Occupational Related Shoulder and Neck Pain among Working Population of Ethiopia: Systematic Review and Meta-Analysis

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Abstract

Background: Musculoskeletal disorders associated with the workplace are currently a major public health problem, as they are one of the main causes of disability-adjusted life years and reduced quality of life. Despite various studies on shoulder and neck pain, there is inconsistency in the findings and a lack of overall data on the prevalence of these issues among the working population in the country. Thus, the purpose of the current systematic and Meta analysis was to determine the pooled prevalence of shoulder and neck pain, throughout Ethiopia.

Methods: The systematic and Meta analysis considered studies done in Ethiopia that were published in English between 2017 and 2024. Web of Science, CINAHL, Scopus, Embase, African Journals Online, PubMed, and Google Scholar were used to retrieve articles. The pooled shoulder and neck pain prevalence was determined using Comprehensive Meta-analysis software, version 4. The quality assessment of the studies was done using Joanna Briggs Institute Critical Assessment tools.

Results: A total of 27 articles with 12,386 study participants were included in the current study. The pooled prevalence of occupational-related neck and shoulder pain was 34.1% [95% CI: 28.5, 39.8%] and 35.7% [95% CI: 28.6, 43.6%], respectively. The pooled prevalence of neck pain after analyzing subgroups by study region and survey year was 36.8% [95% CI: 31.2, 42.8%] and 34.3% [95% CI: 12.2, 66.1%], respectively. For shoulder pain, the prevalence based on study region and survey year was 45.3% (95% CI: 13.0, 82.1%) and 36.7% (95% CI: 9.3, 76.5%), respectively.

Conclusions: The current systematic review and meta-analysis show that at least one-third of study participants reported having shoulder and/or neck pain. The result of this study indicates the need for occupational health and safety practices, including availing of occupational health services, to be implemented to lower the risk of shoulder and neck pain.

***Keywords*:** Ergonomic hazards; musculoskeletal disorders; neck pain; occupational health hazards; shoulder pain; Ethiopia

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Introduction

Occupational-related musculoskeletal disorders (MSDs) are a major public health problem that affects various regions of the body, such as the shoulder, elbow, lower back, hips, knees, wrist, neck, hands, upper back, ankle, and feet (Roquelaure *et al*., 2018; Maduagwu *et al.,* 2014; Kotwani *et al*., 2019). They are characterized by pain, aches, and discomfort (Al-Hourani e*t al*., 2017; Bethge, 2017).

Globally, neck pain affects two-thirds of all people at some point in their lives (Binder, 2007). From 1990 to 2010, the effect of adjusted life years on neck pain increased from 23.9 million to 33.6 million across the world (Hoy *et al.,* 2014). According to the Global Burden of Diseases report in 2015, neck pain was among the leading causes of disability in most parts of the country (Vos *et al*., 2016).

Employees working in different working settings such as health care, transport service (driving), the manufacturing industry, general labor, maintenance, repair, and cleaning are potentially at risk of musculoskeletal disorders (OSH, 2013). According to the Global Burden of Disease Report in 2016, MSDs were among the leading causes of disability-adjusted life years (Briggs

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et al., 2018) with a double burden of economic costs, healthcare service utilization, and social problems (Chang *et al*., 2012; Coyte *et al*., 1998).

Occupational-related MSDs such as shoulder and neck pain are among the most common causes of morbidity and absenteeism from work and reduced productivity in many countries (Sadeghian *et al.,* 2013; Larsson *et al*., 2007; Erick and Smith, 2011; Temesgen et al., 2019) and have multifactorial bio-psychological origins and socioeconomic costs (Erick and Smith, 2015; Kraatz *et al.,* 2013; Bongers *et al*., 2006; Temesgen *et al.,* 2019; Coyte *et al*., 1998).

In developing countries, the implementation of occupational health and safety practices is often neglected, and preventive measures are poor (Lucchini and London, 2014). As a result of a lack of adequate training, poor awareness, and under-reporting of problems, MSD-related health problems have been increasing and remain less prioritized (Abraha *et al*., 2018; Woolf et al., 2008). In Ethiopia, several studies have been conducted on work-related MSDs in various occupational settings (Tamene *et al*., 2020; KasawKibret *et al*., 2020; Wami *et al.,* 2019; Henok and Bekele, 2017; Mekonnen *et al.,* 2019; Lette *et al*., 2019). Similarly, previously conducted systematic reviews and meta-analyses were conducted on upper and low back pain (Mengistu *et al*., 2021) and lower and upper extremity disorders (Mengistu *et al*., 2022), not addressing neck and shoulder pain. Therefore, the current study provides an overall pooled prevalence of work-related neck and shoulder pain in Ethiopia that provides current evidence, which can be crucial in providing the extent of the problem, which helps policymakers, the Ministry of Labor and Social Affairs, and the ministry of health in designing prevention strategies.

The current systematic reviw and Meta- analysis addresses the following questions: “What is the prevalence of occupational-related shoulder and neck pain in Ethiopia?” and “What is the prevalence of occupational-related shoulder and neck pain in different regions of Ethiopia?”

Materials and Methods

The review was carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher *et al.,* 2015).

Eligibility Criteria

For the current study, research published between 2017 and 2024 in English with full English texts and presenting clear objectives and methodologies, and including cross-sectional studies that provide quantitative results (such as magnitude, frequency, prevalence, or rate) were included. On the other hand, research papers released before 2017, not written in English, lacking clear objectives and methodologies, and only provided as abstracts were excluded.

Searching Databases and Strategies

The searches of the literature were performed using keywords from systematic review and meta-analysis using search strategies such as the databases SCOPUS, PubMed/ MEDLINE, Embase, Cochrane Library, Google Scholar, CINAHL, and African Journals Online. Articles were searched using a combination of Boolean logic operators (“AND, and OR”), medical subject headings (MeSH), and keywords. The following search terms: "Prevalence" OR "Magnitude" AND “Occupational" OR, "Occupational related" OR "Work-related" OR "Ergonomic related" AND "Musculoskeletal" OR "shoulder" OR "Neck" AND "Disorders" OR "Disease" OR Problems" OR "Pain" OR "Injury" AND "Working group" OR "Working population" OR "Workers" AND "Ethiopia” was used by the authors in the initial search of literature from included databases. Furthermore, manual searching of the literature was performed to cover those articles that were difficult to locate and missed from the included electronic databases. Finally, all identified keywords and index terms were checked across the electronic databases.

Study Selection

The study selection process was performed using the PRISMA flow chart, which shows the articles included in the study and the articles excluded from the study for various reasons. After the articles were retrieved from the included electronic databases, duplicated articles were removed using the Endnote software version X5 (Thomson Reuters, USA). Five authors (DAM, DD, FA, EM, and SM) independently screened the titles and abstracts of the identified articles by applying the inclusion and exclusion criteria, while four authors (LM, AB, MM, and YMD) checked the consistency and resolving the disagreement made between authors on the selection of articles. Then, full-

text articles were retrieved and assessed for eligibility based on the eligibility criteria.

Data Extraction

Six authors (DAM, DD, FA, MM, SM, and LM) extracted the required data from the eligible articles, while three authors (AB, EM, and YMD) checked the accuracy and consistency of the extracted data. The data were extracted from the included articles under the main topics of author(s), year of publication, survey year (study period), occupation, sample size, study region, and prevalence of occupational-related shoulder and neck pain using the Microsoft Excel 2016 format.

