: none"> • 40-59 years, AOR= 4.7 & 95%CI (2.3, 9.6) • Had >1 husband, AOR= 2.0; 95%CI (1.0, 3.9) and

					<ul style="list-style-type: none"> • Had > 4 children, AOR =10.3, 95% CI (3.6, 29.0)
2	16	Deksissa etal, 2015	334	43 (12.9%)	<ul style="list-style-type: none"> • Sexual intercourse < 16 years, OR=2.2,95% CI (1.1, 4.3)
3	35	Getinet M. etal, 2015	194	55 (14.0%)	<ul style="list-style-type: none"> • HIV+ women, AOR =1.9, 95 % CI (1.1, 3.4) • Multiple sexual partnership, AOR =3.2, 95 % CI (1.1, 10.0) • First sexual contact <15 years, AOR =5.2, 95 % CI (1.5, 17.9) and • Long term oral contraceptive pills use, AOR =11.9, 95% CI (2.1, 16.7)
4	47	Kassa R. 2018	164 (55:109)	NA	<ul style="list-style-type: none"> • Use of oral contraception OR=2.342, 95CI (1.1, 4.9) • History of STI, A OR= 2.485, 95CI (1.19 5.2) and • Age at1st sexual intercourse <15 years, AOR=6.70, 95CI % (1.73, 10.12)
5	50	Leyh-B. etal, 2014	537	86 (16.1%)	<ul style="list-style-type: none"> • Widowed AOR =1.85, 95%CI (1.0, 3.4) and • Had >1 lifetime sexual partners AOR =1.83, 95%CI (1.0, 3.2)
6	61	Gebreheat G. etal, 2018	343 (114:229)	NA	<ul style="list-style-type: none"> • 40-49 years, AOR=2.55, 95% CI (1.5, 4.2) • having history STI AOR=3.20, 95% CI (1.2, 8.1) and • had >=2 lifetime sexual partners, AOR=2.17, 95% CI (1.0, 4.7)
7	64	Wolday D. etal, 2018	233	92 (39.5%)	<ul style="list-style-type: none"> • Of rural reside, AOR=6.89, 95% (1.9, 4.8) and • had history of STI, AOR=2.72, 95% (1.4, 5.2)
8	69	HailemariamT.etal,2017	1945	32 (16.5%)	<ul style="list-style-type: none"> • With HIV, AOR=9.03, 95%CI (4.5, 18.0), • had history of STI, AOR=8.36:95% CI (5.6, 12.4) and • age at first sexual intercourse, AOR=9.07 95%CI (5.6, 14.4)

					AOR=6.97, 95%CI (3.0, 14.4)
9	76	Misgina etal,2016	342	23 (6.7%)	
10	85	Ali etal, 2019	360	50 (13.7%)	<ul style="list-style-type: none"> • Unemployed AOR=9.17, 95%CI (1.6, 52.2) • Positive AOR=5.73, 95%CI (1.1,30.9) and • Resided out of Addis Ababa AOR=8.12, 95%CI (1.1, 57.9)

Table 4: Eligible studies included to estimation the pooled prevalence of cervical cancer among women in Ethiopia

Study	Sample size	Proportion (%)	95% CI	Weight (%)	
				Fixed	Random
1. Ali etal 2019	366	13.661	10.31 -17.61	9.27	14.34
1. Deksissa etal 2015	334	12.874	9.48 -16.95	8.46	14.24
1. Getinet M etal 2015	194	10.309	6.41 - 15.47	4.93	13.49
1. HailemariamT.etal 2017	1945	16.504	14.88 -18.23	49.17	15.21
1. Leyh B. etal 2014	537	16.015	13.01 -19.39	13.59	14.67
1. Misganaetal 2016	342	6.725	4.31 - 9.92	8.67	14.27
1. Wolday D. etal 2018	233	39.485	33.16 -46.08	5.91	13.78
Total (fixed effects)	3951	15.723	14.60 -16.89	100.00	100.00
Total (random effects)	3951	15.686	10.78 -21.31	100.00	100.00

Test for heterogeneity

Q	106.1961
DF	6
Significance level	P < 0.0001

1. HailemariamT.etal, 2017	44	399	45	89
Occupation:(n=3) Unemployed vs Employed				
1. Ali etal, 2019	4	14	34	356
1. Gebreheat G. etal, 2018	83	228	31	115
1. HailemariamT.etal, 2017	65	839	256	1106
Residence:(n=2) Urban vs Rural				
1. HailemariamT.etal, 2017	256	1210	65	735
1. Melese B. etal, 2015	15	54	45	126
Income:(n=2) <1000 Birr vs ≥ 1000 Birr				
1. Gebreheat G. etal, 2018	34	80	80	263
1. Melese B. etal, 2015	37	90	23	86
Previous history of STI: (n=6) Yes vs No				
1. Deksissa etal, 2015	8	50	35	280
1. Gebreheat G. etal, 2018	39	62	75	281
1. Kassa R. 2018	21	45	33	118
1. Leyh B. etal, 2014	11	26	73	511
1. Melese B. etal, 2015	5	27	55	153
1. Misgina etal,2016	8	82	15	260
Ever had cervical cancer screening:(n=2) Yes vs No				
1. Gebreheat G. etal, 2018	87	276	28	68
1. Melese B. etal, 2015	58	171	2	9

Table 6: Socio-Demographic and other variables associated with cervical cancer among women in Ethiopia (continued)

Articles	Experiment		Control	
	Positive	Total	Positive	Total

Ever use modern Contraceptives:(n=3)	Yes		vs		No	
1. Deksissa etal, 2015	18	111	25	219		
1. HailemariamT.etal, 2017	274	1487	108	1477		
1. Kassa R. 2018	41	102	14	59		
HIV status: (n=6)	Positive		vs		Negative	
1. Deksissa etal, 2015	21	134	20	168		
1. Gebreheat G. etal, 2018	46	99	67	240		
1. Getinet M. etal, 2015	35	181	20	194		
1. HailemariamT. Etal, 2017	39	65	282	1844		
1. Kassa R. 2018	9	18	33	67		
1. Misgina etal,2016	1	16	22	326		
Age at 1st sexual intercourse: (n=6)	<15 year		vs		≥ 15 years	
1. Ali etal, 2019	2	39	38	327		
1. Deksissa etal, 2015	22	144	17	175		
1. Gebreheat G. etal, 2018	26	70	88	286		
1. Kassa R. 2018	25	45	30	119		
1. Leyh B. etal, 2014	55	414	31	123		
1. Melese B. etal, 2015	6	34	54	146		
No of Life time sexual partners: (n=4)	> 1		vs		1	
1. Deksissa etal, 2015	32	241	11	89		
1. Gebreheat G. etal, 2018	43	202	71	141		

