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

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Research Article

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Abstract

Background

Currently, work-related musculoskeletal disorders are a significant public health concern and are a leading cause of disability-adjusted life years and reducing the quality of life worldwide. In developing countries including Ethiopia, there is no adequate evidence on the overall prevalence of work-related musculoskeletal disorders and it remains less prioritized and unrepresented. Thus, the current study aimed to provide the country wide prevalence of work-related musculoskeletal disorders particularly shoulder and neck pain in Ethiopia.

Methods

This study considered the studies conducted in Ethiopia, written in English language and published from 2017–2020. The studies were searched using various electronic databases such as PubMed/MEDLINE, Web of Science, Google Scholar, CINAHL, Cochrane Library, SCOPUS, Embase, African Index Medicus, and African Journals Online database from 16 July 2020 to 22 August 2020. The articles were searched using a Boolean logic operator (“AND”, “OR”, “NOT”) in combination with Medical Subject Heading (MeSH), terms, and keywords. Quality assessment of the studies was done using Joanna Briggs Institute (JBI) Critical Appraisal tools to determine the relevance of each included article to the study.

Results

The current study found the pooled prevalence of work-related shoulder and neck pain in the previous one year accounted 37.9% [95% CI:26.5, 50.8%; P-value < 0.001] and 29.9% [95% CI:20.1, 41.9%; P-value = 0.002] respectively. Based on the subgroup analysis, the pooled prevalence of work-related shoulder pain in the last one year based on the study population, publication year, and study region was 47.6% [95% CI: 45.8, 49.4%], 49.8% [95% CI: 45.7, 53.9%] and 44.6% [95% CI: 41.4, 47.8%] respectively while the pooled prevalence of neck pain in the last one year based on study population, publication year, and study area was 39.1% (95% CI: 37.5, 40.7%), 25.1% [ 95% CI: 20.8, 29.9%] and 32.6% [95% CI: 29.8, 35.5%] respectively.

Conclusion

This study found that at least one-third of the study participants were experienced occupational-related shoulder and/or neck pain in the previous last one year. The study suggests that there is a need to improve and implement occupational health and safety in the working environments to reduce work-related musculoskeletal disorders such as shoulder and neck pain, and other, occupational hazards.

1. Introduction

Musculoskeletal disorders (MSDs) are a major public health problems that affect various body’s regions such as shoulder, elbow, low back, hips, knees, wrist, neck, hands, upper back, ankle, and feet [1–3] and characterized by symptoms such as pain, ache, and discomfort [4, 5]. Workers working in different working environments such as health care, driving, manufacturing industry, general labor, maintenance or repairing, and cleaning are potentially at risk of musculoskeletal disorders [6].

According to Global Burden of Disease report in 2016, MSDs were among the leading causes of disability-adjusted life years [7] with a double burden of economic costs, healthcare service utilization, and social problems [8, 9]. Occupational-related health problems such as shoulder and neck pain are among the most common causes of morbidity and absenteeism from work and reduced productivity in many countries [10–13] and have multifactorial biopsychological origin and socio-economic costs [9, 13, 14–16].
Two-thirds of all populations experience neck pain at some point in their lives [17]. From 1990 to 2010, the effect of neck pain disability adjusted life years increased from 23.9 million to 33.6 million [18]. According to the Global Burden of diseases reported in 2015, neck pain was among the leading causes of disability in most parts of the country [19].

In developing countries, occupational health and safety practices implementations are often disregarded and preventive measures are poor [20]. As a result of lack of adequate training, poor awareness, and underreporting of problems, the work-related MSDs have been increased in developing countries [21] and remain less prioritized [22]. In Ethiopia, there are several studies conducted on work-related MSDs such as neck and shoulder in various occupational settings [23–33].

However, there is no study that provides adequate evidence on the overall pooled prevalence of work-related MSDs such as neck and shoulder MSDs that can be crucial for policymakers or/and ministry of health in designing prevention and control programs and for the better understanding of the current evidence on the prevalence of shoulder and neck pain. Thus, this study aimed to determine the pooled prevalence of work-related shoulder and neck musculoskeletal disorders in Ethiopia.

