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Review Article

Prevalence and determinants of occupational injuries among small-scale industry workers in sub-saharan Africa. A systematic review and meta-analysis

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ABSTRACT

Introduction: Occupational injuries are manifestations of diseases because of different exposure in the workplace like Small-Scale cement factories, tanneries, textile and/or street sweeping, and woodworkers all of which affect the health condition and productivity. In sub-Saharan Africa, several primary studies were conducted regarding the magnitude of occupational injuries with a prevalence of 68.89% in street sweepers and determinant factors with inconsistent results.

Objectives: This meta-analysis aimed to the pooled prevalence of occupational injuries and their associated factors in Sub-Saharan Africa among workers working in small-Scale industries.

Materials and Methods: PubMed, African Journals Online, Google Scholar, Cochrane Library, and Direct Google were systematically searched to identify primary studies. Three authors performed data abstraction and quality assessment for each included study independently. Cochran's Q-statistic and I-squared statistics were used to check heterogeneity. The random-effects models were used to estimate the pooled prevalence and associated factors of occupational injuries. Publication bias was checked by funnel plot and Egger's test, and also sensitivity analyses were performed.

Results: 20 primary studies with 7,235 study participants were included in the Systematic review and meta-analysis of the pooled prevalence of occupational injuries among Small-Scale industry workers in Sub-Saharan Africa. The pooled prevalence of overall occupational injuries among Small-scale industry workers in Sub-Saharan Africa was 53.23% (95% CI= 44.71, 61.74). Training, Sleeping disturbance, and Educational level were significantly associated with occupational injuries.

Conclusion: In this review, the pooled prevalence of occupational injuries was high. The findings of this study dictate the need for the implementation of workplace safety measures. Special attention is required for employees with lower educational levels and training.

1. Introduction

According to the World Health Organization, creating a safe and healthy physical and psychosocial workspace (work environment) is the top priority for promoting health and well-being in the workplace. The workplace can greatly improve the health and happiness of employees and, in turn, that of their families and communities at large.[1]

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WHO and the International Labor Organization (ILO) produce the Joint Estimates of Work-related Burden of Disease and Injury Estimates the number of deaths and quantity of health loss brought by occupational risk factors are quantified in these Joint Estimates.

According to initial combined estimates, nearly 1.9 million people died in 2016 from work-related illnesses and injuries, including 750,000 deaths attributed to employees working extended hours and sleep disturbances, which were

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originally calculated as part of the joint estimates and recognized as having the risk factor the highest work-related disease burden.[1,2] As safe jobs and jobs are essential for improved productivity and production, their promotion and protection are complementary aspects of industrial development.[2,3]

However, industrial occupations create unsafe work and work environments because of inherent sources of hazard present in their material, process, and technologies. These sources of hazards may pose the risk of accidents and work-related diseases to the people within the industrial premises in particular and the general public in the vicinity and the environment.[4]

Recent economic developments have brought changes to workplaces in developing countries, and the organization of occupational health and safety services is not yet resilient enough to meet the growing worker health demands in the context of industrialization, including for Welders, refuse collectors, and road workers sweepers.[5] Although the development of these industries has been blamed for the incidence of workplace accidents such as respiratory illnesses and personal injury in developed countries,[6] it is also widespread in low- to middle-income countries due to workers' knowledge and practices related to prevention and Prevention has limited control effects.[7]

The total number of accidents at work is 53% among woodworkers in Iran[8] and 21.1% among cement factory workers in eastern Nepal.[9] It is common in India and is also observed in street sweeper workers (23.97%).[10]

Sub-Saharan Africa is transforming agriculture into an industry that requires labor, leading to an increase in work-related accidents. The prevalence of accidents at work in sub-Saharan Africa ranges from 31.2%[11] to 86.5%.[12] To our knowledge, there is no comprehensive national study on this topic in sub-Saharan Africa. Therefore, we performed a meta-analysis to fill the above gaps and planned to consolidate the overall prevalence of work-related accidents and their association with worker sleep disorders, workers' education levels, and small-scale industry workers' training. Factories can use the results of this study as evidence to understand the magnitude of the problems and to tailor preventative actions to the modifiable risk factors to ensure workplace safety.

