Austin Journal of Public Health and Epidemiology

Open Access

Austin Publishing Group

Research Article

Knowledge, Attitude, and Practices of Population towards Brucellosis in Ethiopia: A Systemic Review and Meta-Analysis

Kasse GE[1]*, Alemayehu YD[2], Aynew DW[3] and Yimam TM[4]

College of Veterinary Medicine and Animal Sciences, University of Gondar, Ethiopia

***Corresponding author:** **Gashaw Enbiyale Kasse**

College of Veterinary Medicine and Animal Sciences, University of Gondar, Ethiopia

Received: December 12, 2022; **Accepted:** February 06, 2023**; Published:** February 13, 2023

Abstract

Background: Brucellosis is one of the zoonotic pathogen in the world which is a challenging issues for health and responsible for enormous economic losses in many developing countries such as/like Ethiopia. Considering the high prevalence and economic importance of brucellosis, the aim of this study was systematically review published data to explore the distributions of the pooled knowledge, the awareness, attitude and practice of level of the disease in Ethiopia.

Methodology: A comprehensive literature search was conducted through search engine includes Web of Science, Google Scholar, Scopus, Scirus, Science Direct, HINARI databases, PubMed and reference lists of previous studies. Published articles were included based on inclusion and exclusion criteria. Overall knowledge, awareness levels, attitude and practices of study participants regarding the mode of brucellosis transmission, zoonotic nature, and symptoms of brucellosis in animals and humans. Results were presented in funnel plot, the forest plot, figures, and tables with a 95% Confidence Interval (CI). To assess heterogeneity we used inconsistency index (I2) test statistics. And also we used random effect model and R studio (4.2.0) statistical software to compute the analysis of the data. The analysis was conducted and reported in accordance with Meta-analyses guidelines and the Preferred Reporting Items for Systematic Review.

Results: After excluded articles which did not fulfill the inclusion criteria, a total of 28 original articles that reporting the brucellosis awareness levels of communities in Ethiopia were included in the analysis. 16.98% of the studies population had overall knowledge of brucellosis, and the pooled awareness levels regarding the zoonotic nature and mode of transmission of brucellosis were 22.75% with 95% CL (0.1337; 0.3373). And also 18.5% of study participants had awareness about clinical sign of signs of human and animal brucellosis. From the study participants, 74.3% of them had poor practice regarding transmission of brucellosis includes consumption of raw milk and meat, unsafely contact their animals. Sub-group analyses showed that there were differences in brucellosis awareness levels among regions. In Oromia region 20.4% of respondents had knowledge with 95% CL (0.0999; 0.2524), I2 = 94.8%, p-value < 0.0001 where as in Amhara region 69.8% of respondents had knowledge about brucellosis. Regarding attitudes in Amhara region the studies participants had lowest attitudes (22%) towards brucellosis as compared with others region.

Citation: Kasse GE, Alemayehu YD, Aynew DW, Yimam TM. Knowledge, Attitude, and ractices of Population towards Brucellosis in Ethiopia: A Systemic Review and Meta-Analysis. Austin J Public Health Epidemiol. 2023; 10(2): 1143.

Conclusion: In general, the result of the present study showed that the population had less clear understanding about brucellosis as it affects their animals, cause abortion and its zoonotic importance. This result implies that it is necessary to create awareness of the zoonotic and its economic effect of brucellosis through a various methods, including the public media, veterinary professionals, community health extension, and local leaders.

Keywords: Knowledge; Attitude; Practices; Brucellosis; Meta-analysis; Ethiopia

Introduction

The life of human being is closely associated with livestock products in the different livestock production systems particularly in pastoral communities [1]. Because of this interaction the threat of zoonotic diseases for human is high. Brucellosis is one of the most important neglected zoonotic bacterial disease in the world which is caused by Brucella and more than 500,000 human cases occurring globally per year [1,2]. Some important Brucella strains including B. melitensis and B. abortus can affect both livestock and human [3]. World Health Organization (WHO) [4] and World Organization for Animal Health (OIE) [5] reports indicated that brucellosis is rarely prioritized by health systems and is considered a neglected zoonosis. In both agro-pastoral and pastoral livestock production systems, people live closely with livestock making contact with different animal discharge and consumption of raw animal product lead to have a high incidence of brucellosis and thus, are at higher risk of acquiring the infection [4,5]. Brucellosis is the major reproductive problems causes abortions, and infertility in livesock [3,6].

Human brucellosis is characterized by muscular pain, lumbar pain, weight loss, fatigue, fever, sweating, joint pain, headache, and arthritis [7,8]. Humans become infected through ingestion of raw milk or milk products, handling of infected animals, contact with animal discharges such as vaginal fluids, placenta especially during parturition [9]. Veterinary health workers, farmers, pastoral communities, abattoir workers and laboratory personnel are highly exposed for brucellosis and are considered the highest occupational risk- groups [10-12]. Generally, due to prevalence of the disease in animals and poor hygiene practices of humans that expose to infected animals or their products can significantly increase the risk of the occurrence of the disease in humans. As its clinical manifestation resembles other febrile illnesses such as tularaemia, malaria, typhoid fever and tuberculosis, and lacking resources and laboratory diagnostics, the disease is difficult to accurately diagnose based solely on clinical sign [13-15]. The prevalence of brucellosis in Ethiopia is ranging between 1.3% and 22.8% with depending on husbandry systems and livestock species [2,16]. Dairy cattle owners, consumers, institutions promoting dairy industry, public health professionals, veterinarians and policy makers require baseline information about the health of dairy cattle, the public health implication and the safety of dairy products. Control and eradication of brucellosis cannot be achieved through test-and-slaughter, vaccination and treatment only; the cooperation of relevant occupational groups is an important component in achieving this goal [17]. Knowledge and attitude are promotes people to take protective measures at work and actively participate in disease control programs, thus greatly assisting the development of brucellosis control strategies. So far, in Ethiopia, different studies have been done on the prevalence, knowledge, attitude, and practice about brucellosis among the public. However, the findings of these different studies show that there is a high variability in the level of the knowledge, attitude, and practice across the regions of the country and unclear. The aim of this systemic and meta-analysis was to explore the knowledge, attitude and practice of peoples towards brucellosis in Ethiopia.

Materials and Methods

Data Bases, Literature Search and Selection

Typically, the published papers were reported based on the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guideline [18]. The published papers and abstracts were identified by a computerized literature search of electronic databases include PubMed (www.ncbi.nlm.nih.gov./entrez/), Science Direct (www.sciencedirect.com), Scirus (www.scirus.com/srsapp), ISI Web of Knowledge (http://www.isiwebofknowledge.com), Google Scholar (http://scholar.google.com) and HINARI databases. The search was performed from May to July 2022. The search queries were set based on Medical Subject Headlines (MESH) and Boolean logic. Relevant MeSH terms and keywords were used to retrieve all relevant articles from the databases listed above. The keywords and MeSH terms used were "brucellosis AND knowledge OR awareness AND perception OR KAP) OR attitude AND Ethiopia:" [Publication Date]). ("Knowledge" [Mesh] OR "Knowledge, Attitudes, Practice" [Mesh])OR("Attitude"[Mesh] OR "Attitude" [Mesh] OR" Attitude to brucellosis "[Mesh])) OR "Awareness" [Mesh]) AND ("Ethiopia"[Mesh].To identify additional relevant citations search was conducted on the previous studies of reference lists as well as "cited by" and "related information" tools in PubMed and Google scholars were searched. Only those articles which fulfill the selection criteria and written by English language were used to analyses the information.

Inclusion and Exclusion Criteria

Studies were chosen for this systemic review and meta-analysis based on inclusion criteria includes randomized subjects in all studies, trial procedures, provide complete data, the study design, method of assessing the outcome, and handling of protocol deviations whereas, secondary reports, no original research, comments, editorials and reviews were directly excluded. Research conducted on knowledge, attitude and practices towards brucellosis in Ethiopia and full-length published articles in the English language were included in the analysis. The papers that were conducted to assess only the prevalence of brucellosis in Ethiopia not included. The studies were included cross-sectional observational studies and conducted in Ethiopia only.