2. Methods

This study aimed to determine the overall prevalence of shoulder and neck musculoskeletal disorders in the previous one year. The study was conducted under the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [34].

2.1 Eligibility Criteria.

The articles that met the following predetermined inclusion criteria were included in the systematic review and meta-analysis.

i. Population: Working population of Ethiopia regardless of their occupation.

ii. Outcome: Articles conducted on the prevalence of MSDs and reported one-year prevalence of shoulder and/or neck pain.

iii. Study design: A cross-sectional study that provides quantitative outcomes (magnitude, frequency, or prevalence or rate).

iv. Study location: Full text articles conducted in Ethiopia

v. Publication issue: Articles published in peer-reviewed journals from 2017 to 2020

vi. Language: Full-text articles written in English language.

2.2 Data/Information Sources and Search Strategies.

The searches of the literatures were done using keywords of the systematic review and meta-analysis through search strategies such as SCOPUS, PubMed/ MEDLINE, Embase, Cochrane Library, African Index Medicus, Google Scholar, CINAHL, and African Journals Online databases.

The articles were searched using a combination of Boolean logic operators (“AND, OR, and NOT”), Medical Subject Headings (MeSH), and keywords. The following are among the search terms the author (DA. Mengistu) used in the initial searching of literatures from included databases: "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".

Furthermore, the manual searching of the literatures was made to cover those articles difficult to locate and missed from the included electronic databases. Finally, all identified keywords and index terms were checked across the electronic databases. The last search was done on 22 August 2020.

2.3 Outcomes Measure

The primary outcome of interest was the prevalence of occupational-related shoulder and neck disorders/pain that was estimated or reported by dividing those experienced disorder/s by the total population at a given time. Furthermore, the
prevalence of shoulder and neck pain was estimated by dividing the number of people who experienced shoulder or neck pain by the sample size of each study for articles not reported the prevalence or rate.

2.4 Study Selection.

Duplicated articles were removed using the ENDNOTE software version X5 (Thomson Reuters, USA). The author (DA. Mengistu) screened the titles and abstracts of the identified articles by applying the inclusion and exclusion criteria. Study selection process was made using PRISMA flowchart showing the articles included in the study and articles excluded from the study with the reasons. Finally, the systematic review and meta-analysis included studies conducted in Ethiopia and published from 2017 to 2020 that reported the last one-year prevalence of shoulder and neck musculoskeletal disorders.

2.5 Data Extraction and Quality Assessment

The author extracted the required data from the eligible articles. The relevant data required for the study under the following headings: author/s; year of publication; sample size, study region; study design and primary outcomes were extracted using a Microsoft Excel, 2016 format. The selected articles were subjected to a rigorous appraisal using standardized critical appraisal tools, Joanna Briggs Institute (JBI) Critical Appraisal tools) [35] to determine the quality and relevance of each article. Then the score was taken across the articles and graded as high (85% and above score), moderate (60–85% score), and low (< 60% score) quality. The included articles were subjected to the evaluation (appraisal) at least two times at different time periods to check the accuracy of the work and to reduce the error.

2.6 Data Analysis and Statistical Procedures.

The pooled prevalence of work-related shoulder and neck MSDs in the previous one year was done using Comprehensive Meta-Analysis (CMA) version 3.0 statistical software. Furthermore, the forest plot and random-effects model were used to determine the pooled prevalence of shoulder and neck pain in the previous last one year.

The publication bias of the included studies was evaluated using funnel plots and P-value of < 0.05 was considered as the evidence for publication bias. Furthermore, the subgroup analysis was done based on the year of publication, study population/occupation categories, and study region to minimize the random variations between the included studies. Finally, the results were presented using texts, tables, and graphs/figures.

2.7 Heterogeneity

Cochran’s Q test, (Q) and (I Squared test) I² statistics were used to evaluate the heterogeneity among the included articles. I² statistics is the proportion of the variation in the estimates of prevalence due to genuine variation in prevalence [36, 37]. Furthermore, subgroup analysis based on the years of publication, occupation, and study areas were done to determine the heterogeneity in the prevalence of shoulder and neck pain.