2. Materials and Methods

2.1. The study protocol registration and reporting

This systematic review and meta-analysis were conducted to determine the pooled prevalence of occupational accidents among small-scale industrial workers in sub-Saharan Africa using the standard PRISMA checklist guideline[13] (Supplementary file 1). The protocol was registered at PROSPERO with registration number CRD42023427400.

2.2. Searching strategies and sources of information

Data search was performed Pub Med, Web of Science, Scopus, Google Scholar, Cochrane Library, and African Journals Online databases used to get the research articles. Boolean operators ("OR" or "And") and the following keywords and phrases were used to create search strategies: Occupational injuries, Small- Scale Industry, and Sub-Saharan Africa. The search strategy made in PubMed was**:** Search: Occupational injuries [tw] OR "Occupational injuries"[MeSH Terms] OR "Occupational exposure" [MeSH Terms] OR "Occupational injuries"[Subheading] OR "injuries"[MeSH Terms] AND Sub-Saharan Africa. The search period was from March 1/2023 to May 10/2023.

2.3. PECO Frameworks

2.3.1. Population

The small-scale industry workers.

2.3.2. Exposure

Exposure is a key factor that increases or decreases the likelihood of Occupational injuries among Small-Scale Industry workers in Sub-Saharan Africa.

2.3.3. Context

Sub-Saharan Africa.

2.3.4. Condition

Occupational injuries.

2.3.5. Outcome measurement

The primary outcome of the study was the prevalence of industrial accidents among workers in small-scale industries in sub-Saharan Africa. The secondary outcome of the study was determinants influencing the primary outcome.

2.4. Inclusion and exclusion criteria

2.4.1. Inclusion criteria

Studies were considered relevant if they provided a dominant observational study of occupational accidents. All work available for the study was performed on all population groups and published and unpublished work in English was included. They also explained the methods for analyzing accidents at work and their determinants.

2.4.2. Exclusion criteria

Studies were excluded if they had no relevance to one another, insufficient data, redundant sources, unclear methodology, interventional studies, case reports, or journals whose complete text was unavailable, and Contact with the corresponding author was made.

2.4.3. Quality assessment

Two authors (YAA and KAG) independently assessed the standard of the studies using the Joanna Briggs Institute (JBI) standardized quality assessment checklist.[14] The disagreements raised during the quality assessment were resolved through a discussion led by the third author (NAG). Eventually, the dispute was settled and an agreement was reached. The critical analysis checklist contains eight parameters with the options Yes, No, Unclear, and Not Applicable.

The parameters are about the following questions:

1. Where were the criteria for inclusion in the sample clearly defined?
2. Were the study subjects and, therefore, the setting described in detail?
3. Was the exposure measured result validly and reliably?
4. Were the main objective and standard criteria used to measure the event?
5. Where confounding factors identified?
6. Were strategies to affect confounding factors stated?
7. Were the results measured indeed and dependably? and,
8. Was the statistical analysis suitable? Studies were considered low risk when they scored 50% and above on the quality assessment indicators, as reported in a supplementary file (Supplementary file 2).

2.5. Risk of bias assessment

We used the tools from Hoy et al.[15] to test internal and external validity against 10 criteria to determine the risk of bias. The tool included (1) population representation, (2) sampling frame, (3) methods of participant selection, (4) non-response bias, (5) data collection directly from subjects, (6) acceptance of case definition, (7) reliability and validity of study instruments, (8) type of data collection, (9) length of prevalence period, and (10) adequacy of numerator and denominator. Each element was assigned a low or high risk of bias. Articles with unclear assessment tools for data collection were classified as having a high risk of bias. Finally, the overall risk of bias rating was assessed based on the number of studies with a high risk of bias: low (2), moderate (3-4), and high (5) (Supplementary file 3).

2.6. Study selection and extraction process

Endnote X7 was used to remove duplicates. The publications were screened based on title, abstract, and full-text review. The majority of discrepancies during study selection were resolved by consensus following extensive debate.

The abstract and full text was reviewed by the three independent reviewers. The author's name, year of publication, study design, country, occupational status, and sample size were extracted for the assessment of risk factors and the Prevalence of occupational injuries among adults in sub-Saharan countries. Data were extracted using a standardized data extraction format prepared in Microsoft Excel by three independent authors. Any difference during extraction was solved through discussion.