Selection of the Identified Publications

All the retrieved studies were imported and duplicates were

removed by using the software of EndNote version 8. The two investigators (GEK and YD) independently selected the research titles and abstracts which were followed by a full-text review to determine the eligibility of each study. If there was any disagreement between the two investigators the gap was solved by consensus with the presence of the third investigator (DW). The screening and selection of studies were promoted by the creation of appropriately labeled sub-groups in EndNote.

Data Extraction

The selected articles were coded and the data were extracted from selected articles using a format prepared in Microsoft Excel. The format consist of the following basic information: author name, study period, publication year, geographic region, study design, study population, sampling method, number of participants (sampling size), sample type, gender distribution and the number of participants for the assessment of brucellosis awareness, knowledge, and acceptance, or the rate percentage proportions for these studied factors. The number of studied cases (n) and sample size (N) were the two necessary parameters for the calculation of the pooled level of awareness, knowledge, and practices of brucellosis in the meta-analysis. In particular, the number of participants who answered positively (n) was obtained directly from these studies or by multiplying the sample sizes (N) with the proportions (%) associated with the investigated items reported in the studies.

Quality Control

The quality of each search study was evaluated by using different criteria based on Joanna Briggs Institute (JBI) [19]. Quality appraisal criteria adapted for studies including appropriateness of the research design to address the target population, quality of paper, completeness of the information, adequate sample size and appropriateness of methods for isolation of the bacteria and appropriate statistical analysis [20]. The eligibility of selected research articles was also assessed and approved by experts in the discipline.

Publication Bias and Heterogeneity

Part of the strategy in conducting a meta-analysis is to identify factors that may be significant determinants of sub-population analysis or covariates that may be appropriate to explore in all studies. Variation among different trials is usually assessed using Cochran's Q statistic, a chi-squared ($\chi 2$) test of heterogeneity with k-1 degrees of freedom. Variability in the participants, interventions, and outcomes studied has been described. Meta-analysis was conducted sufficiently homogeneous studies in terms of subjects involved, interventions, and outcomes. To check publication bias we used funnel plot and asymmetry detected using Egger's linear regression test, and Begg's rank correlation test [21]. Heterogeneity of results among trials was quantified using the inconsistency index I 2, which describes the percentage of total variation across studies [22]. Therefore, the value of I2, 25%, 50%, and 75% represented low, moderate, and high heterogeneity, respectively. Negative values of I 2 are put equal to zero, consequently I 2 lies between 0 and 100%. In the same way, a p-value less than 0.05 were used to declare heterogeneity. A random effect model was used to reduce the heterogeneity of studies [23].

Data Analyses

The data were compiled in Microsoft Excel 2016 spreadsheet and summarized by descriptive statistics. A random-effect model was used to estimate the overall status of knowledge, attitude, and practice with the 95% Confidence Interval (CI). All statistical analysis was done by using R statistical software (Version 4.2.0). The presence of publication bias was assessed by funnel plot; in addition the Begg and Egger's weighted regression method was used to detect evidence of publication bias. Hence, a p-value of < 0.05 was considered as indicating the presence of significant publication bias. All available data were pooled in the present meta-analysis [24]. The sub-groups and categories considered included region, study population, education, and occupation. The data were described using forest plots, figures, and tables. Statistical heterogeneity was evaluated by Cochran's chi-square (Q-test) and the inconsistency index (I2). A funnel plot was constructed to visually examine the publication bias [21].

Results

Characteristics of the Included Studies

The selection process of different studies for this systematic review was presented through a flow diagram shown in (Figure 1). Of 3886 identified studies, 3086 articles were removed due to duplication then after 725 articles were excluded upon reviewing the titles, abstracts and full articles because they were irrelevant (were not focusing on KAP of brucellosis) or were done outside Ethiopia and review, sero-prevalence and meta-analysis articles. 75 studies were screened and from these screened studies 60 studies were assessed for eligibility, of these 60 studies, 32 articles were excluded because they were not meeting the inclusion criteria. Finally, 28 studies meeting the inclusion criteria were included in the qualitative synthesis and quantitative synthesis (meta-analysis) as presented (Table 1).

Table 1: Characteristics of the included studies regarding brucellosis awareness, attitude and practice in the meta-analysis.

Reference	publication year	Stud. period	Region (study area)	Study population	Gender distribution	Age catagories	Occupation	Sample type (data collection methods)	Study design	sampling method	Sample size
[25]	2017	Nov, 2016 and May, 2017	Amhara(north shewa)	smallholder dairy farmer, milk collectors, retailers	all	young, adult	dairy farmers, retailers	full stractutred quetinarie	cross sectional	random	230
[1]	2020	Dec, 2017 to May, 2018	Oromia (adama town)	dairy farmers	all	adult	farmers	semistructured questionnair	cross sectional	random	384
[26]	2018	Dec, 2015 to April, 2016	oromia (bishoftu)	dairy farmers	all	adult	farmers	full stractutred quetinarie	cross sectional	random	400
[27]	2017	March to April, 2017	Amhara(laygayint)	Rural communities	all	adult	farmer, merchant, embloyer	semistructured questionnair	cross sectional	random	579
[28]	2022	Nov, 2020 to April, 2021	Oromia(borana zone)	pastural comunity	all	_	pasturalist	semistructured questionnair	cross sectional	random	45

[29]	2021	Nov, 2018 to Nov, 2019	Oromia(Bale Zone)	small ruminant owners and attendants	All	_	farmers	full stractutred quetinarie	cross sectional	random	80
[30]	2015	Nov, 2013 to May, 2014	Afar (Mille, Dubti and Chifra)	pastural comunity, animal and human health profetionals	all	_	pasturalist, employers	semis and full tructured questionnair	cross sectional	Stratified sampling method	168
[31]	2020	Oct, 2017 to Feb, 2018	Oromia(borena zone)	Animal owers and attendants	all	young, adult	pasturalist	structured quetinarie and interview	cross sectional	multistage and conveniet sampling	341
[32]	2018	Oct to Dec, 2016	Afar(amibara district)	pastoral community	All	adult	pasturalist, agro-pasturalist	structured and open-ended questions, interivew	cross sectional	multistage (simple random and stratified)	475
[33]	2021	Nov, 2017 and June, 2018	Afar(awash,afambo, chifra,mille) and Somali afdem, erer, aysha,mieso, hadegale)	all community (pasturalist, atendant, keeping animals for their livelihood)	all	adult	pasturilist, employer	A semi-structured questionnaire	cross sectional	random (multistage cluster sampling)	647
[34]	2021	_	Centeral highland of ethiopia	farm owners, farm managers	all	adult	farmers, employers	interview	cross sectional	random	284
[35]	2021	Oct, 2016 and Oct, 2017	Oromia(Jimma zone)	livestock owners	all	adult	farmers and others	structured and semi-structured questinarie	cross sectional	random	180
[2]	2011	Oct, 2007 to March, 2008	Southern and Eastern Ethiopia	livestock owners	All	adult	farmers		cross sectional	random	90
[36]	2005	Oct, 2003 to April, 2004.	Oromia (Jimma zone)	abattoir workers, butchers, farmers and animal health workers	ALL	young, adult	abattoir workers, butchers, farmers and animal health workers	structured quetinarie and interview	cross sectional	Multi stage sampling	126
[37]	2008	Sep, 2005 and March, 2006	Oromia (walmara district, lume and adami tulu)	households which keep cattle,	all		not specify	structured questionnaire	cross sectional	rundom (one-stage, cluster sampling method)	176
[38]	2021	Feb, 2017 to Jan, 2019	Afar (Dubti, Asaita, and Chifra.)	pastoral community	all	young, adult	pasturalist	Semistructured questionnaire	cross sectional	randomized and purposive sampling techniques	384
[39]	2019	Nov, 2016 to April, 2017.	Somali (Fafan Zone)	pastural community	all	young, adult	livestock owners and tendants	Questionnaire interview	cross sectional	random	211
[40]	2016	Nov , 2013 to April, 2014	Afar Region(Chifra and Ewa)	livestock owners/ herders	all	adult	farmers	structured questionnaire and interview	cross sectional	random	45
[41]	2013	Oct, 2011 and April, 2012	tigray(Southern Zone)	livestock owner	all	adult	farmer	semi-structured questionnaire	cross sectional	Multistage random sampling	100
[42]	2012	Nov, 2010 and April, 2011	Diredewa region estern ethiopia	small ruminant owners and attendants	all	adult	farmers	questionnaire and interview	cross sectional	random	49
[27]	2017	Feb to Sep, 2010	Harari region	semi-intensive and intensive farms owners	all	adult	farmers	semi-structured questionnaire	cross sectional	random	307
[43]	2018	May to June, 2013	SNNP (Nechisar National Park)	all community who have contact with animals	all	young, adult	livestock owners and tendants	structured questionnaire and interview	cross sectional	random and systematic	50
[44]	2022	_	Oromia (Borena zone)	pastural comunities	all	young, adult	pasturalist	interview and questionarie	cross sectional	random sampling methods.	60
[45]	2016	Nov 2013 to May 2014	Oromia (in and around Asella)	all comunities	all		_	interview and questionarie	cross sectional	random	500
[46]	2018	Oct 2016 and April 2017	Oromia (Yabello districts)	pastural community	all	young, adult	pasturalist	questionarie	cross sectional	random	120
[47]	2013	Nov, 2011 to April, 2012	Oromia (jimma zone)	public	all		farmers	semi-structured questionnaire	cross sectional	simple random sampling method	175