3. Results

3.1 Study Selection

About 921 articles, and reports were searched through electronic databases such as Web of Science, SCOPUS, PubMed/MEDLINE, Embase, Google Scholar, CINAHL, Cochrane Library, African Index Medicus, African Journals Online databases and Science Direct from 16 July to 22 August 2020. Following the searching of articles, 222 articles duplicated articles were excluded. Furthermore, 443 articles excluded after initial screening and 66 articles excluded after full-text articles were assessed for eligibility. Finally, a total of 11 articles were included in the systematic review and meta-analysis (Fig. 1).

3.2 Characteristics of Included Articles

In this study, a total of 4,713 participants were included in 11 articles conducted in Ethiopia and published from 2017 to 2020 [23–33]. Regarding the region of the country where the studies were conducted, 3 (27.27%) articles [28, 30, 33] conducted in Oromia, 3 (27.27%) articles [25, 27, 29] in Amhara, 2 (18.2%) articles [24, 31] in Tigray, 2 (18.2%) in SNNP [23, 26] and one
(9.1%) article in Addis Ababa city administration [32]. The included studies were cross-sectional studies with a sample size ranging from 264 [31] to 755[32] study participants.

Based on JBI Critical Appraisal tool [35], all of the included articles had a low risk of bias. The work-related prevalence of shoulder and neck pain in the previous one year ranged from 10.5% [28] to 72.1% [29] and 7.6% [28] to 68.3% [29] respectively.

Among the studies included in this work, 10(90.1%) [23–25, 27–33] were reported the prevalence of both shoulder and neck pain, while only one article [26] reported the prevalence of shoulder pain alone. Furthermore, 6(54.54%) of included articles were published in 2020 [23, 24, 29–32] while 3(27.27%) articles [25, 27, 28] were published in 2019. (Table 1).

### Table 1
Overall characteristics of included articles in the systematic review and meta-analysis, 2020.

| Author                | Publication year | Study period | Sample size | Study design    | Prevalence of MSDs | Population          | Region       | Reference |
|-----------------------|------------------|--------------|-------------|-----------------|--------------------|---------------------|--------------|-----------|
| Tamene et al          | 2020             | 2019         | 344         | Cross-sectional | 61                 | 15.2                | Vehicle Repair Workers | SNNP       | [23]      |
| Kibret et al          | 2020             | 2018         | 307         | Cross-sectional | 29.6               | 35.2                | Bank workers         | Tigray     | [24]      |
| Wami et al            | 2019             | 2017         | 422         | Cross-sectional | 54                 | 50.7                | Hotel house keepers  | Amhara     | [25]      |
| Henok                 | 2017             | 2016         | 422         | Cross-sectional | 68.2               | NA                  | Pedestrian BL women  | SNNP       | [26]      |
| Mekonnen et al(a)     | 2019             | 2018         | 417         | Cross-sectional | 27.1               | 29.3                | Barbers               | Amhara     | [27]      |
| Lette, et al          | 2019             | 2017         | 410         | Cross-sectional | 10.5               | 7.6                 | Construction workers | Oromia     | [28]      |
| Mekonnen et al(b)     | 2020             | 2019         | 419         | Cross-sectional | 72.1               | 68.3                | Tailors               | Amhara     | [29]      |
| Mekonnen et al©       | 2020             | 2019         | 652         | Cross-sectional | 53.7               | 53.4                | Hairdressers          | Oromia     | [30]      |
| Melese et al          | 2020             | 2019         | 264         | Cross-sectional | 14                 | 9.5                 | Cleaners              | Tigray     | [31]      |
| Dagne et al           | 2020             | 2016/17      | 755         | Cross-sectional | 40.9               | 38                  | Bank workers          | Addis Ababa | [32]      |
| Regassa et al         | 2018             | 2015         | 301         | Cross-sectional | 14.1               | 24                  | Nurses                | Oromia     | [33]      |

Keys: MSDs: Musculoskeletal Disorders; NA: Not Applicable; SNNP: Southern Nations, Nationalities, and Peoples.