3. Operational Definition

1. *Small-Scale Industry:* Any industry with fewer than 10 employees that uses power-driven machines.
2. *Occupational Injury:* is a condition in which a worker sustains a wound or suffers bodily harm as a result of an incident at work.

3.1. Data analysis

Microsoft Excel was used to extract the data and STATA version 14 for analysis. The funnel plot was used to check for publication bias, and Begg and Eggers regression tests were used for more objective testing. Potential publication bias was determined to exist when $P < 0.05$.[16,17] The Cochrane Q statistic was used to assess the degree of significant heterogeneity between studies. The heterogeneity between the studies was quantified using I2, with values of 0, 25%, 50%, and 75% denoting no, low, moderate, and increased heterogeneity.[18] A piece of forest was used to visualize the presence of heterogeneity. Because we found a high level of heterogeneity, we used a random effects model for analysis to estimate the pooled effect.[19] In addition, we performed subgroup analyses by country and sample size for outcome variables. A leave-one-out sensitivity analysis was used to determine how a study's results would affect the overall estimate of the meta-analysis. Text, tables, and graphics were used to present the results.

4. Results

4.1. Search outcomes

A total of 16 and 4,382 articles were found using the database and the manual search. After removing duplicate studies, we received 3,403 studies that were selected for full title and abstract screening. Of these, 3,277 studies were excluded based on title and abstract, and the remaining 126 articles were assessed as full-text articles. After reviewing the full text, 106 articles were deleted because they contained missing full titles and abstracts and reported findings from developed countries. Finally, 20 articles with 7,235 study participants were included as criteria for this systematic review and meta-analysis study (Figure 1).

4.2. The characteristics of the primary studies

Twenty (20) primary studies[11,12,20–37] involving 7,235 subjects were included in the systematic review and meta-analysis. One study was unpublished[33] and nineteen studies