1. Gebreneat G. etal, 2018				
1. Kassa R. 2018	15	81	40	83
1. Melese B. etal, 2015	36	128	24	49

Figures

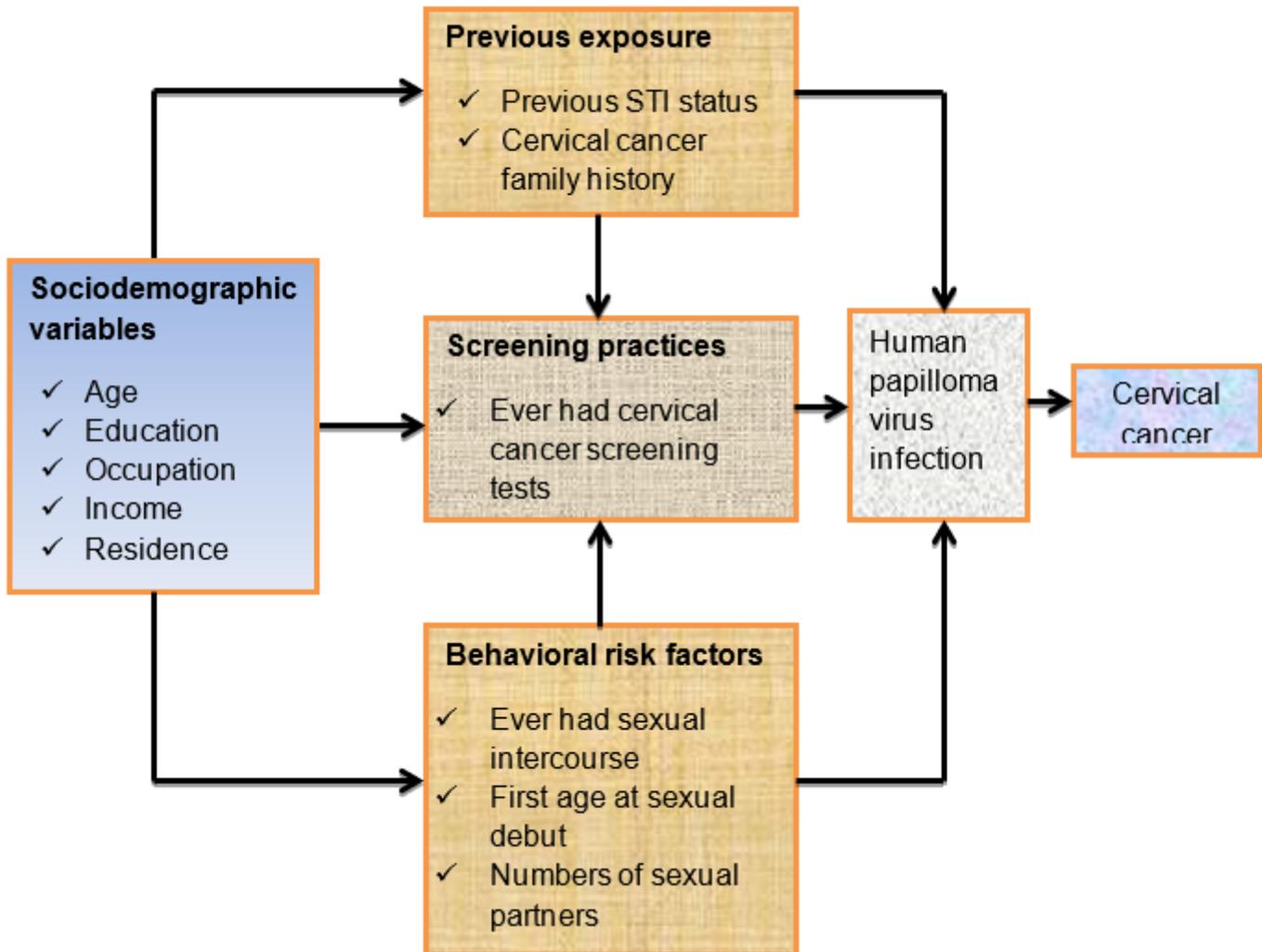


Figure 1

Conceptual framework showing determinants of cervical cancer among women in Ethiopia.