Selection and Quality Assessment

The selected articles were subjected to a rigorous evaluation using standardized critical evaluation tools, Joanna Briggs Institute (JBI) Critical Evaluation Tools) (JBI, 2019) to determine the quality and relevance of each article by the authors independently. The evaluation tools have the following nine evaluation criteria/ parameters; (1) appropriate sampling frame; (2) proper sampling technique; (3) adequate sample size; (4) description of the study subject and setting description; (5) sufficient data analysis; (6) use of valid methods for identified conditions; (7) valid measurement for all participants; (8) use of appropriate statistical analysis and (9) adequate response rate. Then, the score was taken across the articles and classified as high (85% and above score), moderate (60-85% score), and low quality (<60% score). The included articles were subjected to the evaluation (appraisal) of the authors (DAM, DD, MM, FA, SM, LM, AB, EM and YMD) independently to ensure accuracy and minimize errors. One article was assessed by two authors. In cases where the two authors did not agree on the assessment, other authors reviewed the articles for eligibility.

Data Processing and Analysis

The pooled prevalence of occupational-related shoulder and neck pain in the previous year was done) using Comprehensive Meta-Analysis (CMA) version 4.0 statistical software. Furthermore, the forest plot and the random-effects model were used to determine the pooled prevalence of shoulder and neck pain. Cochran's Q test, (Q), and (I Squared test) I^2 statistics were used to evaluate the heterogeneity among the included articles. I^2 statistics is the proportion of the variation in prevalence estimates due to genuine variation in prevalence (Higgins and Thompson, 2002; Stroup *et al.,* 2000). Additionally, subgroup analysis was performed based on the years of publication, occupation, and study areas to determine the heterogeneity in the prevalence of shoulder and neck pain. The publication bias of the included studies was evaluated using funnel plots and the p-value of < 0.05 was considered evidence of publication bias. Furthermore, the subgroup analysis was performed according to the year of publication, study population/occupation categories, and study region to minimize random variations between the included studies. Finally, the results were presented using texts, tables, and graphs/figures

Ethical Consideration

Not applicable

Results

Description of Studies

A total of 1121 articles and reports were searched through electronic databases from June 1 to July 25, 2024. Following the search for articles, 301 duplicate articles were excluded. Furthermore, 543 articles were excluded after initial screening, and 50 articles were excluded after full-text articles were assessed for eligibility. Finally, a total of 27 articles were included in the systematic review and meta-analysis (Figure 1).

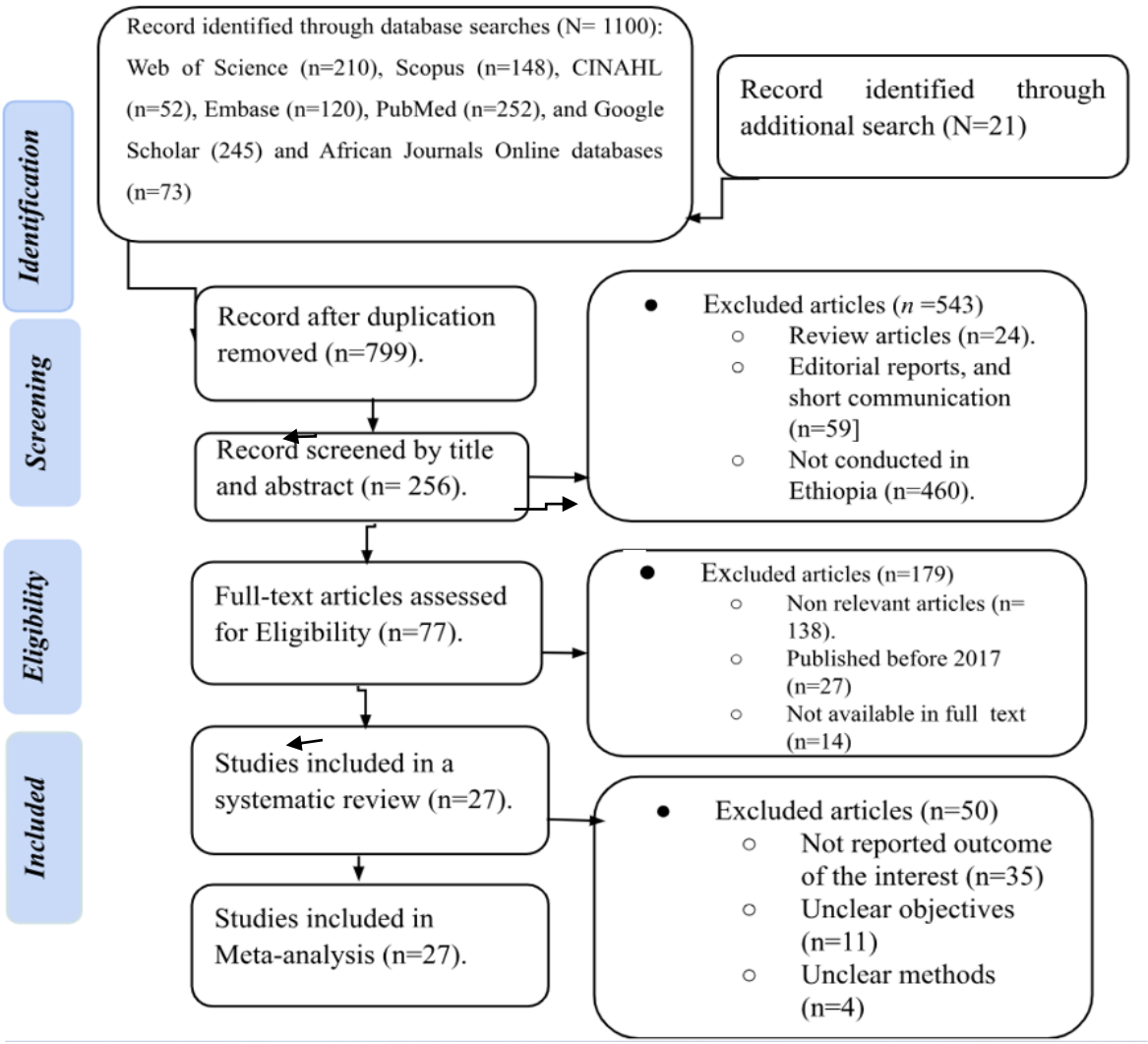

Figure 1 Flow diagram for systematic reviews adopted from PRISMA updated in 2024

Reviewed Studies

A total of 12,386 participants were included in 27 articles published in Ethiopia between 2017 and 2024. The studies were conducted in various regions of Ethiopia, with 18.5% in Oromia, 48.1% in Amhara, 14.8% in Tigray, 11.1% in Southern Nations, Nationalities, and Peoples (SNNP), and 7.4% in Addis Ababa. The studies were mainly cross-sectional with varying sample sizes. Most articles, 96.3%, were found to have a low risk of bias. The prevalence of shoulder and neck pain related to work ranged from 10.5% to 76.1%. The majority of studies reported the prevalence of both shoulder and neck pain (Table 1).

Prevalence of occupational-related shoulder pain

This study revealed that the pooled prevalence of occupational-related shoulder pain was 35.7% with a 95% CI of 28.6 to 43.6%; I2 = 98.7% with a P-value < 0.001 (Figure 2).