### 3.3 Prevalence of Musculoskeletal Disorders

The meta-analysis was conducted using the Comprehensive Meta-Analysis (CMA) Version 3 statistical package (software) to determine the pooled prevalence of work-related shoulder and neck musculoskeletal disorders in Ethiopia.

### 3.3.1 Prevalence of Occupational Related Shoulder Pain

#### 3.3.1.1 Overall Pooled Prevalence of Shoulder Pain
The pooled prevalence of occupational-related shoulder pain in the previous one year was found to be 37.9% with 95% CI of 26.5 to 50.8%; $I^2 = 98.51\%$ with p-value $< 0.001$ (Fig. 2).

### 3.3.1.2 Subgroup Analysis of Prevalence of Shoulder Pain Based on Study Population

Based on the subgroup analysis by the study population, the lowest prevalence [10.5% (95% CI: 7.9, 13.9%) with a p-value $< 0.001$] of occupational-related shoulder pain in the previous one year was reported among construction workers whereas the highest prevalence [72.1% (95% CI: 67.6, 76.2%) with a p-value of $< 0.001$] was reported among tailors.

After the subgroup analysis of the prevalence of work-related shoulder pain was done based on the study population or participants, the overall pooled prevalence of shoulder pain in the previous one year was 47.6% (95% CI: 45.8, 49.4% with P-value of = 0.009) (Fig. 3).

### 3.3.1.3 Prevalence of Shoulder Pain by Publication Year

Based on a subgroup analysis of the prevalence by year of publication, the lowest [14.7% (95% CI: 10.6, 18.5%) with a p-value of $< 0.001$] prevalence of work-related shoulder pain in the previous one year was reported in the study published in 2018 whereas the highest prevalence [68.2%, (95% CI: 63.6, 72.5%) with a p-value of $< 0.001$] was observed in the study published in 2017.

After subgroup analysis was done based on the year of publication, the overall pooled prevalence of occupational related shoulder pain in the previous one year was 49.8 % with 95% CI: 45.7, 53.9%) and a p value of $> 0.05$] (Fig. 4).

### 3.3.1.4 Prevalence of Shoulder Pain Based on Study Region of the Country

Based on the subgroup analysis of pooled prevalence of work-related shoulder pain by study region, the lowest pooled prevalence [20.9% (95% CI: 9.4%, 40.1%) with a p-value = 0.005] of shoulder pain in the previous one-year was reported among the study conducted in Tigray regional state whereas the highest prevalence [64.7%, (95% CI: 57.4, 71.4%) with a p-value of $< 0.001$] was reported by the study conducted in Southern Nations, Nationalities, and Peoples.

Furthermore, after the subgroup analysis of the prevalence of shoulder pain was done by the study region, the overall pooled prevalence of occupational related shoulder pain was 44.6 % with 95% CI: 41.4, 47.8%) and a P-value of = 0.001] (Fig. 5).

### 3.3.2 Prevalence of Occupational Related Neck Pain.

#### 3.3.2.1 Overall Prevalence of Neck Pain

The pooled prevalence of occupational related neck pain in the previous one year was 29.9% with 95% CI of 20.1, 41.9% with p-value of 0.002 and $I^2 = 98.29\%$ with P-value $< 0.001$ (Fig. 6).

#### 3.3.2.2. Prevalence of Neck Pain Based on Study Population

After the subgroup analysis of the work-related neck pain in the previous one year based on the study population, the lowest prevalence [7.6% (95% CI: 5.4, 10.6%) with a p-value $< 0.001$] was reported among construction workers whereas the highest prevalence [68.3% (95% CI: 63.7, 72.6%) with a p-value of $< 0.001$] was reported among tailors.

Furthermore, after subgroup analysis was done based on study population or participants, the overall pooled prevalence of occupational-related neck pain in the previous one year was 39.1% (95% CI: 37.5, 40.7% with P-value of $< 0.001$] (Fig. 7).
3.3.2.3 Prevalence of Neck Pain Based on Year of Publication

After a subgroup analysis based on the year of publication, the lowest pooled prevalence [24.0% (95% CI: 19.5%, 29.1%) with p-value of < 0.001] of work-related neck pain in the previous one year was reported in the study published in 2018 whereas the highest pooled prevalence [33.6%, (95% CI: 20.3, 50.2%) with a p-value of = 0.05] was observed among studies published in 2020.

