

Research Article

Effect of an Occupational Health and Safety Educational Intervention on Knowledge, Practices, Musculoskeletal Disorders, and Injuries Among Oilseed Processing Workers

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Abstract

Occupational hazards, injuries, work-related illnesses, and fatalities remain core public health challenges in industrial settings. Workers in oilseed processing factories are exposed to multiple occupational risks; however, evidence regarding the effectiveness of occupational health and safety educational interventions in these settings remains limited and not explored and examined. The main objective of this study is to evaluate the effect of educational program on workers occupational health and safety (OHS) knowledge, attitudes, practices, and the prevalence of occupational injuries in oilseed processing (OSP) factories. A quasi-experimental controlled pretest–posttest intervention study design will be conducted among 466 factory workers selected through simple random sampling and equally allocated to intervention and control groups. Around 466 workers recruited from 10 randomly selected OSP factories in Eastern Ethiopia. The factories will be purposively allocated into intervention ($n = 5$) and control ($n = 5$) groups based on geographical location, with 233 workers randomly selected from each group (1:1 allocation). Eligible participants will be factory workers aged ≥ 18 years with at least one year of employment. OHS Educational intervention program will be implemented for 3 months. The intervention consisted of a three-month OHS educational program incorporating health education sessions, on-the-job training, and informational leaflets. Data will be collected at baseline and post-intervention. Data will be entered using Epi-Data and analyzed in STATA version 16.1. Between-group differences will be assessed using chi-square, independent t -, and Mann-Whitney tests. Multivariable logistic regression and generalized estimating equations (GEE) will be applied to estimate intervention effects using a difference-in-differences approach. Statistical significance will be set at $p < 0.05$. Regarding ethics and dissemination, Ethical approval was obtained from the Jimma University Institute of Health Institutional Review Board (Ref: JUIH/IRPB/217/25). Findings will be disseminated through collaboration with factory management, health professionals, government agencies, community stakeholders, and non-governmental organizations to facilitate the implementation and scale-up of effective workplace OHS interventions. This study will generate robust evidence on the effectiveness of an OHS educational program in enhancing workers OHS knowledge, attitudes, and practices while reducing or not occupational injuries and work-related Musculo-skeletal disorders (WMSDs) among OSP factories workers in Ethiopia. The study is expected to generate context-specific evidence that can inform workplace OHS policies and guide the development of feasible, evidence-based interventions for industrial workers in Ethiopia. At the time of reporting, the intervention is started but not completed, and post-intervention data collection is also not completed.

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Keywords

Occupational-Injuries, Knowledge, Quasi-Intervention, Educational-Program, Effect, Workers, Oil-Seeds, Factories

1. Introduction

1.1. Background

Occupational health is a multidisciplinary field dedicated to protecting and promoting workers' health by preventing occupational diseases and injuries, controlling workplace hazards, and fostering safe and healthy working environments [1]. It has evolved from a hazard-focused discipline into a comprehensive approach that addresses workers' physical, mental, and social well-being while supporting overall health and personal development. A core objective of occupational health is the primary prevention of workplace hazards through effective health and safety measures [2]. Workers' health is influenced by multiple occupational risk factors that contribute to adverse outcomes, including occupational injuries, cancers, work-related musculoskeletal disorders, respiratory and circulatory diseases, hearing impairment, stress-related conditions, and infectious diseases [1, 2].

Workers in dust-generating industries are at increased risk of inhaling airborne particulate matter, including silica, asbestos, cement, wood, sand, and stone dust. Prolonged exposure to these particles can damage the respiratory system, leading to airway irritation, excessive mucus production, impaired lung function, chronic inflammation, chronic obstructive and restrictive lung diseases, pneumoconiosis, and other respiratory disorders [1, 2]. Occupational health aims to prevent such work-related illnesses by protecting and promoting workers' health through hazard control, health promotion, emergency preparedness, and preventive, curative, and rehabilitative services. Effective occupational health programs also strengthen workers' capacity through education, training, and knowledge sharing, thereby fostering safer and healthier workplaces [2].

Although many organizations invest considerable effort in establishing safety measures and conducting workplace safety inspections to reduce incidents, occupational incidents continue to occur, partly due to unsafe behaviors, inappropriate attitudes, and carelessness. Workers' behaviors and work-related activities also contribute to the occurrence of many workplace incidents [3].

Globally, work-related mortality remains a major public health concern. Approximately 65% of global work-related deaths occur in Asia, followed by Africa (11.8%), Europe (11.7%), the Americas (10.9%), and Oceania (0.6%). This distribution reflects differences in workforce size, hazardous working conditions, and levels of economic development, with mortality rates in Africa and Asia estimated to be four to five times higher than those in Europe [4, 5]. In Europe alone,

nearly 167,000 deaths occur annually due to occupational causes, including about 7,500 from workplace accidents [6, 7].

Occupational diseases and injuries remain a major public health challenge in Africa [8]. Sub-Saharan Africa records the highest rate of occupational accidents, with an estimated 42 million incidents and more than 54,000 fatalities reported annually [8]. Although fatal occupational injuries occur across all economic groups, the burden is disproportionately higher in developing countries due to unsafe working environments, limited awareness, inadequate training, and insufficient occupational health services [5].