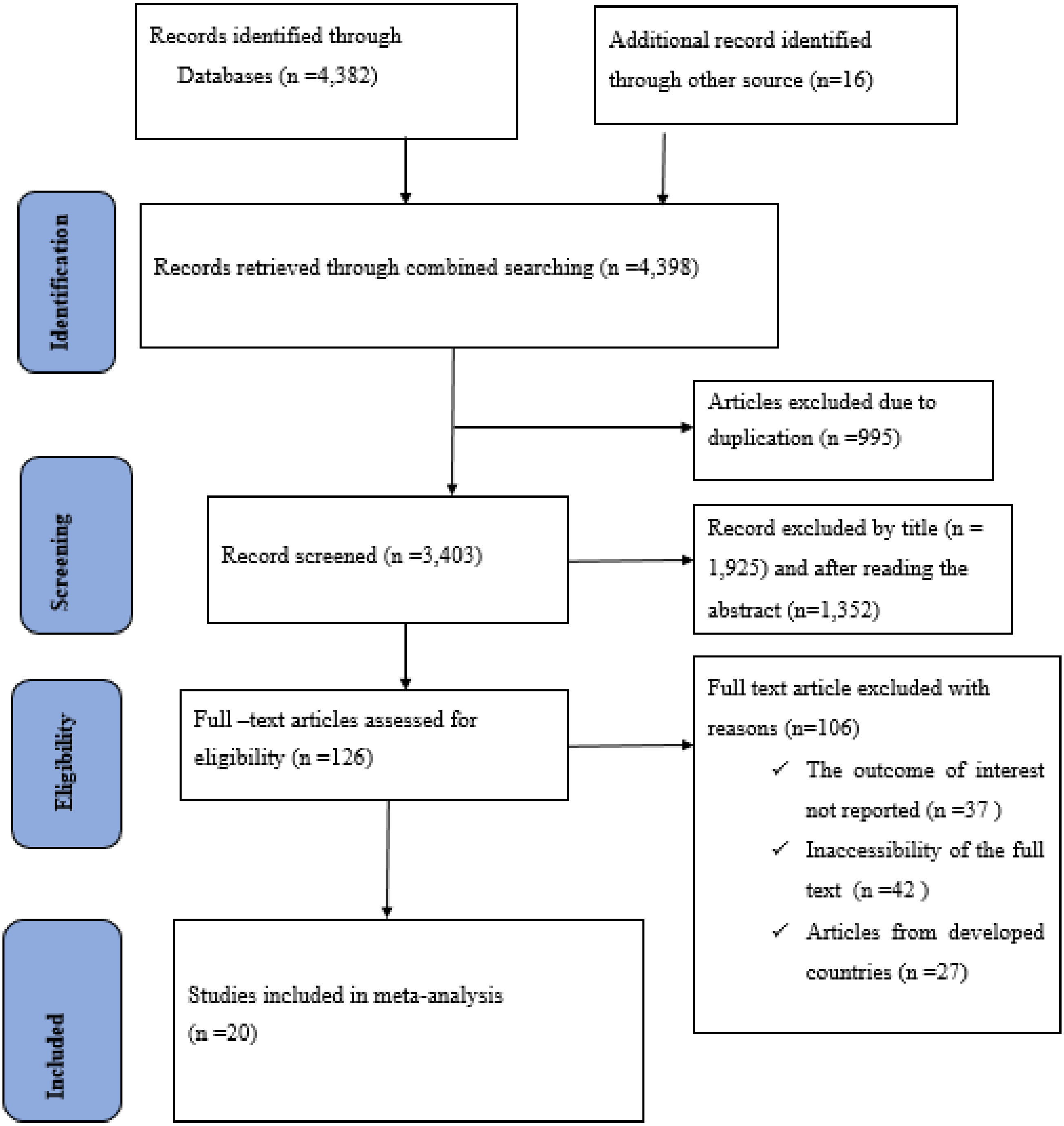

Figure 1: Schematic presentation of study selection for systematic review and meta-analysis of occupational injuries among small-scale industry Workers in Sub-Saharan Africa.

Table 1: Characteristics of studies included in the systematicreview and meta-analysis on the level of occupational injuries among small-scale industry workers in sub-saharan Africa.

Authors Name	Year/publication	Country	Study design	Sample Size	Prevalence(95%CI)	Study Quality
Sandra van. et. Al[11]	2019	South Africa	Cross-sectional	347	31.2	Low
Sebsibe T. et .al[12]	2016	Ethiopia	Cross-sectional	540	86.5	Low
Debassu E. et .al[20]	2016	Ethiopia	Cross-sectional	394	58.5	Low
Zemichael G. et.al[21]	2014	Ethiopia	Cross-sectional	482	63.9	Low
Takele T.et. al[22]	2007	Ethiopia	Cross-sectional	321	49.1	Low
Liku M. et. Al[23]	2022	Ethiopia	Cross-sectional	389	60.4	Low
Samuel Y. et .al[24]	2020	Ghana	Cross-sectional	560	34.3	Low
Patrick E. et. Al[25]	2021	Ghana	Cross-sectional	358	21.62	Low
Norman D. et al[26]	2013	Ghana	Cross-sectional	158	44.7	Low
Shonisani E. et.al[27]	2022	South Africa	Cross-sectional	560	45.9	Low
Steven J. et.al[28]	2016	Zimbabwe	Cross-sectional	32	59.6	Low
Betelhiem E. et. Al[29]	2021	Ethiopia	Cross-sectional	168	48.8	Low
AwokeY.et al[30]	2021	Ethiopia	Cross-sectional	505	69.8	Low
Yetunde O. et.al[31]	2018	Nigeria	Cross-sectional	298	45.8	Low
Iyiade A.et .al[32]	2011	Nigeria	Cross-sectional	405	35.5	Low
Jessy Z. et .al[33]	Unpublished	Zimbabwe	Cross-sectional	430	52.2	Low
Brian I. et .al[34]	2021	Uganda	Cross-sectional	349	76.6	Low
Karl K. et .al[35]	2020	Ghana	Cross-sectional	382	59.7	Low
Berhe B.et.al[36]	2019	Ethiopia	Cross-sectional	278	51.9	Low
Tamene M.et al[37]	2017	Ethiopia	Cross-sectional	279	68.9	Low

were published from 2007 to 2022[11,12,20–32,34–37] The sample size ranged from 32 to 560.[27,28] Nine studies were conducted in Ethiopia (12.20-23.29.30.36.37), four studies in Ghana.[24–26,35] two studies in South Africa,[11,27] two studies in Zimbabwe.[28,33] two studies in Nigeria[31,32] and one study in Uganda.[34] The risk level of each study was assessed and we found that all studies were rated as low risk of bias (Table 1). Regarding the study design, all studies used a cross-sectional study design. The highest rate of accidents at work (86.5%) was recorded in a primary study from Ethiopia.