Furthermore, after the subgroup analysis was done based on the year of publication, the overall pooled prevalence of neck pain in the previous one year was 25.1 % with 95% CI: 20.8, 29.9%) and a P-value < 0.001 (Fig. 8).

3.3.2.4 Prevalence of Neck Pain by Study Areas (Region)

Based on the subgroup analysis of pooled prevalence of work-related neck pain by study regions of the country, the lowest pooled prevalence [15.2% (95% CI: 11.8, 19.4%)] in the previous one year was reported by studies conducted in Southern Nations, Nationalities, and Peoples whereas the highest prevalence [49.3%, (95% CI: 28.2, 70.7%)] was reported among the studies conducted in Amhara regional state.

Furthermore, after the subgroup analysis was done based on the study region, the overall pooled prevalence of work-related neck pain was 32.6 % with 95% CI: 29.8, 35.5%) and a p value of < 0.001 (Fig. 9).

4. Discussion

This study was aimed to determine the pooled prevalence of occupational-related shoulder and neck pain in the previous one year in Ethiopia based on the previously published articles. In the current study, a total of 4713 of the study participants were included in 11 articles conducted in Ethiopia [23–33].

Musculoskeletal disorders such as neck and shoulder pain are the leading causes for the loss of productivity, employee absenteeism and affect quality of life. The current study found the pooled prevalence of occupational-related shoulder pain in the previous one year account 37.9% [95% CI:26.5, 50.8%; P-value < 0.001]. However, the pooled prevalence of shoulder pain was increased to 47.6%, 49.8%, and 44.6% after the subgroup analysis of the prevalence based on the study population, publication year, and study region respectively.

Furthermore, the study found the highest prevalence of shoulder pain (72.1%) among tailors [29] followed by the prevalence among pedestrian back-loading women (68.2%) [26], vehicle repair workers (61.0%) [23], hotel housekeepers (54.0%) [25] and hairdressers (53.7%) [30] respectively while the lowest prevalence of shoulder pain or disorders (10.5%) [28] was reported among construction workers. There is a variation in the prevalence of occupational-related shoulder pain among the included working populations with various occupations. The difference may be due to the variation in activities or nature of the work, availability of occupational health services, and implementation of occupational health and safety practices.

On the other hand, the current study found the pooled prevalence of work-related neck pain in the previous one year account 29.9% [95% CI:20.1, 41.9%; P-value = 0.002]. However, the pooled prevalence of neck pain among various working populations was increased to 39.1%, and 32.6% based on the subgroup analysis by the study population and study region, respectively. However, reduced to 25.1% based on the subgroup analysis of prevalence of neck pain by publication year. Furthermore, the study found the highest prevalence of neck pain (68.3%) among tailors [29], followed by the prevalence among hairdressers (53.4%) [30], and hotel housekeepers (50.7%) [25] respectively while the lowest prevalence of neck pain (7.6%) [28] was reported among construction workers. The variation may be due to the difference in activities, work load or nature of the work, and implementation of occupational health safety practices.

In general, the current study found that at least two participants out of seven study participants were experienced occupational-related shoulder pain, while three participants out of eight study participants were experienced occupational-related neck pain regardless of the occupation categories. This indicates that occupational-related MSDs continue to have
potential health and economic impacts. Thus, the implementation of occupational health and safety practices such as engineering control, administrative control, and use of personal protectives in the working environment play an important role in reducing these problems [38, 39].

Limitations
There was an unequal distribution of the occupations among the included articles. On the other hand, the prevalence of MSDs such as shoulder and neck pain in some regions of Ethiopia was not covered because of the lack of studies in those regions. Furthermore, cross-sectional studies were included and causal relationships between MSDs and risk factors cannot be established.