[48]	2013	Oct 2011 and Mar 12	Oromia (Arsi zone)	livestock owners	all	adult	farmers	open and closed end question	cross sectional	stratified cluster sampling	130
[49]	2020	Feb 2019 to Nov 2019	Gambella (Gambella and Itang districts)	livestock owners	all	adult	farmers	interview and questionnaire	cross sectional	random	80

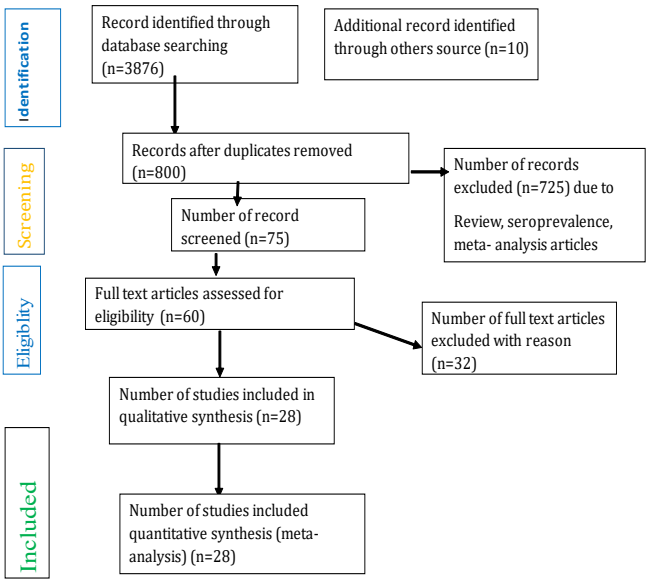

Figure 1: Flow diagram of study selection for systematic review and meta-analysis of KAP towards brucellosis in Ethiopia, 2022.

Among the included Publications, 3 (10.7%) studies from Amhara, 13 (46.4%) studies from Oromia, 5 (17.9%) studies from Afar, 2 (7%) studies from South Nation and Nationalities People (SNNP), 1 (3.6%) studies from Harari region, 1 (3.6%) Tigray, 1 (3.6%) studies from Diredewa administration, 1 (3.6%) studies from Somali region and 1 (3.6%) studies from Gambella region. However, we did not found published articles in Benishangul Gumuz regions of the country) (Figure 1). All selected studies were published in English and all the studies enrolled in this systematic review were cross-sectional studies. The study populations of the studies included pastoral community, animal and human health professionals, farmers, animal owners, abattoir workers, butchers, and farm managers. A questionnaire survey was conducted for all the studies included in the analysis, which were interview-administered and self-administered questionnaires. The main animals reared by the respondents were cattle, sheep and goats and camels.

All cross-sectional studies were conducted from 2003 to 2021 and published online from 2005 to 2022. The knowledge was assessed based on the overall knowledge of the respondents includes mode of transmission, clinical signs, symptoms, treatment and vaccine availability and mechanisms of prevention. Knowledge was defined as good if the respondents scored above the mean level. Attitude was assessed the way the community views and behaves on brucellosis preventive measures, fear of acquiring the disease and interest. Practice was assessed about protective measures for brucellosis during assisting abortion, including the use of gloves when handling an aborted fetus, washing after contact with animals and animal products, and methods of disposing of aborted fetuses and placenta and the respondent was categorized as good and poor practice based on the mean score of practice.

The sample size of all studies which were included ranged from 45 to 647 and all studies were used random sampling methods. The highest level of good knowledge (56.3%) was recorded in a study from Oromia region and the lowest (19%) was recorded in a study. A conducted in Tigray. There was a high level of poor practice recorded in a study done in Tigray region which was 93.2%.

As the (Figure 2) showed below, currently the country has 11 regions and two city administrations. Reports were from 9 of them which are indicated in the figure. Reports were not found from Sidama, South-west Ethiopia and Benishangul Gumuz regions during the period of data. The results of the meta-analysis were presented separately for over all knowledge, awareness on zoonoticity and means of transmission, awareness of respondents on clinical signs of brucellosis, awareness on the source of information, awareness on disease control and prevention strategies, over all attitudes respondents for brucellosis and over all practices of respondents on brucellosis.

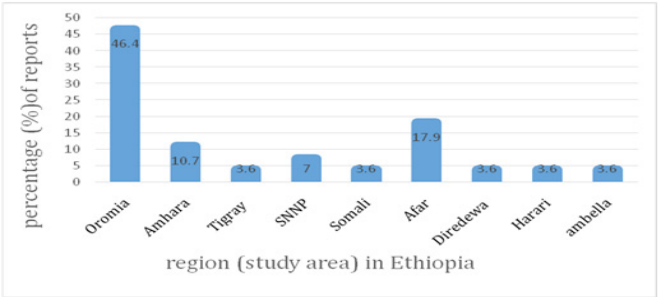

Figure 2: Percent of published studies in different regions of Ethiopia.

Publication Bias

The presence of publication bias for knowledge, attitude, and practice towards brucellosis was assessed using Egger regression test at P<0.05 and funnel plot. There was statistical evidence that there was no publication bias for a good level of knowledge of respondents with P-values = 0.663. For knowledge, each article's effective size was visual inspection of the funnel plot suggests asymmetry and allocated against the standard error. Since eight studies lay on the right side and fifteen studies on the left side of the line representing the estimated status (Figure 3).

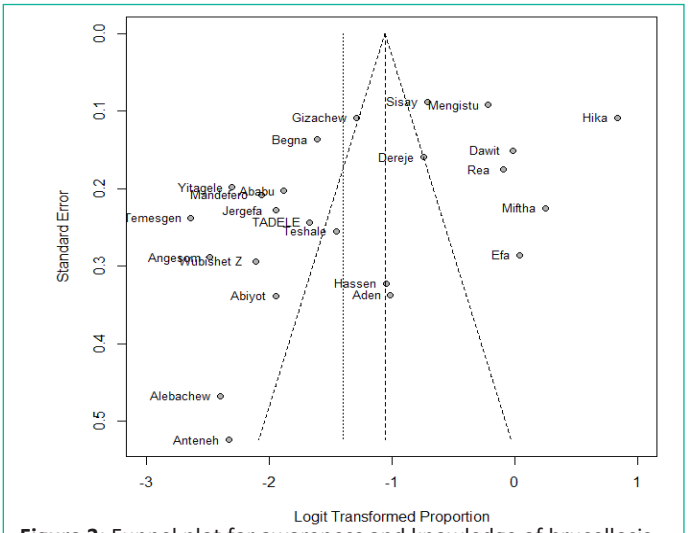

Figure 3: Funnel plot for awareness and knowledge of brucellosis.