5. Meta-Analysis

5.1. Prevalence of occupational injuries among small-scale industry workers in sub-saharan Africa.

Based on the main studies included, the prevalence of occupational accidents among employees was between 31.2% and 86.5%[11,12] However, the forest plots below show the predicted overall prevalence of occupational injuries among workers in sub-Saharan Africa. The overall pooled prevalence of occupational accidents among small-scale industrial workers in sub-Saharan Africa was 53.23% (95% CI = 44.71, 61.74), representing significant heterogeneity between included studies (I2 = 98.4%; P- value 0.001). The random effects model was used to analyze the pooled prevalence (Figure 2).

5.2. Handling heterogeneities between studies

5.2.1. Subgroup analysis

Subgroup analysis was performed by study countries and occupation status was used to measure the outcome variable. The country subgroup analysis publicized 62.12% (95% CI=52.83, 71.42) Pooled prevalence of occupational injuries in Ethiopia 53.22% (95%CI= 44.708, 61.743) in the country

Table 2: Subgroup analysis for the pooled prevalence of Occupational injuries among Small-Scale Industry Workers in Sub-Saharan Africa.

Variable	Characteristics	D +L pooled estimate with 95% CI	Participants	No of Studies	I^2(p -value)	Degree freedom (n – 1)
By Country	Ethiopia	62.125 (52.831, 71.420)	3,356	9	97.2%(<0.001)	8
	Ghana	40.006 (23.451, 56.560)	1,458	4	97.8% (<0.001)	3
	South Africa	38.610 (24.204, 53.015)	907	2	95.1%(<0.001)	1
	Zimbabwe	52.730 (48.181, 57.279)	462	2	0.5% (p=0.411)	0
	Nigeria	40.520 (30.429, 50.611)	703	2	86.8% (<0.001)	1
	Uganda	53.225 (44.708, 61.743)	349	1	…..	0

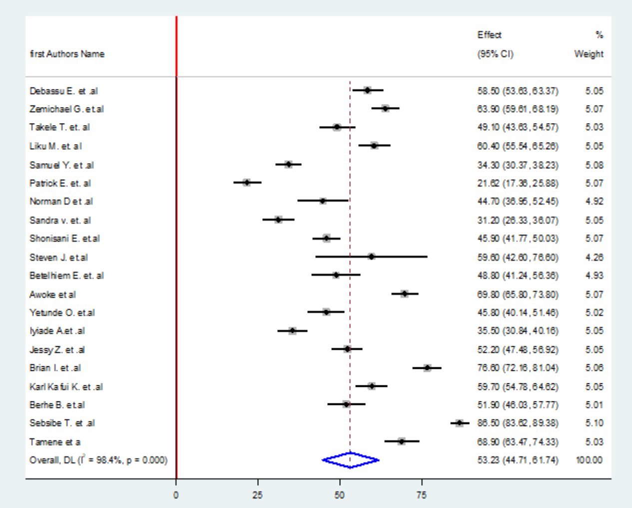

Figure 2: Forest plot depicting estimated pooled prevalence of occupational injuries among Small-Scale Industry Workers in Sub-Saharan Africa.

Uganda, 52.73% (95%CI:48.181, 57.279) in Zimbabwe 40.52% (95%CI=30.42,50.61) in Nigeria, 40% (95%CI: 23.451, 56.560) in Ghana and the least pooled prevalence 38.61% (95%CI= 24.20, 53.01) in South Africa. (Table 2).

5.3. Leave-out-one sensitivity analysis

A leave-out-one sensitivity analysis was done to evaluate the effect of each study on the pooled prevalence level of occupational injuries by excluding each study step-by-step. The results showed that the excluded study did not bring any significant change to the estimated level of occupational injuries respectively (Table 3).