Conclusion
Occupational related musculoskeletal disorders continue to have a potential impact on worker’s health, productivity and quality of life worldwide. Similarly, the current study found that at least one-third of the study participants were experienced occupational-related shoulder and/or neck pain in the previous last one year. Thus, this study suggests that there is a need to improve and implement occupational health and safety to reduce MSDs and other occupational hazards.

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

Declarations
Ethics Approval and Consent to Participate.
Not applicable.

Consent for Publication
Not applicable.

Availability of Data and Materials.
Almost all data are included in this study. However, additional data will be available from the corresponding author on reasonable request.

Competing Interests.
The author declares that there is no competing interest in this work.

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Author Contributions
DA. Mengistu conducted this systematic review and meta-analysis independently. All activities in this work such as generating the idea, extracting and analyzing the data, writing, editing, revising, and approving the final version to be published were done by DA. Mengistu.
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**Figures**

| Study name      | Event rate | Lower limit | Upper limit | Z-Value | p-Value |
|-----------------|------------|-------------|-------------|---------|---------|
| Tamene et al    | 0.610      | 0.557       | 0.660       | 4.047   | 0.000   |
| Kibret et al    | 0.296      | 0.248       | 0.349       | -6.930  | 0.000   |
| Wami et al.     | 0.540      | 0.492       | 0.587       | 1.642   | 0.101   |
| Henok           | 0.682      | 0.636       | 0.725       | 7.299   | 0.000   |
| Mekonnen et al (a) | 0.271   | 0.230       | 0.316       | -8.982  | 0.000   |
| Lette et al.    | 0.105      | 0.079       | 0.139       | -13.301 | 0.000   |
| Mekonnen et al (b) | 0.721   | 0.676       | 0.762       | 8.716   | 0.000   |
| Mekonnen et al © | 0.537   | 0.499       | 0.575       | 1.888   | 0.039   |
| Melese et al    | 0.140      | 0.103       | 0.187       | -10.234 | 0.000   |
| Daene et al     | 0.409      | 0.374       | 0.444       | -4.973  | 0.000   |
| Regassa et al   | 0.141      | 0.106       | 0.185       | -10.911 | 0.000   |
|                 | 0.379      | 0.265       | 0.508       | 1.835   | 0.047   |

Heterogeneity (I Squared) = 98.51; P-Value <0.0001

Random effect model

**Figure 2**

Forest plot shows the pooled prevalence of occupational-related shoulder pain in the previous one year in Ethiopia, 2020.
| Group by Region       | Study name     | Statistics for each study |      | Event rate and 95% CI |
|----------------------|----------------|---------------------------|------|-----------------------|
|                      |                | Event rate | Lower limit | Upper limit | Z-Value  | p-Value |
| Addis Ababa          | Dagne et al    | 0.409      | 0.374       | 0.444       | -4.973   | 0.000   |
| Amhara               | Wami et al     | 0.540      | 0.492       | 0.587       | 1.642    | 0.101   |
| Amhara               | Mekonnen et al (a) 0.72 | 0.271      | 0.230       | 0.316       | -8.982   | 0.000   |
| Amhara               | Mekonnen et al (b) 0.72 | 0.676      | 0.672       | 0.762       | 8.716    | 0.000   |
| Amhara               |                | 0.510      | 0.265       | 0.751       | 0.074    | 0.941   |
| Oromia               | Lette et al    | 0.105      | 0.079       | 0.139       | -13.301  | 0.000   |
| Oromia               | Mekonnen et al | 0.537      | 0.499       | 0.575       | 1.888    | 0.059   |
| Oromia               | Regassa et al  | 0.141      | 0.106       | 0.185       | -10.911  | 0.000   |
| Oromia               |                | 0.221      | 0.053       | 0.588       | -1.527   | 0.127   |
| SNNP                 | Tamene et al   | 0.610      | 0.557       | 0.660       | 4.047    | 0.000   |
| SNNP                 | Henok          | 0.682      | 0.636       | 0.725       | 7.299    | 0.000   |
| SNNP                 |                | 0.647      | 0.574       | 0.714       | 3.847    | 0.000   |
| Tigray               | Kibret et al   | 0.296      | 0.248       | 0.349       | -6.930   | 0.000   |
| Tigray               | Melesa et al   | 0.140      | 0.103       | 0.187       | -10.234  | 0.000   |
| Tigray               |                | 0.209      | 0.094       | 0.401       | -2.809   | 0.005   |
| Overall              |                | 0.446      | 0.414       | 0.478       | -3.311   | 0.001   |