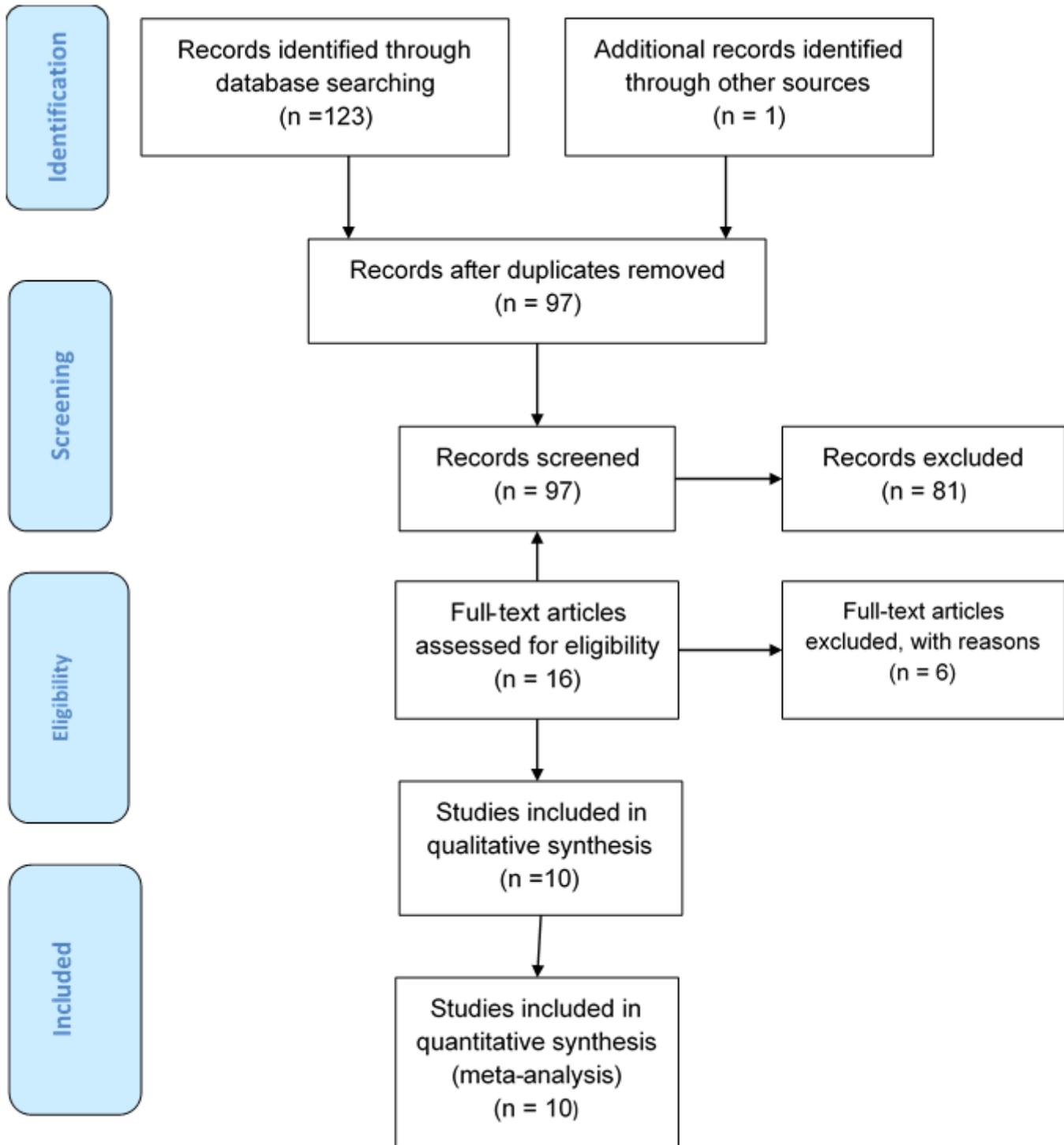


Figure 2

Flow diagram showing included and excluded articles to review the prevalence and associated factors of cervical cancer among women in Ethiopia.

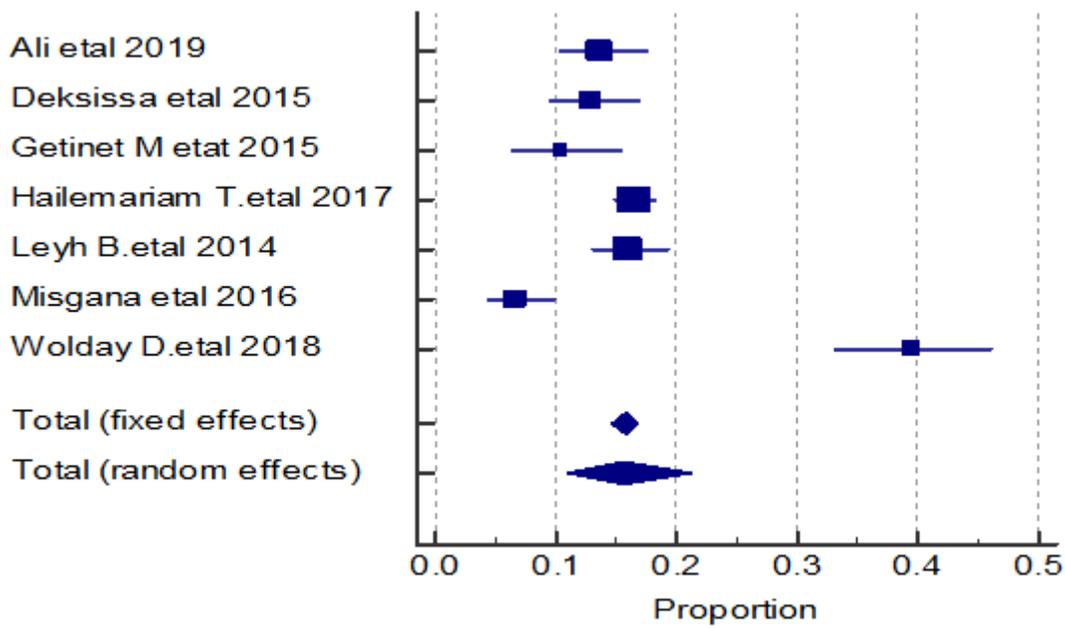


Figure 3

A forest plot showing the pooled prevalence of cervical cancer among women in Ethiopia.

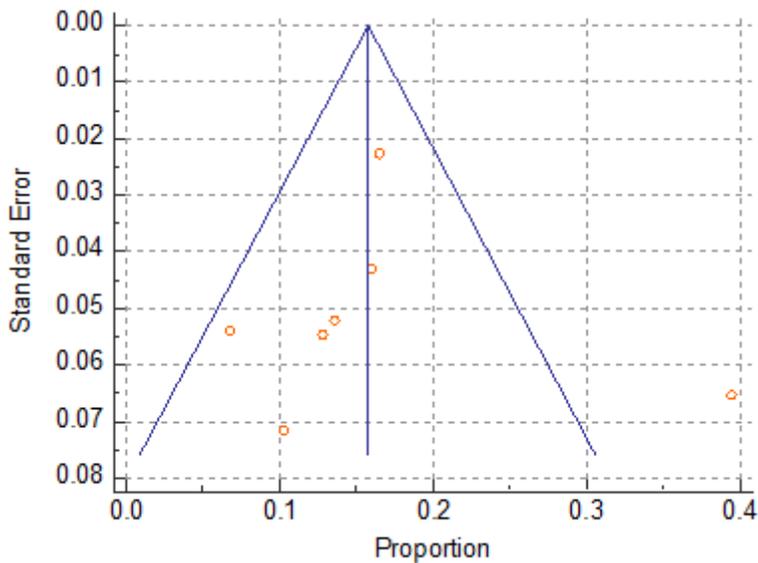


Figure 4

Funnel plot showing publication bias among studies conducted on prevalence of cervical cancer in Ethiopia