5.4. Publication bias

The presence of publication bias was assessed using a funnel plot, and Egger and Begg regression test at a 5% significant level. The symmetrical distribution of included studies by the funnel plot showed the absence of publication. There was none of the statistical evidence of publication bias. Furthermore, the Begg and Egger tests were not statistically significant with a p-value = 0.626 and p-value = 0.364 respectively. The test, thus, shows no evidence of a small-study effect. (Figure 3).

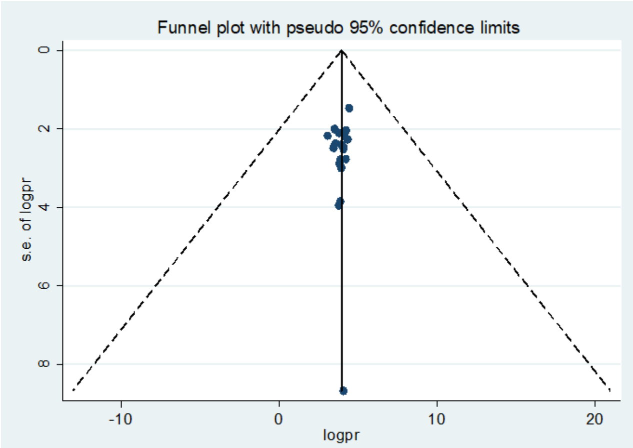

Figure 3: Funnel plots for publication bias of occupational injuries among small-scale industry workers in sub-saharan Africa.

5.5. Meta-regression analysis

To assess the underlying Source of heterogeneity the meta-regression analyses were computed by using the year of publication Country, and the sample size of the studies. However, there was statistically insignificant heterogeneity (p-value=0.95), (p-value=0.86), (p-value=0.73), and

Table 3: A-leave-out -one sensitivity analysis for the prevalence ofoccupational injuries among Small-Scale Industry Workers in Sub-Saharan Africa.

Study omitted	Pooled Estimate	95% Conf. Interval
Debassu E. et .al	52.94	(43.97,61.91)
Zemichael G. et.al	52.656	(43.97,61.91)
Takele T. et. al	53.44	(44.54,62.34)
Liku M. et. al	52.84	(44.54,62.34)
Samuel Y. et .al	54.23	(45.62,62.84)
Patrick E. et. al	54.91	(45.62,62.84)
Norman. D et .al	53.66	(44.86,62.46)
Sandra v. et.al	54.39	(45.81,62.97)
Shonisani E. et.al	53.61	(44.64,62.58)
Steven J. et.al	52.94	(44.21,61.66)
Betelhiem E. et. al	53.45	(44.63,62.27)
Awoke et al	52.34	(43.44,61.23)
Yetunde O.et.al	53.61	(44.75,62.48)
Iyiade A.et .al	54.16	(45.46,62.87)
Jessy Z. et .al	53.28	(44.30,62.25)
Brian I. et.al	51.97	(43.29,60.66)
Karl K.et.al	52.88	(43.92,61.84)
Berhe B.et.al	53.29	(44.40,62.18)
Sebsibe T. et .al	51.41	(44.25,58.57)
Tamene. et al	52.39	(43.55,61.23)
Combined	53.22	(44.70, 61.74)

Table 4: Meta-regression analysis based on year of publication, country, type of occupation, and sample size of the studies.

Source of heterogeneity	Coefficient	Standard error	P-value
By Year of Publication	0.991	0.146	0.953
By Country	0.941	0.330	0.865
By sample size of the studies	1.0007	0.004	0.883

(p=0.88), respectively (Table 4).

6. Factors Associated with Occupational Injuries in Sub-Saharan Africa

We performed a meta-analysis to identify associated factors for work-related injuries using the random effects model. During the extraction process, we planned to show the association of each factor with the outcome variable. However, we could not examine an association between each factor and occupational injuries because factors listed in one study were not found in others and the categorization of predictor variables differed in each primary study. Therefore, we examined the pooled effect of four factors on the outcome variable educational level, sleep disturbances, training, and use of personal protective equipment (PPE) in the workplace.