**Figure 5**

Forest plot shows the subgroup analysis of pooled prevalence of occupational related shoulder pain in the previous one year based on study region, 2020.
### Figure 6

Forest plot shows the pooled prevalence of occupational-related neck pain in the previous one year in Ethiopia, 2020.

| Study name           | Event rate | Lower limit | Upper limit | Z-Value | p-Value |
|----------------------|------------|-------------|-------------|---------|---------|
| Tamene et al         | 0.152      | 0.118       | 0.194       | -11.447 | 0.000   |
| Kibret et al         | 0.352      | 0.301       | 0.407       | -5.107  | 0.000   |
| Wami et al.          | 0.507      | 0.459       | 0.554       | 0.288   | 0.774   |
| Mekonnen et al (a)   | 0.293      | 0.251       | 0.339       | -8.187  | 0.000   |
| Lette et al.         | 0.076      | 0.054       | 0.106       | -13.404 | 0.000   |
| Mekonnen et al (b)   | 0.683      | 0.637       | 0.726       | 7.311   | 0.000   |
| Mekonnen et al ©     | 0.534      | 0.496       | 0.572       | 1.735   | 0.083   |
| Melese et al         | 0.095      | 0.065       | 0.137       | -10.739 | 0.000   |
| Dagne et al          | 0.380      | 0.346       | 0.415       | -6.529  | 0.000   |
| Regassa et al        | 0.240      | 0.195       | 0.291       | -8.541  | 0.000   |
| Overall              | 0.299      | 0.201       | 0.419       | -3.167  | 0.002   |

Heterogeneity (I Squared) = 98.29; P-Value < 0.0001

Random effect model

### Figure 9

Forest plot shows the pooled prevalence of occupational-related neck pain in the previous one year in Ethiopia, 2020.

| Region   | Study name           | Event rate | Lower limit | Upper limit | Z-Value | p-Value |
|----------|----------------------|------------|-------------|-------------|---------|---------|
| Addis Ababa | Dagne et al         | 0.380      | 0.346       | 0.415       | -6.529  | 0.000   |
| Addis Ababa | Wami et al.         | 0.380      | 0.346       | 0.415       | -6.529  | 0.000   |
| Amhara   | Mekonnen et al (a)  | 0.293      | 0.251       | 0.339       | -8.187  | 0.000   |
| Amhara   | Mekonnen et al (b)  | 0.683      | 0.637       | 0.726       | 7.311   | 0.000   |
| Amhara   | Letter et al.       | 0.076      | 0.054       | 0.106       | -13.404 | 0.000   |
| Oromia   | Mekonnen et al ©    | 0.534      | 0.496       | 0.572       | 1.735   | 0.083   |
| Oromia   | Regassa et al       | 0.240      | 0.195       | 0.291       | -8.541  | 0.000   |
| Oromia   | Tamene et al        | 0.152      | 0.118       | 0.194       | -11.447 | 0.000   |
| SNPP     | Kibret et al        | 0.152      | 0.118       | 0.194       | -11.447 | 0.000   |
| Tigray   | Melese et al        | 0.095      | 0.065       | 0.137       | -10.739 | 0.000   |
| Tigray   | Tamene et al        | 0.152      | 0.118       | 0.194       | -11.447 | 0.000   |
| Tigray   | Kibret et al        | 0.152      | 0.118       | 0.194       | -11.447 | 0.000   |
| Overall  | Melese et al        | 0.095      | 0.065       | 0.137       | -10.739 | 0.000   |

Heterogeneity (I Squared) = 98.29; P-Value < 0.0001
Forest plot shows the subgroup analysis of pooled prevalence of occupational related neck pain in the previous one year based on study region, 2020.