The Overall Knowledge of Study Participants toward Brucellosis

The overall awareness about brucellosis was reported in 28 studies, with a pooled awareness level of 22% with 95% CI (0.1021; 0.2683) by using random-effects model. These result shows significant heterogeneity among studies (I^2=96.7%, p≤0.0001). Participants' knowledge and perceptions further demonstrated that brucellosis might be passed from animals to people by ingesting raw milk. The estimated overall level of good knowledge, practice in Ethiopiais presented in a forest plot (Figure 4).

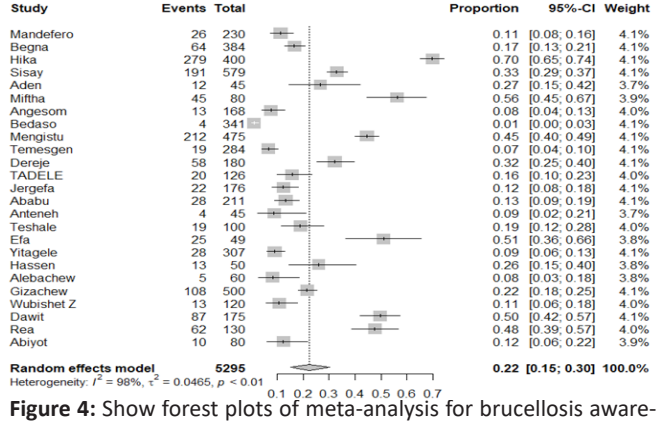

Figure 4: Show forest plots of meta-analysis for brucellosis awareness and knowledge of population in Ethiopia. At the bottom of the plot, a diamond shape represents the average effect. The length of the diamond symbolizes the confidence interval of the pooled result on the x-axis.

Awareness of Study Participants on Zoonoticity and Means of Transmission

From included studies fifteen studies were explored the awareness of the respondents about the zoonotic importance and the means of transmission of brucellosis from infected animals to humans. Pooled awareness level of respondent which have awareness on zoonoticity and transmission of brucellosis was 22.75% with 95% CL (0.1337; 0.3373) as presented in a forest plot (Figure 5). These result shows significant heterogeneity among studies (I^2=98.1%%, p≤0.0001). The pooled awareness levels of raw milk consumption and the consumption of infected meat as risk factors for brucellosis were 5% and 6%, respectively.

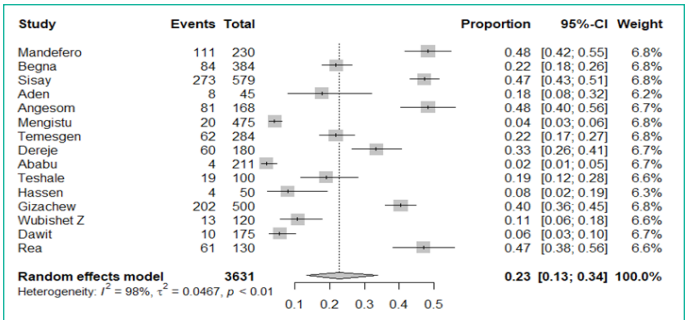

Figure 5: Show forest plots of meta-analysis for awareness population about zoonoticity and transmission towards brucellosis in Ethiopia. At the bottom of the plot, a diamond shape represents the average effect. The length of the diamond symbolizes the confidence interval of the pooled result on the x-axis.

Awareness of Study Participants on Clinical Signs of Brucellosis

From included studies nine studies were explored the awareness of the respondents about clinical signs of brucellosis. Pooled awareness level of respondent which have awareness on clinical signs of brucellosis was 18.5% with 95% CL (0.0639; 0.34930) as presented in a forest plot (Figure 6). We explored the distribution of brucellosis symptoms in human that were mentioned in the included studies. Fever, fatigue, joint pain, sweating and abortion were the most commonly mentioned symptom of animal brucellosis.

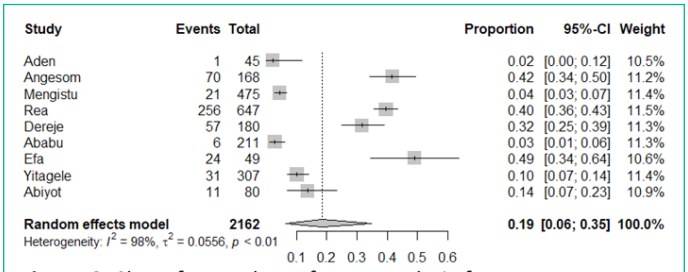

Figure 6: Show forest plots of meta-analysis for awareness population about clinical signs of brucellosis in Ethiopia. The black dot at the center of the grey box represents the pooled proportion of each study and the horizontal line indicates the 95% confidence interval of the estimates. The grey box indicated that the weight of each study which contributing to the pooled proportion estimate.

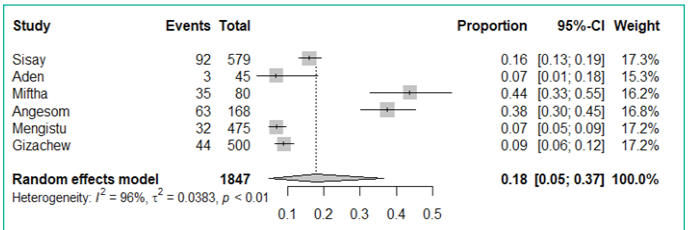

Figure 7: Show forest plots of meta-analysis for awareness population about the source of information of brucellosis in Ethiopia. The black dot at the center of the grey box represents the pooled proportion of each study and the horizontal line indicates the 95% confidence interval of the estimates. The grey box indicated that the weight of each studies which contributing to the pooled proportion estimate.

Source of Information about Brucellosis in the Study Participants

Six studies were explored the awareness regarding the source of information about brucellosis. The pooled awareness level of respondent which have awareness on source of information about brucellosis was 17.83% with 95% CI (0.0476; 0.3657). These six studies were analyzed the information sources of those respondents who had heard about brucellosis. The respondents mainly acquired knowledge of brucellosis from neighbors, friends, mass media, and health workers and from different training. The estimated overall level of good knowledge, practice in Ethiopia is presented in a forest plot (Figure 7).

Awareness of Study Participants on Disease Control and Prevention Strategies

The overall awareness of respondent about control and prevention strategies of brucellosis was reported in 11 studies, with a pooled awareness level of 20% with 95% CI (0.1300; 0.2915) by using random-effects model as presented in a forest plot (Figure 8). The others 79.51% of the respondent have not awareness about control and prevention of the brucellosis. These result shows significant heterogeneity among studies (I2= 91.1%, p ≤0.0001).

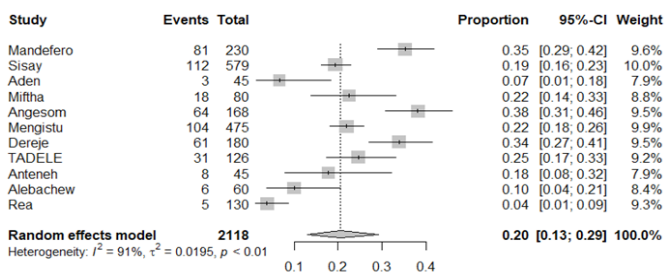

Figure 8: Show forest plots of meta-analysis for awareness of population about brucellosis control and prevention strategies in Ethiopia. At the bottom of the plot, a diamond shape represents the average effect. The length of the diamond symbolizes the confidence interval of the pooled result on the x-axis.

Practices of Study Participants toward Brucellosis

From included studies 25 articles were explored the overall practice of respondents on Brucellosis. The overall poor practices of the respondents were 74.3%, with 95%-CI (0.6411; 0.8333) while the remaining 26% of the respondents had good practice about Brucellosisas presented in a forest plot (Figure 6). These result shows significant heterogeneity among studies (I^2=98.5%, p ≤0.0001). Most of the respondents practiced unsafely contact with their animals; used meat slaughtered from backyard slaughter system, consumed raw milk and had a habit of eating raw meat.