6.1. The association between occupational injuries and the educational level

The relationship between injuries at work and the level of education of workers has been assessed in five studies (20, 21, 29, 30, and 35). The odds of having an injury at work were 3.58 times (pooled OR = 3.58, 95% CI: 2.40, 5.33) for those who had elementary education (Grade 8 and below) than for those who attended secondary education and above. A low degree of heterogeneity was found in all studies (I-squared = 13.1%, p = 0.331); for this reason, we used a random effects model (Figure 4).

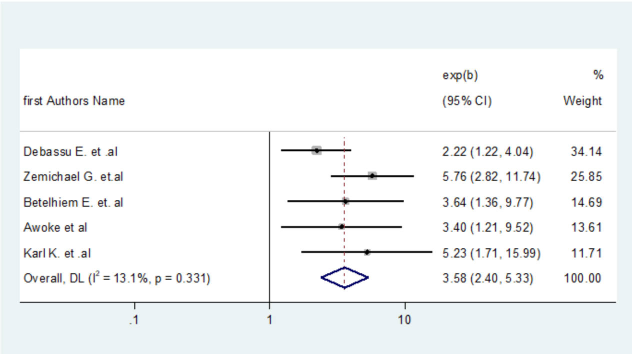

Figure 4: Forest plot showing the association between occupational injuries and educational level.

6.2. The association between occupational injuries and training

The relationship between injuries at work and training has been assessed in five studies[21,29,30,33,35]. The result showed that the combined effect of training was significantly associated with injuries at work among small-scall industries workers. Employees who received training on workplace accidents were 2.30 times less likely to be injured at work than untrained employees (pooled OR = 2.95, 95% CI = 2, 08, 4,17). No heterogeneity was observed across studies (I-squared = 0.00%, p = 0.79); For this reason, we used a random effects model (Figure 5).

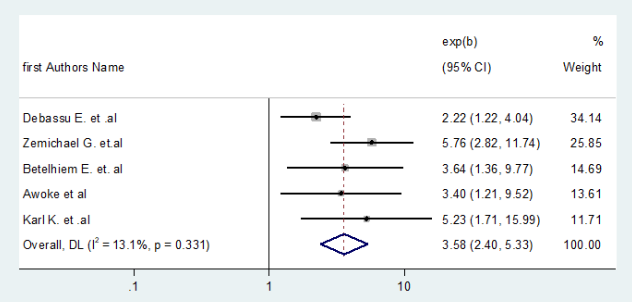

Figure 5: Forest plot showing the association between occupational injuries and having training on the workers.

6.3. The association between occupational injuries and sleeping disturbance of workers

Finally, the five studies showed that sleep disturbances in workers were significantly associated with workplace injuries.[20–22,30,37] Workers with normal sleeping habits were 2.30 times more likely to have fewer injuries than workers with sleep disorders. (Pooled OR = 2.30, 95% CI = 1.58, 3.35). Because heterogeneity was moderate, we used a random effects model (I-squared = 0.53.3%, p = 0.073) (Figure 6).

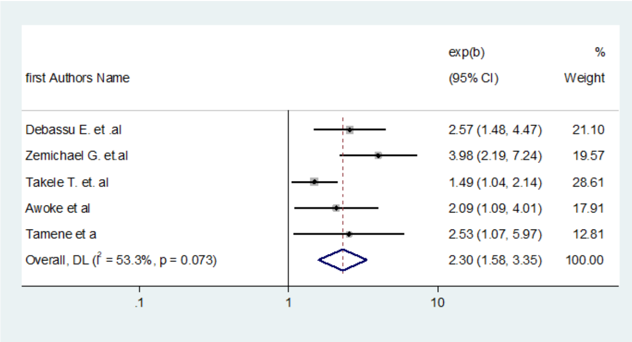

Figure 6: Forest plot showing the association between occupational injuries and sleeping disturbance of workers.