Table 1: Overall characteristics of included articles in the systematic review and meta-analysis, 2024

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Authors	Region	Survey year	Publica-tion year	Population	Sample size	Prevalence (%)		Risk of bias
						Shoulder pain	Neck pain	
Tamene A *et al,* 2020	SNNP	2019	2020	Garage	344	61.0	15.2	Low
Kibret *et al*, 2018	Tigray	2018	2020	Bank workers	307	29.6	35.2	Low
Wami *et al*, 2019	Amhara	2017	2019	Hotel housekeepers	422	54.0	50.7	Low
Henok *et al*, 2017	SNNP	2016	2017	Pedestrian back-loading women	422	68.2	NA	Low
Mekonnen *et al*,2019	Amhara	2018	2019	Barbers	417	27.1	29.3	Low
Lette *et al*, 2019	Oromia	2017	2019	Construction work-ers	410	10.5	7.6	Low
Mekonnen *et al* 2020	Amhara	2019	2020	Tailors	419	72.1	68.3	Low
Mekonnen *et al*,2019	Oromia	2019	2020	Hairdressers	652	53.7	53.4	Low
Melese *et al,* 2020	Tigray	2019	2020	Cleaners	264	14.0	9.5	Low
Dagne *et al,* 2020	Addis Ababa	2016/17	2020	Bank workers	755	40.9	38.0	Low
Regassa *et al*, 2018	Oromia	2015	2018	Nurses	301	14.1	24.0	Low
Tesfaye *et al*, 2020	Amhara	2021	2020	Teacher	607	49.66	48.11	Low
Tesfaye *et al*, 2024	Amhara	2022	2024	Shopkeepers	625	15.7	35.4	Low
Etana *et al*, 2021	Oromia	2019	2021	Bank workers	335	37.9	45.4	Low
Haftu *et al*,2023	SNNP	2021	2023	Cloth weavers	420	76.1	56.3	Low
Yirdaw *et al*, 2021	Amhara	2017	2021	Students	422	12.3	36.7	Medium
Biadgo *et al,* 2021	Tigray	2017	2021	Garment factories workers	293	NA	42.3	Low
Demissie *et al*, 2022	Amhara	2021	2022	Bank workers	422	24.65	45.26	Low
Afework *et al*, 2024	Addis Ababa	2021	2024	Cleaners	437	29.1	5.9	Low
Tesfaye *et al*, 2023	Amhara	2022	2023	Cashiers	634	51.5	24.3	Low
Wami *et al*, 2020	Amhara	2018	2020	Students	422	12.3	36.7	Low
Ayhualem *et al*,2021	Amhara	2019	2021	Students	808	NA	47.4	Low
Weleslassie *et al,* 2020	Tigray	2018	2020	Students	419	NA	49.2	Low
Abebaw *et al,* 2024	Amhara	2023	2024	Kitchen workers	415	36.6	12.8	Low
Tegenu *et al*, 2021	Amhara	2020	2021	Restaurant workers	595	44.7	36.1	Low
Yirdaw , and Adane 2024	Amhara	2022	2024	Drivers	422	47.1	50.4	Low
Nemera *et al*, 2024	Oromia	2021	2024	Nurses	397	28.0	45.8	Low

NA: Not Applicable; SNNP: Southern Nations, Nationalities, and Peoples.

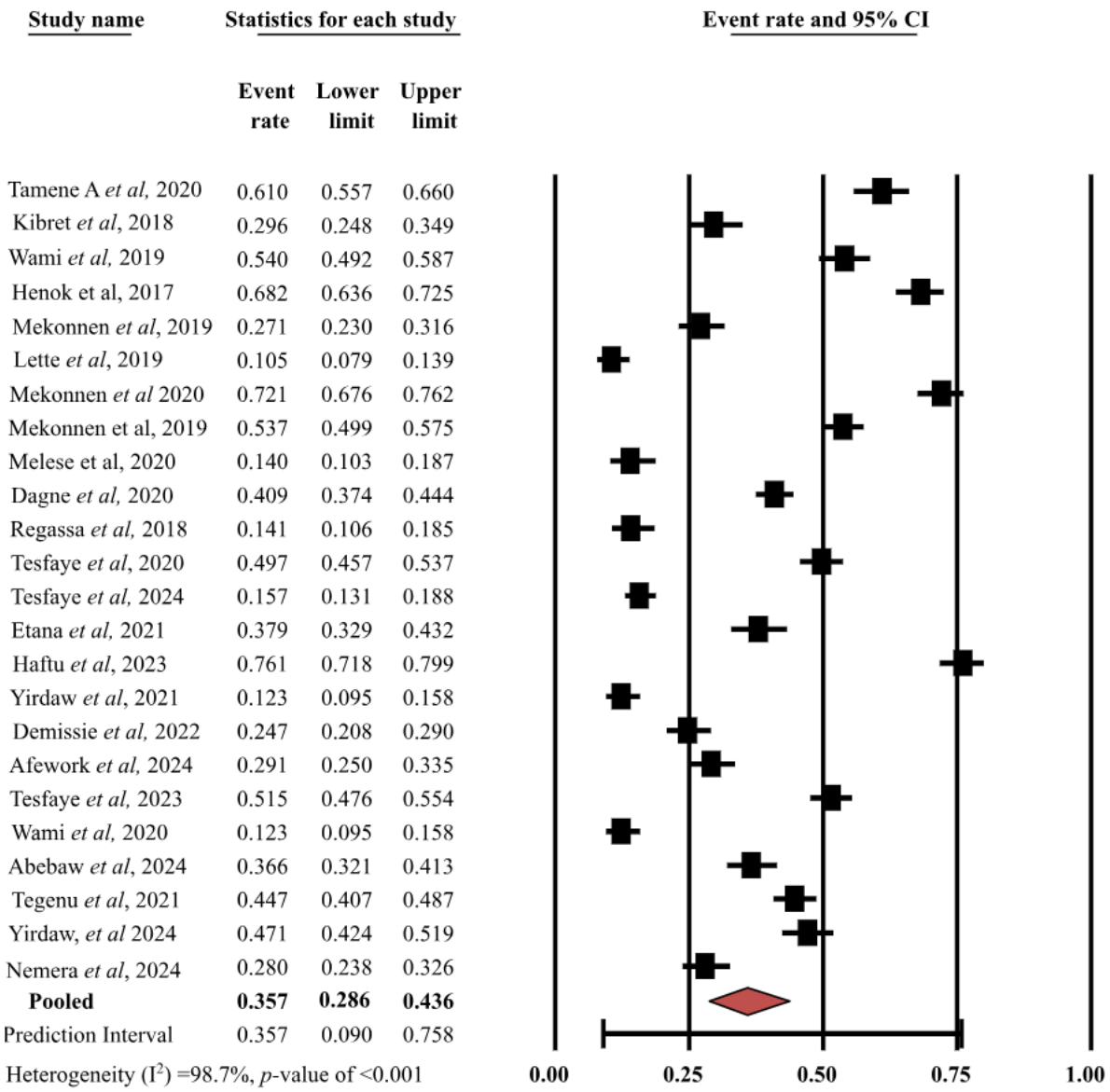

Figure 2: The forest plot shows the pooled prevalence of occupational-related shoulder pain between 2017-2024 in Ethiopia, 2024.