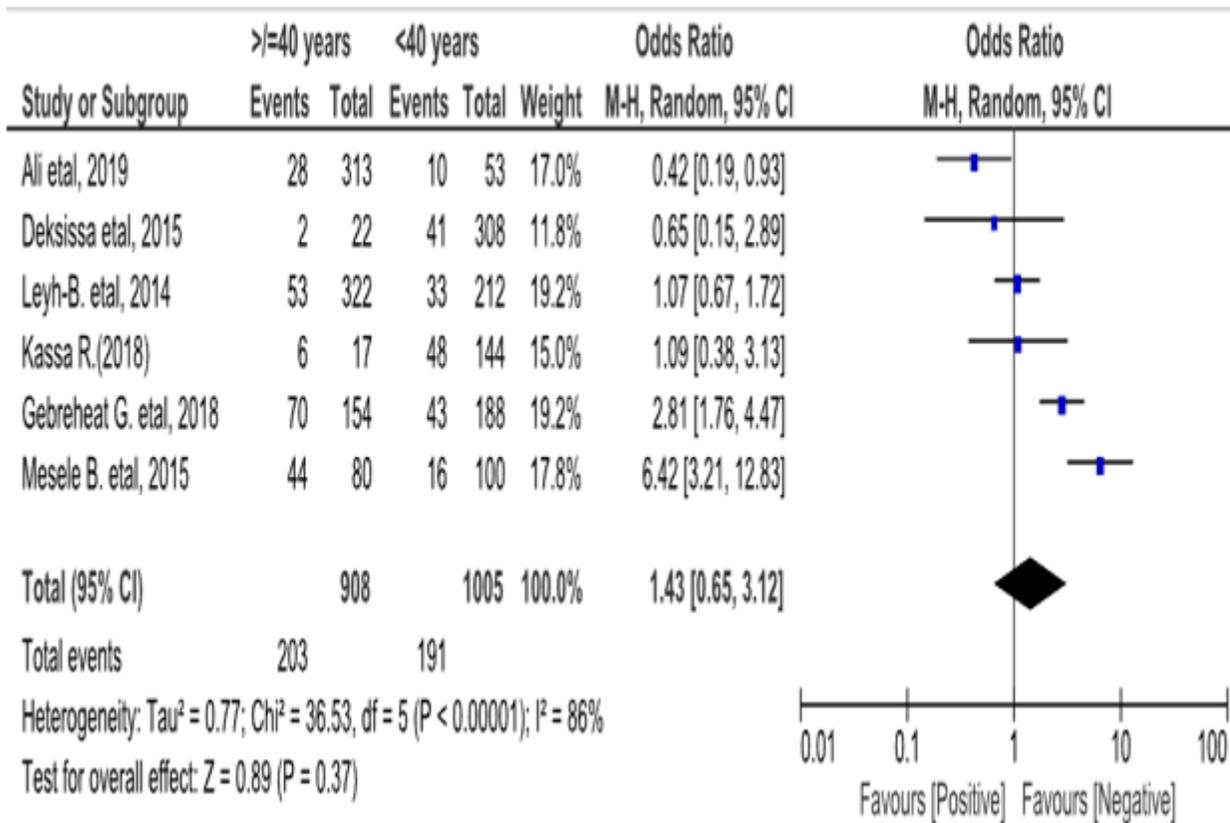


Figure 5

Forest plot showing the association between age and cervical cancer among women in Ethiopia (n=6)