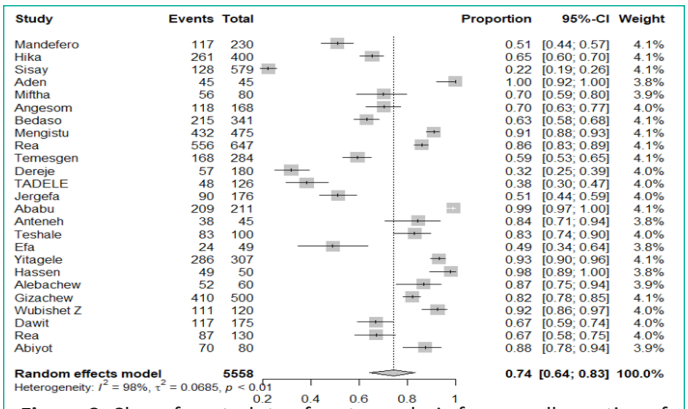

Figure 9: Show forest plots of meta-analysis for overall practice of population about Brucellosis control and prevention strategies in Ethiopia. The black dot at the center of the grey box represents the pooled proportion of each study and the horizontal line indicates the 95% confidence interval of the estimates. The grey box indicated that the weight of each studies which contributing to the pooled proportion estimate.

Sub-Group Analysis for Knowledge Based on Occupation and Region

Sub-group analysis was done for overall knowledge of respondent based on region, occupation, sampling method, and animal species and we checked the possible heterogeneity among studies. In Oromia region, 20.4% of respondents have knowledge with 95% CL (0.0999; 0.2524), I^2=94.8%, p-value < 0.0001 where as in Amhara region 69.8% of respondents had knowledge about brucellosis. Furthermore, we have done a sub-group analysis by way of occupation, since there is heterogeneity. Hence, three was the highest estimated status of the knowledge for pastoralist, and agro-pastoralist sub-group which was 20% (0.0314; 0.4574) while dairy farmers and retailers had 22.6% (0.1425; 0.3217) (Table 2). Again, the heterogeneity still existed. So, for the last, we performed sub-group analysis based on the study area but there is no evidence of heterogeneity.

Sub-group analysis also done for practices respondents towards brucellosis based on occupation and region. Of the 25 studies, the highest estimated status of poor practice respondents towards brucellosis was 98% (0.6650; 1.0000) in Dire dawa city administration. While Amhara region respondents had the lowest poor practice with 22.11% 95% CI (0.0027; 0.6343). Finally, we have carried out a sub-group analysis based on occupation. Hence, the highest estimated prevalence of the poor practice among pastoralist and, agro-pastoralist with 85.9% 95% CI (0.4062; 1.0000) but farmers and employers had less poor practice with 59% 95% CI (0.1369; 0.9631).

Sub-group analysis for attitude towards brucellosis using methods of a region, and occupation was done. Of the 12 studies, the highest estimated status of attitude towards brucellosis studied in Harari region, 98% the respondents had positive attitudes with (0.6650; 1.0000) whereas, the lowest one was in Amhara region which was 22% of the respondents had positive attitudes towards brucellosis with 95% CI (0.0027; 0.6343). Furthermore, we have done a sub-group analysis based on occupation since heterogeneity existed. Hence, 90% of employer and agro-pastoralist had positive attitudes towards about brucellosis with 95% CI (0.4062; 1.0000) but, 50% dairy farmers and retailers had less attitudes towards brucellosis with 95% CI (0.0839; 0.9256).

The pooled awareness level of the zoonotic nature of brucellosis had higher in pastoralist (16%) than farmer (14%). The Livestock owners (farmers) (24%) showed relatively higher awareness of the zoonotic nature of brucellosis than dairy farmers (11%), pastoralist (15.8%) and abattoir workers,\butchers (12.5%). Regarding the mode of transmission from infected animal to human, a low awareness level was found in the occupationally exposed population, whereas a relatively higher awareness level was found in human health care providers and animal health workers. However, abattoir workers and dairy farmers had extremely low awareness levels. With regards to awareness of the symptoms of brucellosis in human and animals, higher awareness levels were found in employers and pastoralists.

Table 2: Sub-group analysis of knowledge of brucellosis.

Subgroups	Categories	Numbers of studies	Pooled Proportion	Level (95%CI)	I^2	P-Value
Region	Oromia	14	20.4%	0.0999; 0.2524	95%	< 0.0001
	Amhara	1	69.8%	0.2941; 0.9730	_	_
	Afar	5	21.4%	0.0077; 0.5784	99.1%	< 0.0001
	Tigray	1	51%	0.1174; 0.8957	_	_
	Somali	1	8.9%	0.0000; 0.4677		
Occupation	Livestock owners (farmers)	14	22.6%	(0.1425; 0.3217)	95.5%	<0.0001
	Pastoralist and agro-pastoralist	7	20%	0.0314; 0.4574	98.8%	<0.0001
	Employers	2	26.5%	0.0001; 1.0000	98.7%	<0.0001
	Others	2	10.4%	0.0000; 0.4694	51.2%	<0.0001

Table 3: Sub-group analysis of poor practices of study participants toward brucellosis.

Subgroups	Categories	Numbers of studies	Pooled Proportion	Level (95%CI)	I^2	P-Value
Region	Oromia	14	68%	0.5453;0.8018	96.5%	< 0.0001
	Amhara	1	22.11%	0.0027; 0.6343		-
	Afar	5	87.71%	0.7052; 0.9809	95.7%	< 0.0001
	Tigray	1	48.98%	0.0936; 0.8938	-	-
	Somali	1	84.44%	0.4155; 1.000	-	-
	Harari	1	98%	0.6650; 1.0000	-	-
	SNNP	1	86.67%	0.4551; 1.0000	-	-
Occupation	Livestock owners (farmers)	15	70.7%	0.5461; 0.8452	98.6%	<0.0001
	Pastoralist and agro-pastoralist	6	85.9%	0.7051; 0.9246	91.2%	<0.0001
	Employers	2	64.95%	0.4018; 0.8608		_
	Others	2	81.97%	0.0001; 1.0000	99.4%	<0.0001

Discussion

Occupation based training regarding raising of the awareness of brucellosis is an important for the effective control of brucellosis [19]. Raising the awareness of brucellosis and brucellosis-related knowledge in occupation-related groups is an important aspect for the effective control of brucellosis [50]. The overall result of this study revealed that from the total study participants 16.96% had awareness and knowledge about brucellosis, while the remaining 83% had no awareness about brucellosis. This finding is nearly similar with study in India (region of Puducherry) revealed 16.4% in brucellosis [51]. But, it is lower than another study (30.8 %) which was done in Punjab region of India [52]. Brucellosis is neglected zoonotic disease that causes a considerable animal and human morbidity in many areas of the world especially poor countries like Africa [53,54]. However, the results of this study revealed that the study participants had no information on the zoonotic importance of brucellosis with 22.75%. The result is also in agreement with the study reports from Tajikistan in which the majority (85%) of the study participants had no awareness about brucellosis [55].

The awareness of the participants in this study about the zoonotic importance of brucellosis was lower than others studies which have done at Jimma in Oromia region with reported 46.0% [56]. On the other hand, similar studies done in Jimma reported 22.1%, while 0% in another case for brucellosis respectively [57,58]. There were similar findings in Afar Region in which only (7.7%) study participants had knowledge about a disease called brucellosis. This variation could be due in the variation of socio-economic, socio-demographic, training access and residence factors.

This study revealed that study participants were consumed raw milk (54%), raw meat (50%) and contact of sick animal product without protective. This study in agreement with other studies in Jimma and 66.8% responded by consumption of both raw milk and meat [47], while in Cape Town which is reported 67% and 56% of raw milk and meat, respectively [59]. The result of this study indicated that the study respondents had poor level of knowledge on transmission of brucellosis through milk and meat. This could be due to the respondent had not training access about means of transmission of brucellosis.