Subgroup Analysis

Subgroup analysis was conducted to determine the pooled prevalence of shoulder pain based on survey year and study locations because of the high heterogeneity observed in the current study. After performing the subgroup analysis based on the study region, the overall pooled prevalence of occupational-related shoulder pain was 45.3% (95% CI 13.0, 82.1%). The highest prevalence of shoulder pain (68.8% with a 95%CI 59.8, 76.5) was observed in SNNP, while the lowest prevalence was observed in Tigray, which accounted for 20.9% (95%CI: 9.0, 40.1) (Figure 3).

Group by Study region	Study name	Event Rate	Lower Limit	Upper Limit
Addis Ababa	Dagne *et al,* 2020	0.409	0.374	0.444
Addis Ababa	Afework *et al,* 2024	0.291	0.250	0.335
Addis Ababa	**Pooled**	0.349	0.243	0.472
Addis Ababa	Prediction Interval			
Amhara	Wami *et al,* 2019	0.540	0.492	0.587
Amhara	Mekonnen *et al*, 2019	0.271	0.230	0.316
mhara	Mekonnen *et al* 2020	0.721	0.676	0.762
Amhara	Tesfaye *et al,* 2020	0.497	0.457	0.537
Amhara	Tesfaye *et al*, 2024	0.157	0.131	0.188
Amhara	Yirdaw *et al*, 2021	0.123	0.095	0.158
Amhara	Demissie et al, 2022	0.247	0.208	0.290
Amhara	Tesfaye *et al*, 2023	0.515	0.476	0.554
Amhara	Wami et al, 2020	0.123	0.095	0.158
Amhara	Abebaw *et al*, 2024	0.366	0.321	0.413
Amhara	Tegenu *et al*, 2021	0.447	0.407	0.487
Amhara	Yirdaw *et al* 2024	0.471	0.424	0.519
Amhara	**Pooled**	0.351	0.256	0.460
Amhara	Prediction Interval	0.351	0.079	0.773
Oromia	Lette *et al*, 2019	0.105	0.079	0.139
Oromia	Mekonnen *et al*, 2019	0.537	0.499	0.575
Oromia	Regassa *et al*, 2018	0.141	0.106	0.185
Oromia	Etana et al, 2021	0.379	0.329	0.432
Oromia	Nemera *et al*, 2024	0.280	0.238	0.326
Oromia	**Pooled**	0.261	0.136	0.442
Oromia	Prediction Interval	0.261	0.014	0.895
SNNP	Tamene A *et al*, 2020	0.610	0.557	0.660
SNNP	Henok *et al*, 2017	0.682	0.636	0.725
SNNP	Haftu *et al*, 2023	0.761	0.718	0.799
SNNP	**Pooled**	0.688	0.598	0.765
SNNP	Prediction Interval	0.688	0.016	0.997
Tigray	Kibret *et al*, 2018	0.296	0.248	0.349
Tigray	Melese *et al*, 2020	0.140	0.103	0.187
Tigray	**Pooled**	0.209	0.094	0.401
Tigray	Prediction Interval			
Overall		0.453	0.130	0.821

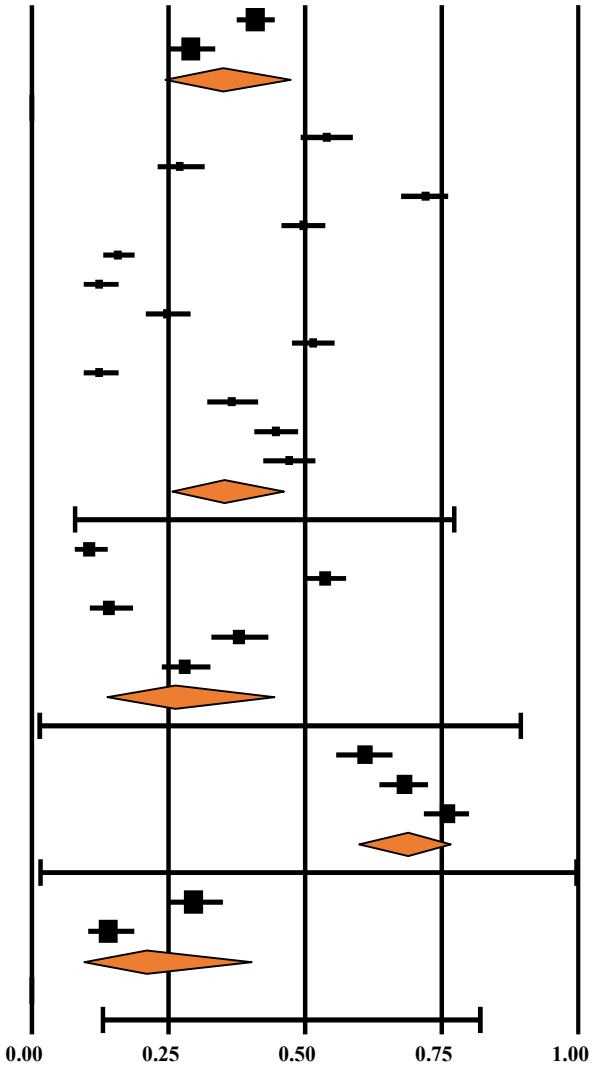

Figure 3: The forest plot shows the subgroup analysis of the pooled prevalence of occupational-related shoulder pain between 2017-2024 by study region, Ethiopia, 2024.

After the subgroup analysis of the prevalence of shoulder pain was performed based on the survey period, the overall pooled prevalence of occupational-related shoulder pain was 36.7% with a 95% CI of 29.2 and 44.9%.

The lowest pooled prevalence of shoulder pain (29.2% with a 95%CI of 14.7, 49.7) was from 2015 to 2017, while it was relatively equal from 2018 to 2020 (37.1% with a 95%CI of 25.5, 50.6) and 2021 to 2023 (38.9% with a 95%CI of 27.8, 51.2) (Figure 4).