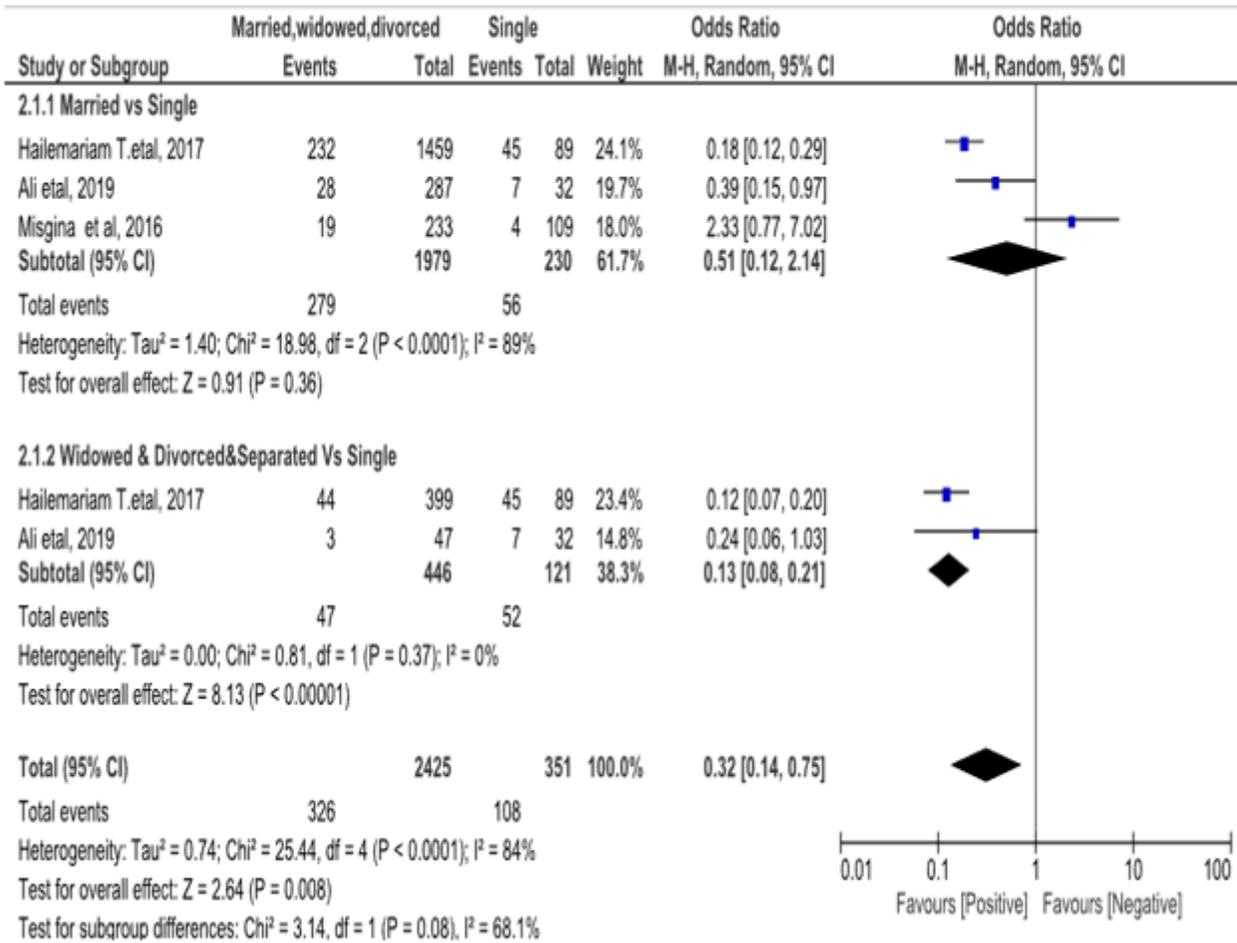


Figure 6

Forest plot showing the association between marital status and cervical cancer among women in Ethiopia

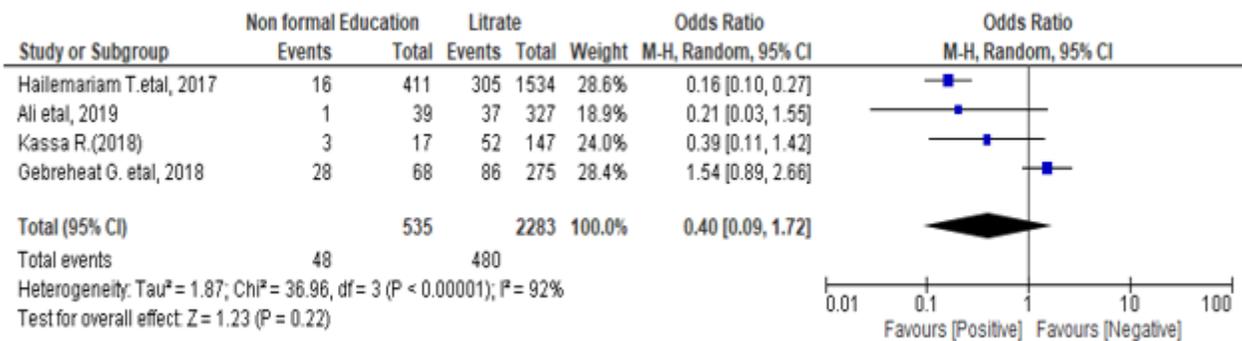


Figure 7

Forest plot showing the association between educational background and cervical cancer among women in Ethiopia (n=4)

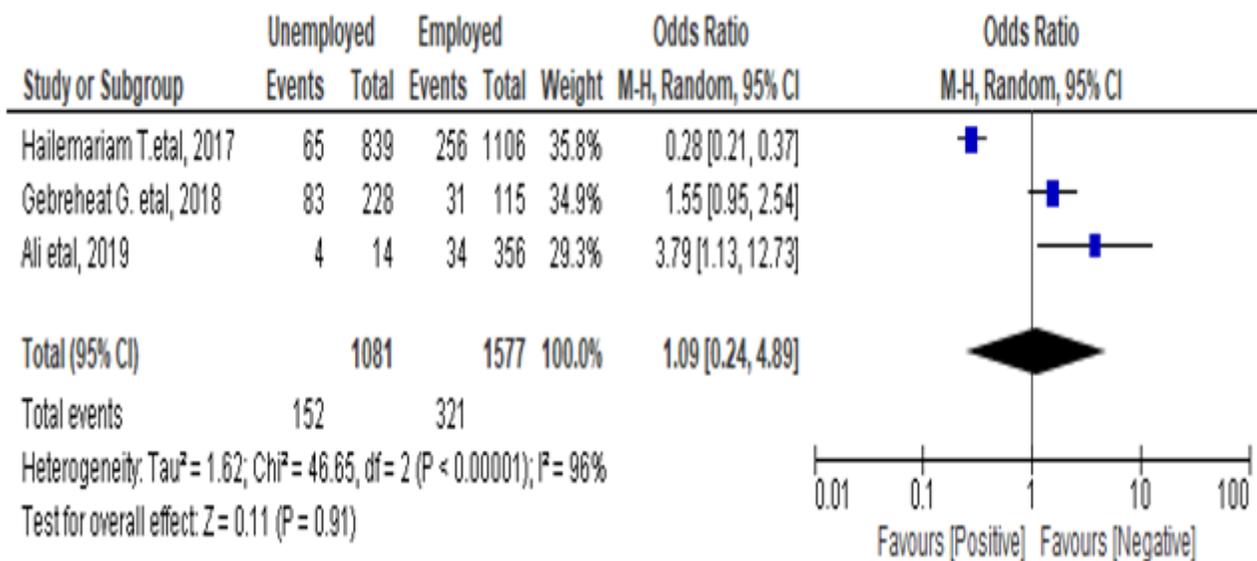


Figure 8

Forest plot showing the association between occupation and cervical cancer among women in Ethiopia (n=3)