Only 20% the pastoral and agro-pastoralist community had concern about brucellosis which causes abortion in their animals. This is similar to the findings of a study by Kothalawala et al. [60] in Sri Lanka where farmers identified this disease as a cause of abortion in their cattle, but they had no adequate information regarding brucellosis as a cause of abortion in animals.

On the other hand, 28.5% of the present study participants mentioned brucellosis (hahayita) as a disease which causes abortion in animals. However, the finding of this study contrasts the findings of studies which showed that most of the study participants mentioned abortion as the major clinical sign of brucellosis in animals from elsewhere [61]. The present study indicated that in Ethiopia there was lack of well-organized extension system communities to create awareness to the community members about diseases which cause abortion in their animals like elsewhere [62].

In contrast to present studies, studies done in other countries such as Kenya [61,58,63] indicated that a large proportion of the study participants knew the disease by the name brucellosis. 74.3% of present study participants not wearing protective glove when assisting of animal during abortion, calving, and removing retention placenta. 80% of respondent in study area was had no about prevention and control method of brucellosis in animal and human. The main practices for management of aborted material and fetus in the present studies were giving to dogs, and throw on the ground without disposing properly.

17.83% of study participants mentioned they had information about brucellosis from different sources includes mass media (radio/TV), friends and training; this fact may suggest that dissemination of knowledge about brucellosis by using of television or radio was the main way to reach the communities. This should be considered in the development of education programs regarding brucellosis control. And also the study participants heard information about the zoonoticity of brucellosis was from health education, training, and families. Generally, most of present study participants had not information sources [27].

The results of 14 studies in Oromia region showed that the estimated practice towards brucellosis (poor practice) was 68% (95% CI (0.5453; 0.8018)) as well as Amhara region had less poor practice as compared to other regions as shown in (Table 3). Based on the occupation of study participants, 85.9% of pastoralist and agro-pastoralists had poor practice as compared to different occupation.

Due to the low knowledge of brucellosis, public food safety need and highly exposed population in the government sectors more attention. This knowledge gap could lead to delay in seeking medical support diagnosis and treatment of the disease

[64,65]. This could result long-term complications and disabilities [66]. In addition, the low brucellosis awareness and knowledge level of people involved in the livestock value chain could lead to a neglect in disease prevention and incorrect practices in handling, cooking and preserving animal-based food, which poses a great threat to public food safety [67]. So knowing the high-risk behaviors associated with brucellosis infections could be important to promote individuals to take protective measures, such as avoiding the consumption of uncooked meat and raw milk, wearing gloves when delivering or handling abortion materials. Several studies in the meta-analysis have indicated there was many factors which are related to the level of awareness of brucellosis includes education, and researches [68].

On the other hand, in Harari region 80% of study participants had information regarding the zoonotic importance and mode of transmission as presented on (Table 4). These finding contrasts with the findings of studies from the previous studies in Afar region 50% of the study participants had information about zoonotic [33]. Similar previous reports from Sri Lanka [60] and Nigeria [69] regarding the zoonotic importance and mode of transmission, most of the study participants had no a clear information.

Table 4: Subgroup analysis of Awareness of study participants on zoonoticity and means of transmission.

Subgroups	Categories	Numbers of studies	Pooled Proportion	Level (95%CI)	I^2	P-Value
Region	Oromia	11	29.93%	0.1910; 0.4202	96.5%	< 0.0001
	Afar	3	67.3%	0.0000; 0.3841	92.6%	< 0.0001
	Harari	1	80%	0.0000; 0.3905	-	-
Occupation	Livestock owners (farmers)	8	29.34%	0.1776; 0.4244	95.3%	<0.0001
	Pastoralist and agro-pastoralist	4	17.45%	0.0004; 0.5242	97.6%	<0.0001
	Employers	2	23.42%	0.0000; 1.0000	98.9%	<0.0001
	Others	1	19%	0.0000; 0.2770	_	_

Overall, knowledge and awareness of brucellosis were insufficient in the occupation-related groups. The knowledge levels regarding mode of transmission and symptoms in humans, the zoonotic nature, and animals of brucellosis were lower than the awareness level of brucellosis, which means that people had heard of brucellosis but did not necessarily have a clear understanding of brucellosis. This could be an obstacle for brucellosis control and prevention in Ethiopia [70]. The low awareness and knowledge levels elucidated in this study are therefore of great importance, particularly considering the zoonotic nature and the public health significance of brucellosis.

Health education about brucellosis for animal owners, and health workers was essential in gaining support for a control program [71]. Therefore, exploring the knowledge, attitude and practice of communities is important for the development and implementation of more efficient health education activities and brucellosis control programs that concerned the needs and perceptions of communities [72].

In the present study, greater brucellosis awareness and knowledge were reported in the respondents involved in employers, and the awareness level of the participants involved in dairy production was higher than that pastoral and agro-pastoral communities involved in small ruminant production. Health workers play an important role in health education and disease knowledge advocacy for occupational groups. In this study, the greatest awareness was reported in health care providers, including both animal and human health workers. This can be explained by their medical background and the training and experience they receive over their career, which proves the importance of education and training to improve the awareness of brucellosis in high-risk groups [73,74]. The results showed that the main brucellosis information sources were friends and neighbors. Cooperation and communication between the human and animal health sectors, the education sectors, the agricultural sector, animal producers and other relevant occupational groups are very important to improve the awareness and control of brucellosis.

Limitations

The limitation of this study was searching of published articles because there was no enough data or studies regarding the level of knowledge, practice and perception of the studied populations about brucellosis. The fact that each studies was used different measurements for the level of knowledge, practice and perception. So that this difference makes difficult to conclude and compare our finding with others finding. The scarcity of data in the study regions of Ethiopia. We used quantitative approach to measuring knowledge, attitude, and practice, so, we did not included qualitative work and focus group discussion which are important to gather detailed and additional information regarding study populations awareness about brucellosis.

Conclusions

Awareness, attitude and practice of communities towards brucellosis were differing by occupation, and region. This study generally found that most of the study participants were engaged in at least one risky practice that is crucial for the transmission of brucellosis from animal to human. As a result, a large percentage of communities in Ethiopia have inadequate awareness of brucellosis. It is crucial to raise knowledge of brucellosis among livestock owners and health professionals, especially veterinarians, because perceptions of affected communities have an impact on the creation and adoption of best practices and habits as well as the implementation of disease control initiatives.

Author Contribution Statement

Gashaw Enbiyale and Yohans Dagnaw: data extraction, analyzed and interpretedthe data, wrote the paper.

Daniel working: wrote the paper and editing; Tadesse Mihret: editing and interpreted the data.

Funding Statement

This study was not supported by any grant from funding agencies inthe public, commercial, or not-for-profit sectors.

Declaration of Interests' Statement

The authors declare no conflict of interest.

Data Availability

The data will available based on request.