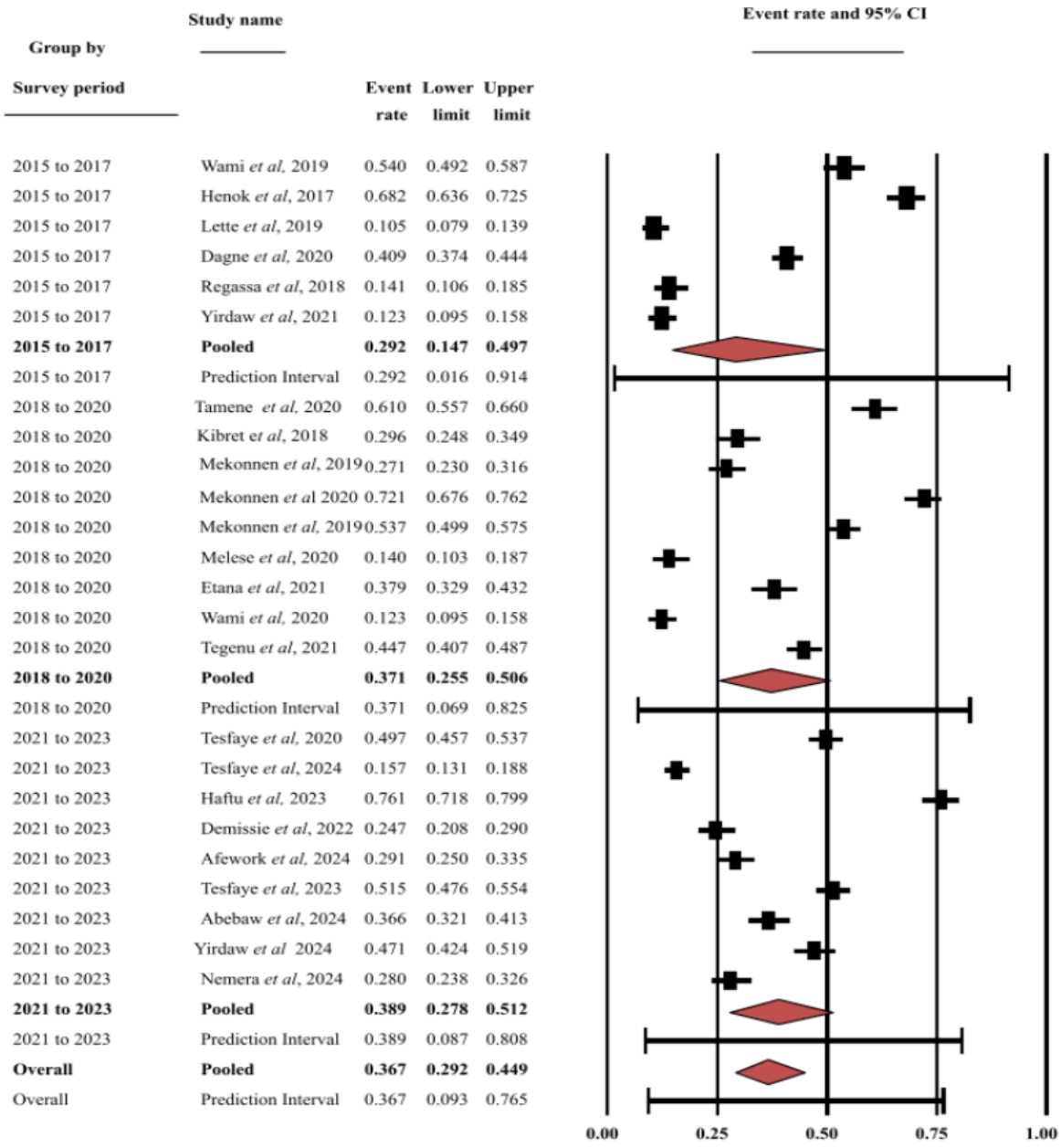

Figure 4: A forest plot shows the subgroup analysis of the pooled prevalence of occupational-related shoulder pain between 2017-2014 by survey period, Ethiopia, 2024.

Prevalence of Occupational-Related Neck Pain

The pooled prevalence of occupational-related neck pain was 34.1% with a 95% CI of 28.9, 39.8% and I2=97.3%, p-value of <0.001 (Figure 5).

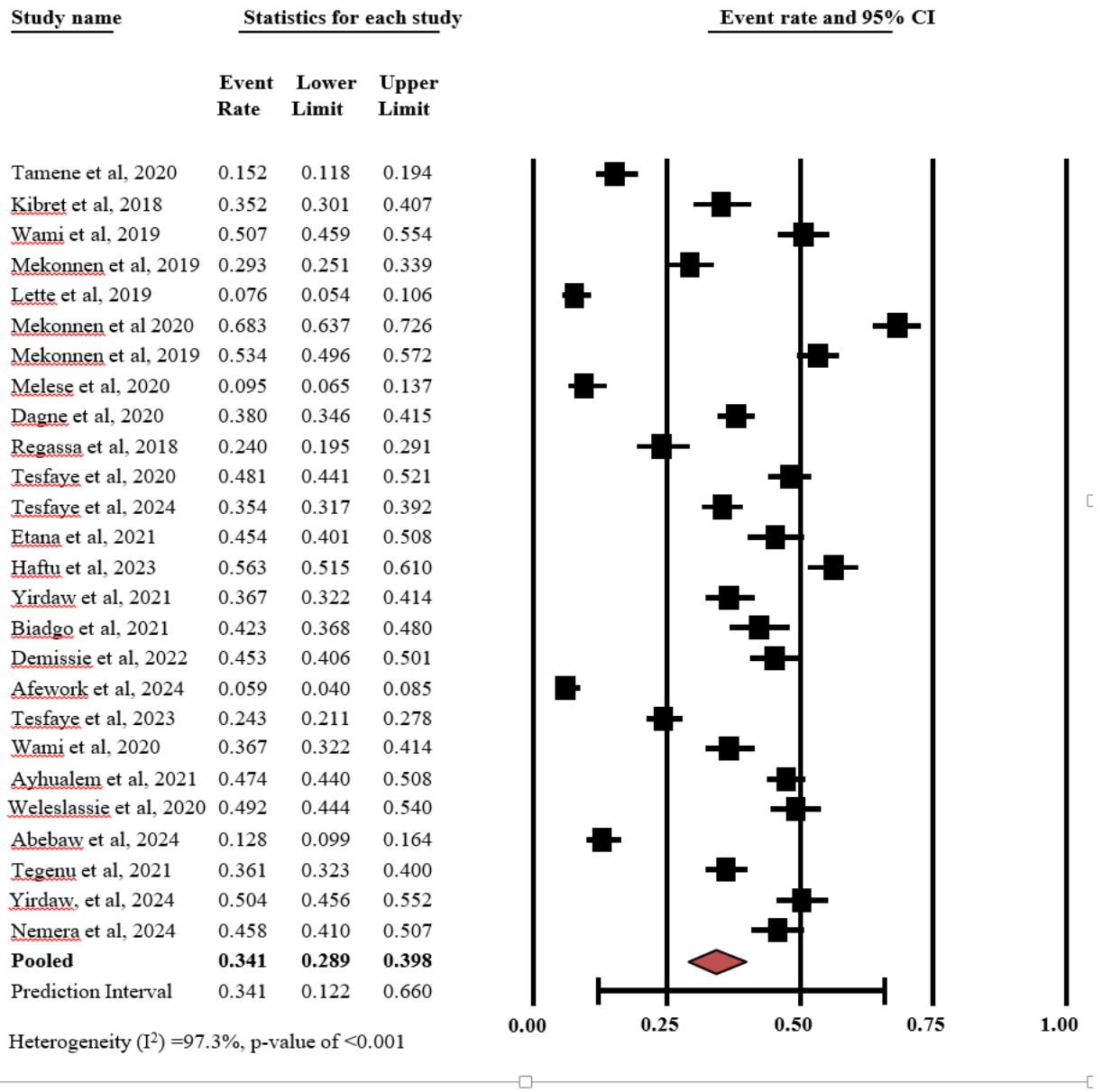

Figure 5: A forest plot shows the pooled prevalence of occupational-related neck pain between 2017-2024 in Ethiopia, 2024.

Subgroup Analysis

Subgroup analysis was conducted to determine the pooled prevalence of neck pain based on publication year and study locations due to the high heterogeneity we observed. However, after the subgroup analysis of work-related neck pain was done based on the study period, the overall pooled prevalence of occupational-related neck pain was 34.3% (95% CI: 28.8, 40.1%). The lowest prevalence of neck pain (30.8% with a 95%CI of 21.1, 42.5) was observed from 2015 to 2017, while the highest prevalence (37.1% with a 95%CI of 29.0, 46.0) was observed from 2018 to 2020 (Figure 6).