7. Discussion

To design more adaptable occupational health and safety policies and strategies to the local context, concrete evidence for regional estimation is essential. These findings could have significant implications for health and safety issues that are more relevant to governments, health and safety agencies, regulators, and policymakers. This systematic review and meta-analysis show that a significant number of workers in Africa are small-scale workers. This study was able to assess the pooled prevalence of work-related injuries and associated factors among workers in small-scale industries in sub-Saharan Africa. To the best of our knowledge, this meta-analysis is the first of its kind to identify the aggregated magnitude of work-related accidents and related factors in sub-Saharan Africa.

The current systematic review and meta-analysis aimed to analyze the pooled prevalence of all work-related injuries and their determinants in sub-Saharan Africa. Comprehensive sub-Saharan country-level studies were not available to allow direct comparison with our results. Nevertheless, efforts have been made to compare our results with previous studies. To account for this, we used pocket studies in different countries to compare our results.

In this meta-analysis, we found a higher prevalence of work-related injuries (53.23%). This is consistent with other studies conducted among street sweepers in India (23.97%).[10] In contrast, the current review found a higher pooled prevalence than other studies conducted in eastern Nepal (21.1%).[9] This difference could be due to the differences in occupation as our study combined the prevalence of different occupational exposures and other studies listed above were for a single occupation, which could lower the prevalence. On the other hand, social education and socio-economic status are lower in Sub-Saharan Africa, which may affect workers' knowledge and practice in implementing preventive measures to protect against occupational problems.

Subgroup analysis of occupational injuries showed a higher percentage of occupational problems among woodworkers 69.80% (65.796, 73.804). This might be because woodworkers are more exposed to dust particles, and the chemicals released are more dangerous. Besides, overall occupational injuries were higher among studies in Ethiopia. This finding was extremely higher than a study finding in Chandigarh, India (12.3%),[38] and Coastal South India among welder workers (44%).[39] the difference in the magnitude of countries might be due to variations in sample size, accessibility of waste practice, and the management principle across countries. Moreover, variations in study periods and the emphasis given to waste practices in health facilities might contribute to this discrepancy.

Education was associated with higher odds of occupational injuries. Other studies supported similar findings.[40,41] This might be because a person with a lower education level would have inadequate knowledge about occupational safety to allow better protection of the health condition. This study found that workers who had received training were more likely to suffer fewer workplace injuries because they were more likely to be injured at work. This finding is supported by a study in northern Iran.[39,42] A possible explanation could be that trained workers allow them to use the tool as needed. This underscores the need for preparatory and on-the-job training. In addition, the availability of training correlates positively with employee satisfaction.

The odds of suffering an accident at work were higher among employees with sleep disorders than among the reference persons. This is supported by other studies, where length of work is associated with a higher percentage of work-related accidents.[40,41] This could be because the longer the working time, the longer the exposure time. This research found that the use of personal protective equipment was not randomly associated with workplace accidents. However, the results of various studies suggest the need to implement workplace safety measures to prevent work-related accidents, as recommended in the Fourth Industrial Revolution.[42]

7.1. Strengths and limitations of the study

We searched articles systematically and included studies using clearly defined criteria to minimize selection bias. We missed some relevant literature only articles in English and some databases were not searched. Additionally, we included preprint articles, not yet peer-reviewed, and results from these studies may change in the future and methodological biases may be present.

8. Conclusion

The combined prevalence of injuries in small-scale industries work in Sub-Saharan Africa was high, making it necessary to take measures to ensure safety at work and reduce the risk of health risks for workers to improve their health. To determine the probability of occupational accidents in the exposed workplace, routine health checks of the staff must be taken into account. In people with less education and more work experience, sleep disorders require special treatment. In cooperation with the government, factories must inform their workers and develop preventive safety measures for the workplace.

9. Authors' Contribution

In addition to creating the protocol and conceptualizing the study Y.A. also worked on database searches, data abstraction, statistical analysis, report writing, and paper preparation.

K.A. and N.A. were involved in initial study screening, conflict resolution during data extraction, statistical analysis, and manuscript writing. Before submission, the final paper was reviewed and approved by all authors. Y.A. and K.A. contributed to the meta-analysis (which combined the impact size), graphics, and result interpretation. The final establish was read by all writers before being approved.

10. Availability of data and materials

The data set and all the relevant files are found by the primary author and can be gained from the authors upon convincing request.

11. Source of Funding

The author(s) received no financial support for the research.

12. Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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