References

1. Bulcha B, Waktole H, Abunna F, Asefa Z. Sero-Prevalence Study of Bovine Brucellosis and Its Risk Factors in Dairy Farms in and Around Adama Town , Oromia Regional State , Central Ethiopia. 2020; 7: 1–1178.
2. Megersa B, Biffa D, Niguse F, Rufael T, Asmare K, Skjerve E. Cattle brucellosis in traditional livestock husbandry practice in Southern and Eastern Ethiopia , and its zoonotic implication. Acta Vet Scand. 2011; 53: 24.
3. Lopes LB, Nicolino R, Haddad JPA. Brucellosis - risk factors and prevalence: a review. Open Vet Sci. 2010; 4: 72–84.
4. Franc KA, Krecek RC, Hasler BN, Gambo AM. renas-Gamboa AM. Brucellosis remains a neglected disease in the developing world: a call for interdisciplinary action. 2018; 18: 125.
5. FAO. One Health: Neglected Zoonoses-FAO-APHCA/OIE Regional Technical Workshop on the Prevention and Control of Animal Brucellosis and Tuberculosisin Asia. 2018; 11.
6. Cadmus SI, Ljagbone IF, Oputa HE, Adesokan HK. Serological survey of brucellosis in livestock animals and workers in Ibadan, Southwestern, Nigeria. Afr J Biomed Res. 2013; 9: 163–8.
7. Franco MP, Mulder M, Gilman RH SH. Human brucellosis. Lancet Infect Dis. 2007; 7: 775– 86.
8. Dean AS, Crump L, Greter H, Hattendorf J, Schelling E, et al. Clinical manifestations of human brucellosis: a systematic review and meta-analysis. PLoS Negl Trop. 2012; 6: e1929.
9. Poester FP, Samartino LE, Santos R. Pathogenesis and pathobiology Livestock, brucellosis in livestock. Rev Sci Tech Off Int Epiz. 2013; 32: 105–15.
10. Rahman AKMA, Dirk B, Fretin D, Saegerman C, Ahmed MU, et al. Seroprevalence and risk factors for brucellosis in a high-risk group of individuals in Bangladesh. Foodborne Pathog Dis. 2012; 9: 190-197.
11. Kutlu M, Ergonul O, Sayin-Kutlu S, Guven T, Ustun C, et al. Risk factors for occupational brucellosis among veterinary personnel in Turkey. Prev Vet Med. 2014; 117: 52–8.
12. Shome R, Kalleshamurthy T, Shankaranarayana PB, Giribattanvar P, Chandrashekar N, et al. Prevalence and risk factors of brucellosis among veterinary health care professionals. Pathog Glob Heal. 2017; 111: 234-239.
13. Al Dahouk S, Tomaso H, N¨ockler K, Neubauer H, Frangoulidis D. Laboratory-based diagnosis of brucellosis-a review of the literature. Part I: techniques for direct detection and identification of Brucella spp. Clin Lab. 2003; 49: 487–505.
14. John K, Fitzpatrick J, French N, Kazwala R, Kambarage D, et al. Quantifying risk factors for human brucellosis in Rural Northern Tanzania. PLoS One. 2010; 5: e9968.
15. Kose S, Serin Senger S, Akkoclu G, Kuzucu L, Ulu Y, et al. Clinical manifestations, complications, and treatment of brucellosis: evaluation of 72 cases. Turk J Med Sci. 2014; 44: 220–223.
16. Asgedom H, Damena D, Duguma R. Seroprevalence of bovine brucellosis and associated risk factors in and around Alage district, Ethiopia. Springerplus. 2016; 5: 851.
17. Godfroid J, Al Dahouk S, Pappas G, Roth F, Matope G, Muma J, et al. A One Health surveillance and control of brucellosis in developing countries: moving away from improvisation. Comp Immunol Microbiol Infect Dis. 2013; 36: 241–8.
18. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 Statement:An updated guideline for reporting systematic reviews. Syst Rev. 2021; 10: 89.
19. Wells G, Shea B, O'Connell D, Peterson J, Welch VLM. The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomized Studies in Meta-Analysis. Ottawa Ottawa Hosp Res Inst. 2012.
20. JBI. The joanna briggs institute critical appraisal tools for use in jbi systematic reviews; Checklist for systematic reviews and research syntheses. 2017; Available from: https://jbi.global/sites/default/files/ 2019-05/JBI-Critical-Appraisal-checklist-for-Systematic-Reviews2017-0.pdf.
21. Rücker G, Schwarzer G, Carpenter J. Arcsine test for publication bias in meta-analyses with binary outcomes. Stat Med. 2008; 27: 746-763.
22. Huedo-Medina TB, Sánchez-Meca J, Marín-Martínez F, Botella J. Assessing heterogeneity in meta-analysis: q statistic or I2 index?. Psychol Methods. 2006; 11: 193-206.
23. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003; 327: 557–560.
24. Haidich A. Meta-analysis in medical research. Hippokratia. 2010; 14: 29–37.
25. Delelegn M, Girma Y. Assessment of community knowledge, attitude and practice on milk borne zoonoses disease in Debre. 2018; 10: 123–31.
26. Waktole H, Geneti E, Ahmed WM, Mammo G, Abunna F. Sero-Prevalence and Associated Risk Factors of Bovine Brucellosis in Selected Dairy Farms in Bishoftu Town, Oromia, Ethiopia Department of Microbiology, Immunology and Veterinary Public Health College of Veterinary Medicine. 2018; 9: 45–53.
27. Terefe Y, Girma S, Mekonnen N, Asrade B. Brucellosis and associated risk factors in dairy cattle of eastern Ethiopia. Trop Anim Health Prod. 2017; 49: 599-606.
28. Aden Giro, Teshale Sori and Dereje Tesfaye. "Sero-epidemiological Investigations of Camel Brucellosis and Community Perception in Selected Districts of Borana Zone, Southern Oromia, Ethiopia. J Agric Res Pestic Biofertilizers. 2022; 3: 1-19.
29. Muhidin M, Degafu H, Abdurahaman M. Seroprevalence of brucellosis in small ruminants, its risk factors, knowledge, attitude and practice of owners in Berbere district of Bale Zone southeast Ethiopia. Ethiopian Journal of Applied Science and Technology. 2021; 12.
30. Desta AH. Public Awareness and Practices of Pastoral and Agro Pastoral Community Towards Zoonotic Brucella Infection in Afar Regional State of North East Ethiopia. European Journal of Preventive Medicine. 2015; 3: 141–6.
31. Mammo B, Id E, Ameni G, Assefa Z, Berg S, Whatmore M, et al. Brucellosis in ruminants and pastoralists in Borena, Southern Ethiopia. PLoS Negl Trop Dis. 2020; 14: e0008461.
32. Legesse M, Medhin G, Bayissa M, Mamo G. Knowledge and perception of pastoral community members about brucellosis as a cause of abortion in animals and its zoonotic importance in amibara district, afar region, Ethiopia. PLoS One. 2018; 13: e0206457.

33. Tschopp R, Gebregiorgis A, Abdulkadir O, Molla W, Hamid M, Tassachew Y, et al. Risk factors for Brucellosis and knowledge-attitude practice among pastoralists in Afar and Somali regions of Ethiopia. Prev Vet Med. 2022; 199: 105557.

34. Getahun TK. Seroprevalence of Bovine Brucellosis and its Public Health Significance in Central High Land of Ethiopia. 2021.

35. Robi DT, Gelalcha BD, Deresa FB. Knowledge and perception of community about causes of cattle abortion and case-control study of brucellosis as cause of abortion in Jimma zone, Ethiopia. Vet Med Sci. 2021; 7: 2240-2249.

36. TADELE TOLOSA FULASA. SEROPREVALENCE STUDY OF BOVINE BRUCELLOSIS AND ITS PUBLIC HEALTH SIGNIFICANCE IN SELECTED SITES OF JIMMA ZONE, WESTERN ETHIOPIA. Accel world's Res. 2004; 60–6.

37. Jergefa T, Kelay B, Bekana M, Teshale S. Epidemiological study of bovine brucellosis in three agro-ecological areas of central Oromiya, Ethiopia. 2009; 28: 933–43.

38. Negash W, Dubie T. Study on Seroprevalence and Associated Factors of Bovine Brucellosis in Selected Districts of Afar National Regional State, Afar, Ethiopia. 2021; 2021: 8829860.

39. Lakew A, Hiko A, Abraha A, Hailu SM. Sero-prevalence and community awareness on the risks associated with Livestock and Human brucellosis in selected districts of Fafan Zone of Ethiopian-Somali National Regional State. Vet Anim Sci. 2019; 7: 100047.

40. Tegegn AH, Feleke A, Adugna W, Melaku SK. Small Ruminant Brucellosis and Public Health Awareness in Two Districts of Afar Region, Ethiopia. J Vet Sci Technol. 2016; 7: 4.

41. Teklue T, Tolosa T, Tuli G. Sero-prevalence and risk factors study of brucellosis in small ruminants in Southern Zone of Tigray Region. 2013; (Csa 2011).