Group by Survey period	Study name	Event rate	Lower limit	Upper limit
2015 to 2017	Wami et al, 2019	0.507	0.459	0.554
2015 to 2017	Lette et al, 2019	0.076	0.054	0.106
2015 to 2017	Dagne et al, 2020	0.380	0.346	0.415
2015 to 2017	Regassa et al, 2018	0.240	0.195	0.291
2015 to 2017	Yirdaw et al, 2021	0.367	0.322	0.414
2015 to 2017	Biadgo et al, 2021	0.423	0.368	0.480
2015 to 2017	**Pooled**	0.308	0.211	0.425
2015 to 2017	Prediction Interval	0.308	0.064	0.744
2018 to 2020	Tamene A et al, 2020	0.152	0.118	0.194
2018 to 2020	Kibret et al, 2018	0.352	0.301	0.407
2018 to 2020	Mekonnen et al, 2019	0.293	0.251	0.339
2018 to 2020	Mekonnen et al 2020	0.683	0.637	0.726
2018 to 2020	Mekonnen et al, 2019	0.534	0.496	0.572
2018 to 2020	Melese et al, 2020	0.095	0.065	0.137
2018 to 2020	Etana et al, 2021	0.454	0.401	0.508
2018 to 2020	Wami et al, 2020	0.367	0.322	0.414
2018 to 2020	Ayhualem et al, 2021	0.474	0.440	0.508
2018 to 2020	Weleslassie et al, 2020	0.492	0.444	0.540
2018 to 2020	Tegenu et al, 2021	0.361	0.323	0.400
2018 to 2020	**Pooled**	0.371	0.290	0.460
2018 to 2020	Prediction Interval	0.371	0.121	0.716
2021 to 2023	Tesfaye et al, 2020	0.481	0.441	0.521
2021 to 2023	Tesfaye et al, 2024	0.354	0.317	0.392
2021 to 2023	Haftu et al, 2023	0.563	0.515	0.610
2021 to 2023	Demissie et al, 2022	0.453	0.406	0.501
2021 to 2023	Afework et al, 2024	0.059	0.040	0.085
2021 to 2023	Tesfaye et al, 2023	0.243	0.211	0.278
2021 to 2023	Abebaw et al, 2024	0.128	0.099	0.164
2021 to 2023	Yirdaw , et al 2024	0.504	0.456	0.552
2021 to 2023	Nemera et al, 2024	0.458	0.410	0.507
2021 to 2023	**Pooled**	0.328	0.234	0.439
2021 to 2023	Prediction Interval	0.328	0.077	0.741
Overall	**Pooled**	0.343	0.288	0.401
Overall	Prediction Interval	0.343	0.122	0.661

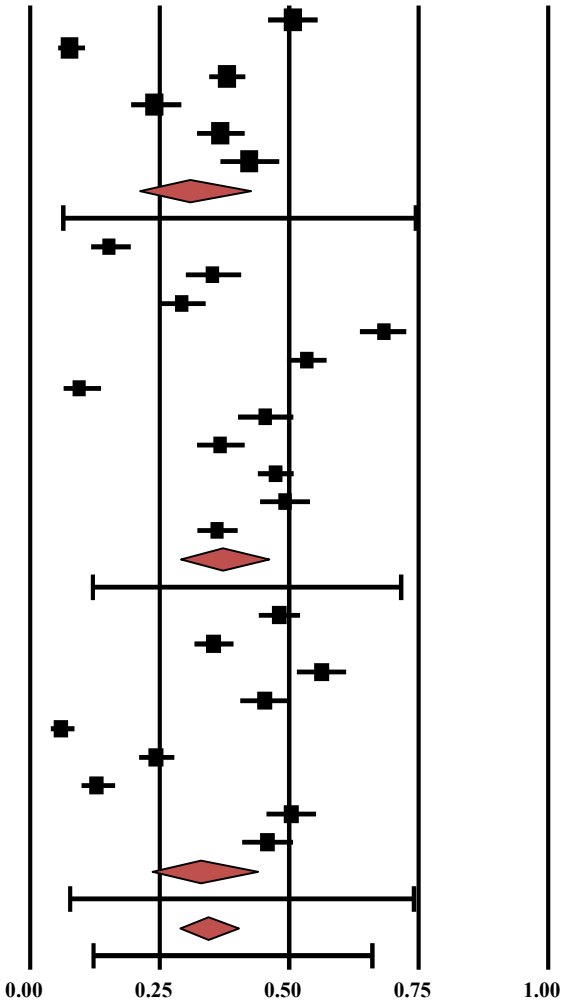

Figure 6. A forest plot shows the subgroup analysis of the pooled prevalence of occupational-related neck pain between 2017-2024 by survey periods, 2024.

Furthermore, after performing the subgroup analysis based on the study region, the overall pooled prevalence of work-related neck pain was 36.8%, with a 95% CI of 31.2–42.8%. The highest prevalence of neck pain (39.2% with a 95%CI of 32.4, 46.5) was observed in the Amhara region, while the lowest prevalence of neck pain (16.5%with a 95%CI of 2.1, 64.9) was observed in Addis Ababa (Figure 7).

Group by Region	Study name	Event Rate	Lower Limit	Upper Limit
Addis Ababa	Dagne et al, 2020	0.380	0.346	0.415
Addis Ababa	Afework et al, 2024	0.059	0.040	0.085
Addis Ababa	**Pooled**	0.165	0.021	0.649
Addis Ababa	Prediction Interval			
Amhara	Wami et al, 2019	0.507	0.459	0.554
Amhara	Mekonnen et al, 2019	0.293	0.251	0.339
Amhara	Mekonnen et al 2020	0.683	0.637	0.726
Amhara	Tesfaye et al, 2020	0.481	0.441	0.521
Amhara	Tesfaye et al, 2024	0.354	0.317	0.392
Amhara	Yirdaw et al, 2021	0.367	0.322	0.414
Amhara	Demissie et al, 2022	0.453	0.406	0.501
Amhara	Tesfaye et al, 2023	0.243	0.211	0.278
Amhara	Wami et al, 2020	0.367	0.322	0.414
Amhara	Ayhualem et al, 2021	0.474	0.440	0.508
Amhara	Abebaw et al, 2024	0.128	0.099	0.164
Amhara	Tegenu et al, 2021	0.361	0.323	0.400
Amhara	Yirdaw, et al, 2024	0.504	0.456	0.552
Amhara	**Pooled**	**0.392**	**0.324**	**0.465**
Amhara	Prediction Interval	0.392	0.159	0.687
Oromia	Lette et al, 2019	0.076	0.054	0.106
Oromia	Mekonnen et al, 2019	0.534	0.496	0.572
Oromia	Regassa et al, 2018	0.240	0.195	0.291
Oromia	Etana et al, 2021	0.454	0.401	0.508
Oromia	Nemera et al, 2024	0.458	0.410	0.507
Oromia	**Pooled**	**0.319**	**0.186**	**0.490**
Oromia	Prediction Interval	0.319	0.027	0.888
SNNP	Tamene et al, 2020	0.152	0.118	0.194
SNNP	Haftu et al, 2023	0.563	0.515	0.610
SNNP	**Pooled**	**0.325**	**0.065**	**0.769**
SNNP	Prediction Interval			
Tigray	Kibret et al, 2018	0.352	0.301	0.407
Tigray	Melese et al, 2020	0.095	0.065	0.137
Tigray	Biadgo et al, 2021	0.423	0.368	0.480
Tigray	Weleslassie et al, 2020	0.492	0.444	0.540
Tigray	**Pooled**	**0.314**	**0.186**	**0.480**
Tigray	Prediction Interval	0.314	0.015	0.931
Overall	**Pooled**	**0.368**	**0.312**	**0.428**