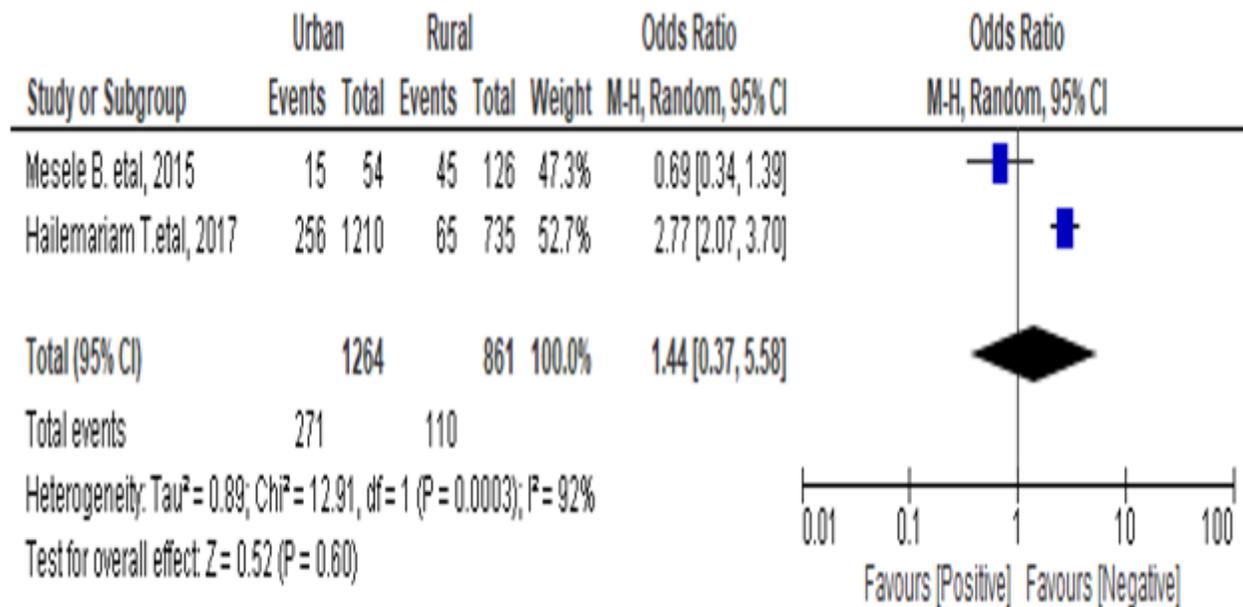


Figure 9

Forest plot showing the association between residence and cervical cancer among women in Ethiopia (n=2)

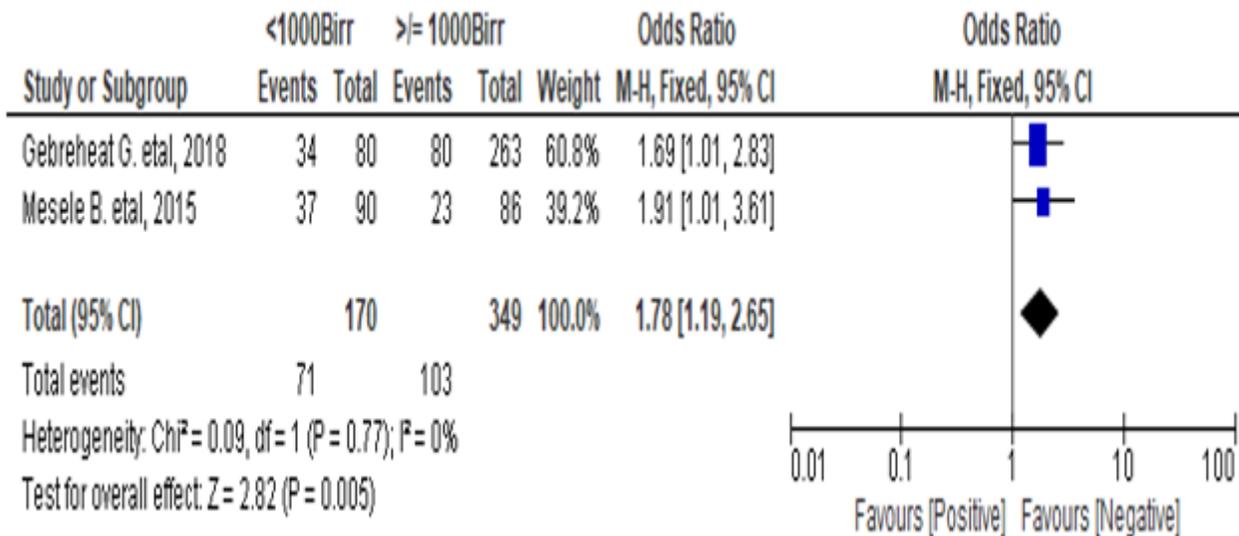


Figure 10

Forest plot showing the association between income and cervical cancer among women in Ethiopia (n=2)

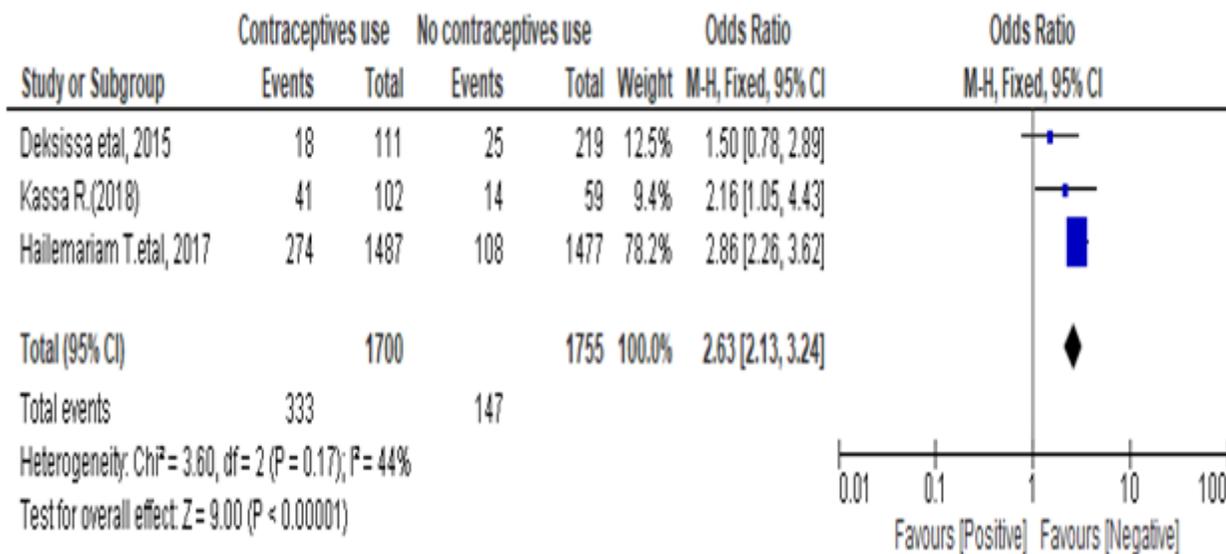


Figure 11

Forest plot showing the association between contraceptive use and cervical cancer among women in Ethiopia (n=3)