42. Negash E, Shimelis S, Beyene D. Seroprevalence of small ruminant brucellosis and its public health awareness in selected sites of Dire Dawa region, Eastern Ethiopia. 2012; 4: 61–6.

43. Chaka H, Aboset G, Garoma A, Gumi B, Thys E. Cross-sectional survey of brucellosis and associated risk factors in the livestock – wildlife interface area of Nechisar National Park, Ethiopia. Trop Anim Health Prod. 2018; 50: 1041-1049.

44. Tilahun A. A Seroprevalence Study of Brucellosis in Boran (Zebu) Breeds of Pastoral Area. 2022; 13: 91–9.

45. Abera G, Kumar N, Gebrewahd TT, Yizengaw HA. International Journal of Livestock Research. 2016; 6: 83-90.

46. Wubishet Z, Sadik K, Abdala B, Mokonin B, Getachew T, Getachew K. Small Ruminant Brucellosis and Awareness of Pastoralists Community about Zoonotic Importance of the Disease in Yabello districts of Borena Zone Oromia Regional State, Southern Ethiopia. 2018; 12.

47. Dawit Tesfaye, Daryos Fekede, Worku Tigre Alemayahu Regassa and Amene Fekadu. Perception of the public on the common zoonotic diseases in Jimma, Southwestern Ethiopia. Int J Med Med Sci zoonotic Dis. 2013; 5: 279–85.

48. Tschopp R, Abera B, Sourou SY, Guerne-bleich E, Aseffa A, Wubete A, et al. Bovine tuberculosis and brucellosis prevalence in cattle from selected milk cooperatives in Arsi zone, Oromia region, Ethiopia. BMC Vet Res. 2013; 9: 163.

49. Alemayehu A, Tolosa T, Tadesse B, Abdurahaman M. Seroprevalence of Bovine Brucellosis and its Associated Risk Factors and Knowledge , Attitude and Practice of Cattle Owners Towards the Disease in Gambella and Itang Districts of Gambella Region , South-Western Ethiopia. 2020; 16: 99–110.

50. Legesse M., Medhin G., Bayissa M. & Mamo G. Knowledge and perception of pastoral community members about brucellosis as a cause of abortion in animals and itszoonotic importance in amibara district, afar region, Ethiopia. PLoS One. 2018;13:1–12.

51. Mabel Kamweli Aworh, Emmanuel Okolocha, Jacob Kwaga, Folorunso Fasina ,David Lazarus, Idris Suleman, Gabrielle Poggensee, Patrick Nguku ,Peter Nsubuga. Human brucellosis: sero-prevalence and associated exposure factors among abattoir workers. 2013; 16: 103.

52. Jaspal SH, Simrinder SS, Aparna G, Jaswinder S, Udeybir SC. Awareness, knowledge, and risks of zoonotic diseases among livestock farmers in Punjab. Vet World. 2016; 9: 186-91.

53. Donev D, Karadzovski Z, Kasapinov B, Lazarevik V. Epidemiological and public health aspects of brucellosisin the Republic of Mecedonia. Biol Med Scie. 2010; 31: 33–54.

54. Liu Q, Cao L, Zhu XQ. Major emerging and re-emerging zoonoses in China: a matter of global healthand socioeconomic development for 1.3 billion. Inter J Infect Dis. 2014; 25: 65–72.

55. Lindahl E, Sattorov N, Boqvist S, Magnusson U. A study of knowledge, attitudes and practices relating to brucellosis among small-scale dairy farmers in an urban and peri-urban area of Tajikistan. PLoS One. 2015; 10.

56. Babiuk S, Bowden TR, Boyle DB, Wallace DB, Kitching RP. Capripoxviruses: an emerging worldwide threat to sheep, goats and cattle. Transbound Emerg Dis. 2008; 263–272.

57. Tadesse G. Brucellosis Seropositivity in Animals and Humans in Ethiopia A Meta-analysis. PLoS Negl Trop Dis. 2016; 10: e0005006.

58. Kansiime C, Mugisha A, Makumbi F, Mugisha S, Rwego IB, Sempa J, et al. Knowledge and perceptions of brucellosis in the pastoral communities adjacent to Lake Mburo National Park, Uganda. BMC Public Heal. 2014.

59. Tebug SF, Njunga GR, Chagunda MGG, Jacob PM, Julius AN. Steffi Wiedemann Risk, knowledge and preventive measures of smallholder dairy farmers in northern Malawi with regard to zoonotic brucellosis and bovine tuberculosis. Onderstepoort J Vet Res. 2014; 81.

60. Kothalawala KACHA, Makita K, Kothalawala H, Jiffry AM, Kubota S, Kono H. Knowledge, attitudes, andpractices (KAP) related to brucellosis and factors affecting knowledge sharing on animal diseases: across-sectional survey in the dry zone of Sri Lanka. Trop Anim Heal Prod. 2018; 50: 983-989.

61. Obonyo M. Knowledge, Attitude and Practices towards Brucellosis among Pastoral Community. Intern J Innov Res Devt. 2015; 4: 375–384.

62. Buhari HU. Knowledge, attitude and practices of pastoralists on bovine brucellosis in the north senatorial district of Kaduna state, Nigeria. J J Anim Heal Prod. 2015; 3: 28–34.

63. Musallam II, Mahomoud NAS, Guitian J. Knowledge, Attitudes, and Practices (KAP) and Practices associated to Brucellosis in Animals of the Livestock Owners of Jordan. Am J Trop Med Hyg. 2015; 93: 1148–1155.

64. Kunda J, Fitzpatrick J, Kazwala R, French NP, Shirima G, MacMillan A, et al. Health-seeking behaviour of human brucellosis cases in rural Tanzania. BMC Public Heal. 2007; 7: 315.

65. John K, Kazwala R, Mfinanga GS. Knowledge of causes, clinical features and diagnosis of common zoonoses among medical practitioners in Tanzania. BMC Infect Dis. 2008; 8: 162.

66. Dean AS, Crump L, Greter H, Hattendorf J, Schelling E, Zinsstag J. Clinical manifestations of human brucellosis: a systematic review and meta-analysis. PLoS Negl Trop. 2012; 6: e1929.

67. Sheahan M, O'Hagan G, Power S, Kenny K. Brucellosis in cattle in Ireland 1998–2005: Progress towards eradication continues. Ir Vet J. 2006.

68. Ruano MP, Aguayo MDZ. Study of the level of knowledge of bovine brucellosis among people linked to the cattle production chain in the province of Manabi, Ecuador. Rev Sci Tech Int Des Epizoot. 2017; 36: 917–25.

69. Buhari HU, Saidu SNA, Mohammed G, Raji MA. Knowledge, attitude and practices of pastoralists on bovine brucellosis in the north senatorial district of Kaduna state, Nigeria. J Anim Heal Prod. 2015; 3: 28–34.

70. Khan HAA, Akram W, Shad SA, Razaq M, Naeem-Ullah U, Zia K. A cross sectional survey of knowlknowledge, attitude and practices related to house flies among dairy farmers in Punjab, Pakistan. J Ethnobiol Ethnomed. 2019; 9: 18.

71. M Thrusfield. Veterinary epidemiology. 3rd Ed Blackwell Sci Oxford. 2007; 251-281.

72. Marcotty T, Matthys F, Godfroid J, Rigouts L, Ameni G, Gey van Pittius NC, et al. Z. Zoonotic tuberculosis and brucellosis in Africa: neglected zoonoses or minor public-health issues? The outcomes of a multidisciplinary workshop. Ann Trop Med Parasitol. 2009; 103: 401–11.

73. Mcdermott JJ AS. rucellosis in sub-Saharan Africa: epidemiology, control and impact. Vet Microbiol. 2002; 90: 111–34.

74. Jelastopulu E, Bikas C, Petropoulos C. Incidence of human brucellosis in a rural area in Western Greece after the implementation of a vaccination programme against animal brucellosis. BMC Public Heal. 2008; 8: 241.