Heterogeneity (I^2) =96.8%, p-value of <0.001

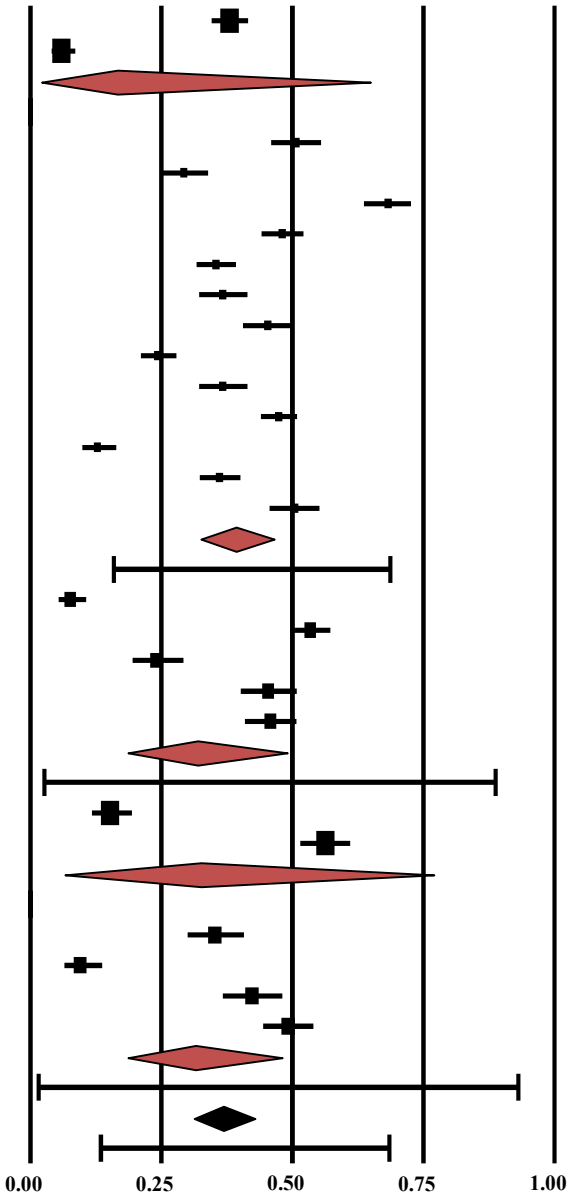

Figure 7. Forest plot shows the subgroup analysis of the pooled prevalence of occupational-related neck between 2017-2024 by study region, 2024.

Funnel Plot for Publication Bias

The distribution of the study findings was observed using the funnel plot based on the standard error and logit event rate for both shoulder and neck pain. The funnel plot shows the unequal distribution of the findings and the presence of non-significant publication bias. A funnel plot of standard error and precision for both neck and shoulder pain is provided as a supplementary file (Fig 8 and 9).

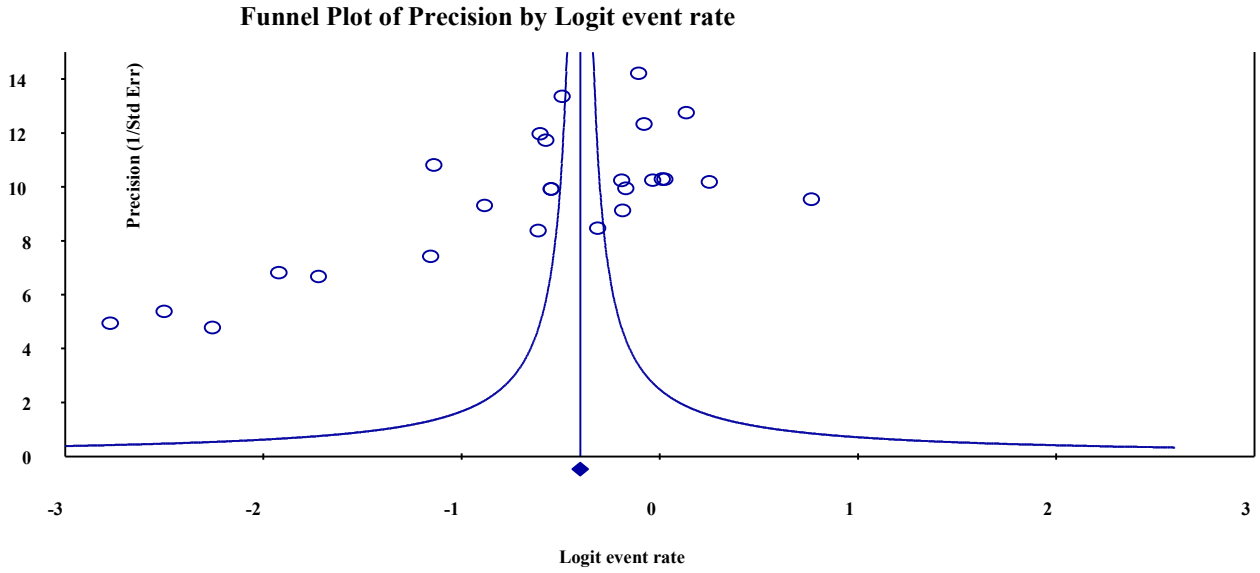

Figure 8: Funnel plot shows the distribution of neck pain in Ethiopia, 2024

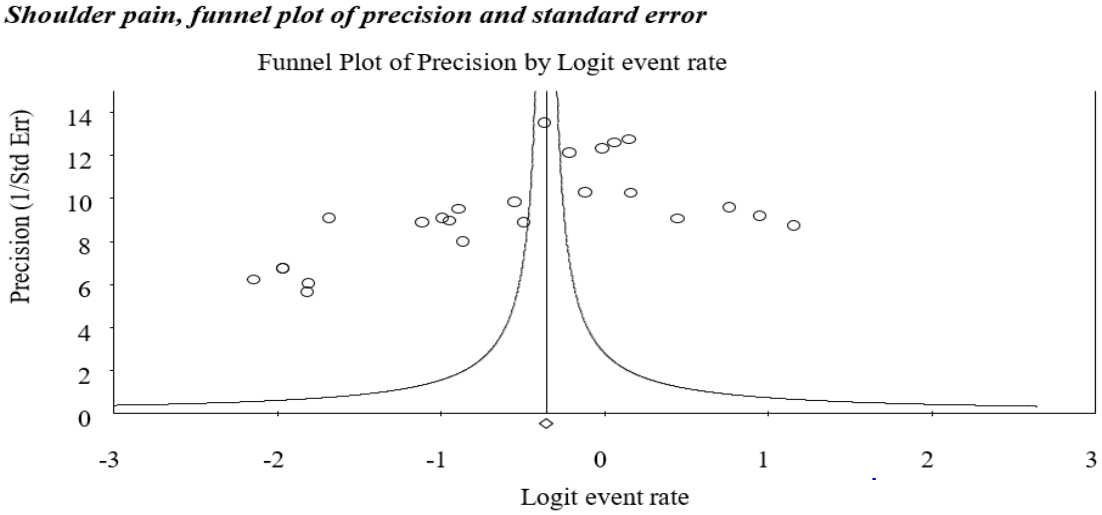

Figure 9:Funnel plot shows the distribution of shoulder pain in Ethiopia, 2024

Sensitivity Analysis

As a result of the high heterogeneity, the authors employed sensitivity analysis for both work-related neck and shoulder pain. However, after the sensitivity was done by excluding extreme values suspected to influence an overall pooled prevalence of work-related shoulder and neck pain, there was no substantial variation in the pooled prevalence (Table 2).