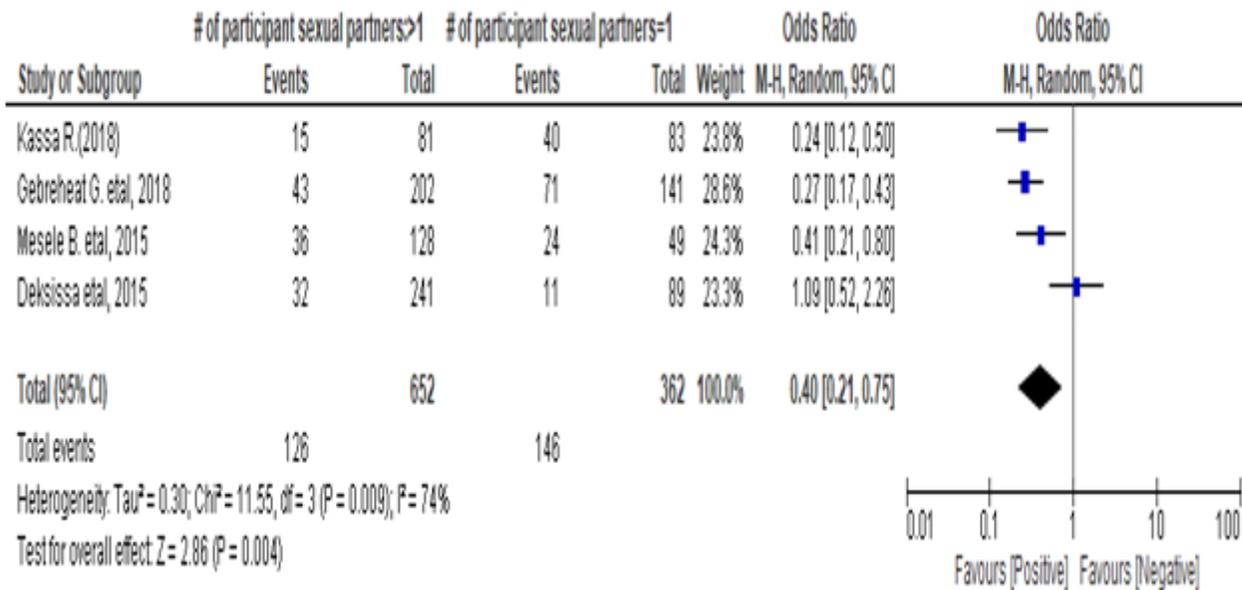


Figure 12

Forest plot showing the association between contraceptive use and cervical cancer among women in Ethiopia (n=3)

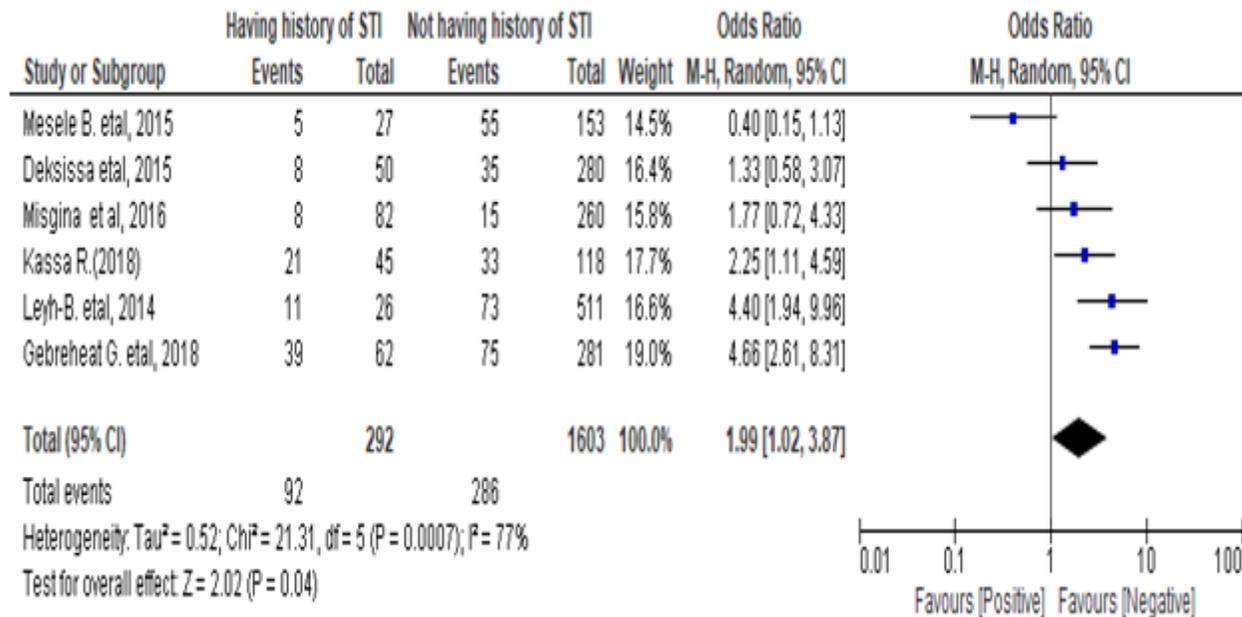


Figure 13

Forest plot showing the association between history of STI and cervical cancer among women in Ethiopia (n=6)