Table 2: Sensitivity analysis employed to assess the influence of extreme values on the pooled prevalence of shoulder and neck pain in Ethiopia, 2024

Criteria used for sensitivity analysis	Pooled prevalence	
	Before sensitivity analysis	After sensitivity analysis
After excluding three smallest prevalence of neck pain	34.1% (95%CI: 28.9,39.8)	39.4%(95%CI: 34.5,44.6)
After excluding one largest prevalence of neck pain	34.1% (95%CI: 28.9,39.8)	32.9%(95%CI: 27.9,38.3)
After excluding one smallest prevalence of shoulder pain	35.7%(95%CI: 28.6,43.6)	37.3%(95%CI: 30.1,45.1)
After excluding two largest prevalence of neck pain	35.7%(95%CI: 28.6,43.6)	32.4%(95%CI: 26.0,39.6)
After excluding one largest sample size (in determining shoulder pain)	35.7%(95%CI: 28.6,43.6)	35.5%(95%CI: 27.9,43.9)

Discussion

This study aimed to determine the pooled prevalence of occupational-related shoulder and neck pain between 2017-2024 in Ethiopia. In the systematic review and Meta- analysis, a total of 12,386 study participants were included in 27 articles published in Ethiopia, with 50 estimates of occupational-related shoulder and neck pain (Tamene *et al.,* 2020; Kasaw Kibret *et al*., 2020; Wami *et al.,* 2019; Henok and Bekele, 2017; Mekonnen *et al*., 2019; Lette *et al*., 2019; Mekonnen et al., 2020b; Mekonnen et al., 2020a; Melese *et al.,* 2020; Dagne *et al.,* 2020; Regassa *et al.,* 2018; Tesfaye *et al.,* 2022; Tesfaye *et al.,* 2024; Etana *et al*., 2021; Haftu *et al.,* 2023; Yirdaw *et al*., 2021; Demissie *et al*., 2022; Afework *et al.,* 2024; Tesfaye *et al*., 2023; Wami *et al.,* 2021; Abebaw *et al*., 2024; Tegenu *et al.,* 2021; Yirdaw and Adane, 2024; Nemera *et al*., 2024; Ayhualem *et al.,* 2021; Weleslassie *et al*., 2020; Biadgo *et al*., 2021).

In the systematic review and Meta- analysis, as a result of high heterogeneity, we have conducted and presented the subgroup and sensitivity analyses. Furthermore, to determine the source of heterogeneity, the authors conducted sensitivity analysis by assessing the influence of different included variables or outcomes, such as sample size and prevalence of shoulder and neck pain. However, after sensitivity analysis was done by excluding extreme values suspected to influence the pooled prevalence of work-related neck and shoulder pain, the authors found no significant variation compared to the findings before sensitivity analysis.The current study found that the pooled prevalence of occupational-related shoulder pain between 2017-2024 accounts for 35.7%. This implies that there is high occupational-related shoulder pain that might lead to loss of productivity and absenteeism among employees and affect their quality of life (Chang et al., 2012; Coyte *et al.,* 1998; Sadeghian *et al*., 2013; Larsson et al., 2007; Erick and Smith, 2011; Temesgen *et al.,* 2019).

Similarly, the pooled prevalence of shoulder pain increased to 45.5% and 36.7% after the subgroup analysis was done based on the study region and survey period, respectively. The highest prevalence of shoulder pain was observed in SNNP and from 2021 to 2023, which accounted for 68.8% and 38.9%, respectively. The lowest prevalence of shoulder pain was observed in the Tigray region, and from 2015 to 2017, it accounted for 20.9% and 29.2%, respectively. Furthermore, the pooled prevalence of shoulder pain in Oromia, Amhara, and Addis Ababa accounted for 26.1%, 35.1%, and 39.4%, respectively.

Similarly, the current study found that the pooled prevalence of occupational-related neck pain between 2017-2024 r accounted for 34.1%. Similarly, after subgroup analysis was done based on the study period and region, there was no substantial variation in the prevalence of neck pain (before and after subgroup analysis), which accounted for 34.3% and 36.8%, respectively. However, the highest prevalence of neck pain (37.1%) was observed from 2018 to 2020 and in the Amhara region (39.2%). However, the lowest prevalence was observed from 2015 to 2017 (30.8%) and in Addis Ababa (16.5%), while it accounted for 32.8%

from 2021 to 2023. Further, the study found that the pooled prevalence of neck pain in Tigray, Oromia, and SNNP accounted for 31.4%, 31.9%, and 32.5%, respectively.

In general, the current study found that at least two of the seven study participants experienced occupational-related shoulder pain, while three of the eight study participants experienced occupational-related neck pain, regardless of the occupation categories. This indicates that there is poor implementation of occupational health and safety practices, particularly in the prevention of occupational-related shoulder and neck pain.

This indicates that occupational-related shoulder and neck pain continues to have potential health and economic impacts. Thus, the implementation of occupational health and safety practices such as engineering control, administrative control, and the use of personal protective devices in the workplace plays an important role in reducing these problems (Azizpour *et al*., 2017; CDC).

Limitations

There was an unequal distribution of studies in different regions of the country and among the different occupations. On the other hand, the prevalence of shoulder and neck pain in some regions of Ethiopia was not covered due to the lack of studies in those regions. Furthermore, the unequal distribution of the occupation of the study participants makes it difficult to do subgroup analysis based on the occupation.

Conclusions

The current study found that at least one-third of the study participants experienced occupationally related shoulder and/or neck pain between 2017-2024. Thus, this study suggests that there is a need to improve and implement occupational health and safety measures to reduce shoulder and neck pain. Both national and international concerned organizations, and agencies or experts should work on these issues, particularly to reduce the health impacts related to occupational related shoulder and neck pain.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

DAM conceived the idea and played an important role in data review, extraction and analysis, writing, drafting, and editing the manuscript. DAM, DD, FA, MM, SM, LM, AB, EM, and YMD have contributed to data extraction and analysis. Finally, all authors (DAM, DD, FA, MM, SM, LM, AB, EM, and YMD) read and approved the final version of the manuscript to be published and agreed on all aspects of this work.

List of Abbreviations

CDC: Centers for Disease Control and Prevention; CMA: Comprehensive Meta-Analysis; JBI: Joanna Briggs Institute; MSDs: Musculoskeletal Disorders; PRISMA: Preferred Reporting Items for Systematic Review and Meta-Analysis; SNNP: Southern Nations, Nationalities, and Peoples

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