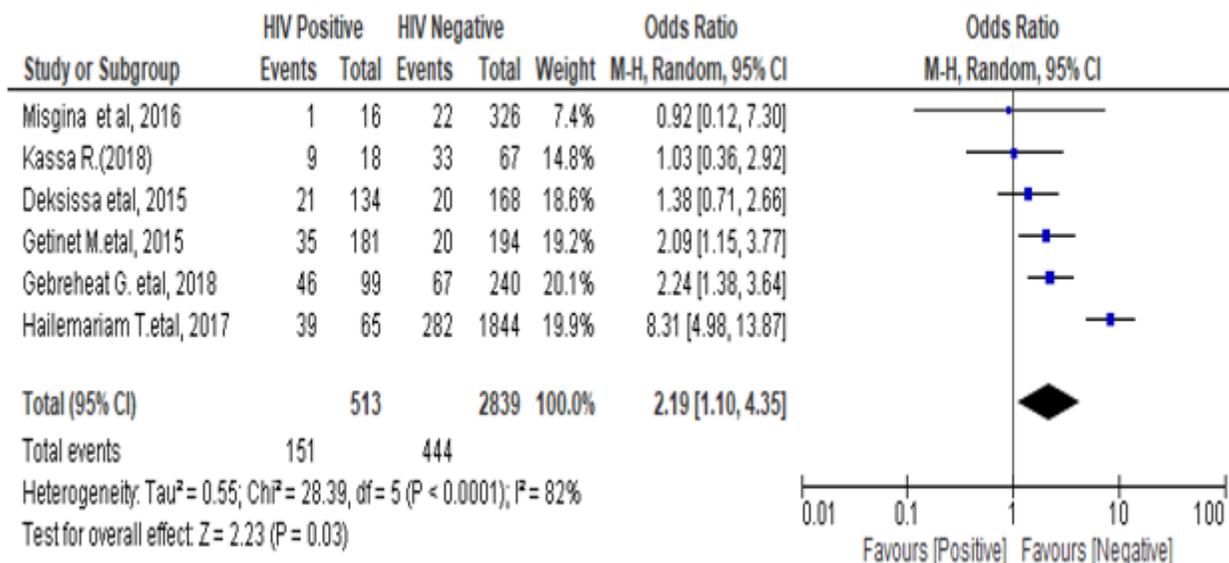


Figure 14

Forest plot showing the association between HIV Status and cervical cancer among women in Ethiopia (n=6)

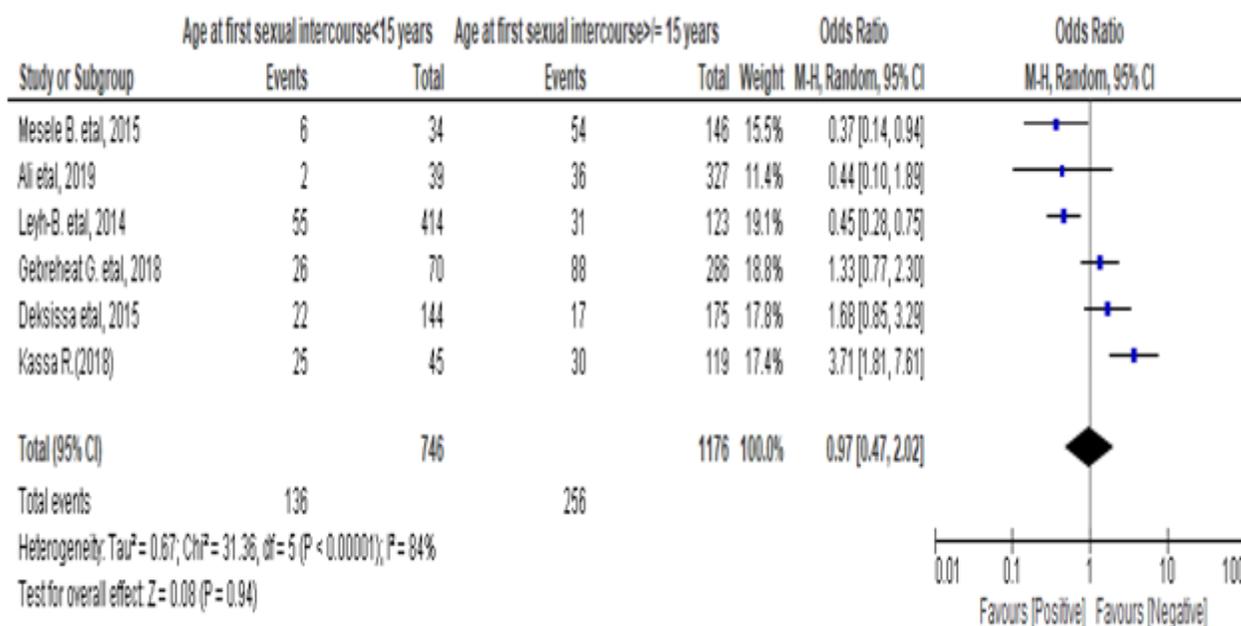


Figure 15

Forest plot showing the association between age at first sexual intercourse and cervical cancer among women in Ethiopia (n=6)

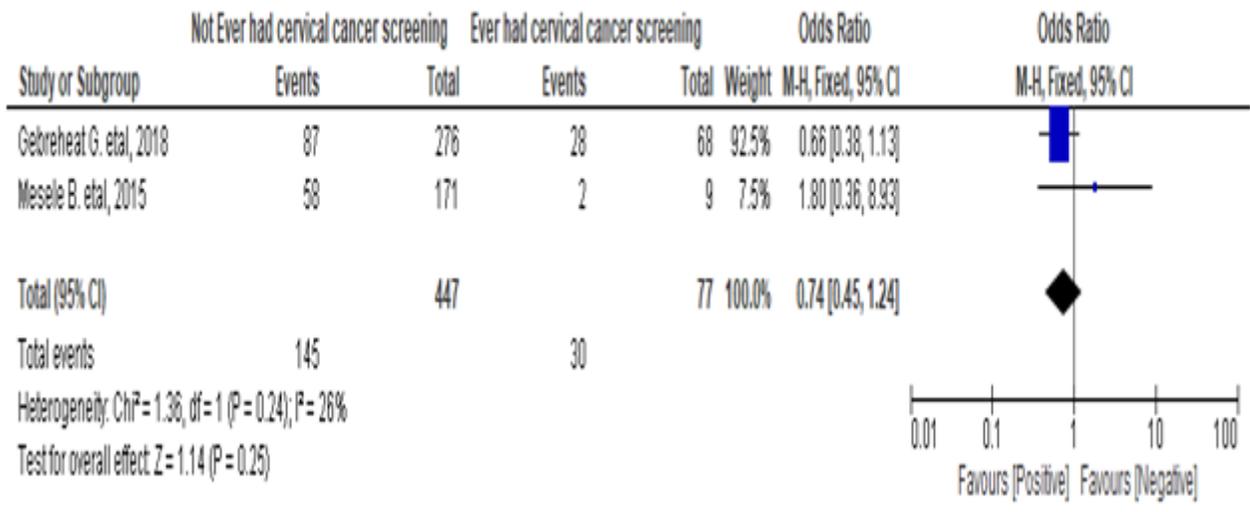


Figure 16

Forest plot showing the association between ever had cervical cancer screening and cervical cancer among women in Ethiopia (n=2)