Literature indicates that data on occupational injuries and illnesses in manufacturing industries are often scarce, incomplete, or unreliable, generally reflecting poor occupational health conditions among workers [9].

Occupational deaths and disabilities remain disproportionately high in developing countries such as Nigeria due to unsafe workplaces [5], limited occupational health services, inadequate worker training, and poor safety awareness, with over 200 industrial accidents reported daily across sectors [10, 11].

These high rates of occupational injuries reduce productivity and impose substantial economic costs, with the International Labor Organization (ILO) estimating that work-related accidents, injuries, and diseases account for 4% of global GDP approximately 2.02 trillion USD in direct and indirect costs [12-14]. Contributing factors include limited awareness unsafe practice and barriers to implementing workplace health and safety measures [15]. Globally, unsafe working conditions are linked to significant health burdens, including over a third of back pain, 16% of hearing loss, nearly 10% of lung cancer, and 8% of depression cases [6, 7].

1.2. Rational of the Study

Many factory workers lack sufficient education to understand or adopt appropriate protective measures [16]. Conducting studies to evaluate occupational health and safety (OHS) educational interventions in oilseed processing (OSP) factories is essential for reducing workplace injuries and diseases while enhancing workers' knowledge, attitudes, and practices. Such research is important for identifying effective strategies and best practices aimed at minimizing occupational hazards and improving workers' health outcomes.

Despite limited evidence from previous studies, particularly in country, robust interventions assessing knowledge, attitude

and practice (KAP) regarding occupational hazards are lacking [17]. This impact of an educational program intervention on improving knowledge, attitudes, and safe practices related to occupational hazards among oilseed processing factories workers is unknown [7, 18].

Promoting occupational health and safety (OHS) practices is a critical priority for policymakers, public health professionals, researchers, and resource managers in Ethiopia and other sub-Saharan African countries, given the substantial workforce employed in this sector [19]. However, evidence on the effectiveness of health education interventions in improving workers OHS-related knowledge, attitudes, and practices, including personal protective equipment (PPE) use and workplace hygiene, remains limited.

Furthermore, there is a lack of data on how safety practices influence the occurrence and prevention of accidents among oilseed processing (OSP) and medium-scale factories workers [19]. Many government organizations, institutions health workers and studies are using health education to prevent occupational diseases, injuries, hazards and accidents but its effectiveness is unknown. Findings from this study inform the development and enforcement of effective policies and interventions to reduce occupational injuries and fatalities [19].

Workers in Ethiopian oilseed processing (OSP) factories have limited studied knowledge regarding dust exposure, ergonomic and psychosocial risks, and their health impacts. Enhanced understanding of OHS through KAP assessments is essential for implementing effective control measures. This study therefore aims to evaluate the effect of educational program on OHS knowledge, practices, and injury incidence among OSP factories.

The findings of this study provide valuable evidence that may inform the design and implementation of targeted intervention strategies aimed at reducing occupational hazards in factory environments. The results may also support the development and strengthening of preventive programs and contribute to the formulation and improvement of occupational health and safety (OHS) guidelines within industrial settings. Furthermore, the evidence generated by this study may assist policymakers, industry stakeholders, and occupational health professionals in revising and enhancing workplace safety policies and practices to better protect workers' health and well-being.

2. Materials and Methods

2.1. Objective

The main objective of the study is to evaluate the effects of occupational health and safety health education program intervention on knowledge and safety practice and incidence of work-related musculoskeletal disorders and injuries among OSP factories workers in Eastern Ethiopia.

The specific objectives: to evaluate the effects of occupational health and safety health education program intervention

on knowledge and safety practice and incidence of work-related musculoskeletal disorders among OSP factories workers in Eastern Ethiopia. To evaluate the effects of occupational health and safety health education program intervention on knowledge and safety practice and incidence of injuries among OSP factories workers in Eastern Ethiopia.

2.2. Materials and Methods

2.2.1. Study Area and Setting

The study will be conducted in Adama, located approximately 78 km northeast of Addis Ababa [20-23]. Ten oil-seed processing factories were selected from 33 factories using simple random sampling.

Study Design

A factory-based quasi-intervention design of intervention/case and comparison/control study with two parallel groups will be conducted from December 10/2025-December 20/2026. This will be followed by a pre and post data collection to evaluate the effect of educational program on workers OHS knowledge, attitudes, practices, and the incidence of work-related Musculo-skeletal disorders (WMSDs) including occupational injuries in OSP factories

Based on this occupational health education intervention, the PICO would be:

Population (P): Oil seed processing factory workers in Adama, Ethiopia.

Intervention (I): Received a 12-week occupational health and safety educational intervention consisting of 16 structured training sessions.

Comparison (C): Workers in the control factories who continued with routine workplace practices and did not receive the educational intervention during the study period.

Outcome (O): Changes in occupational health and safety knowledge, attitudes, practices, occupational injuries, and work-related musculoskeletal disorders.

2.2.2. Sample Size Estimation

To determine workers' knowledge and practice regarding WMSDs in OSP factories of Adama Town. Single population proportion formula was used for both.

To evaluate effect of OHS educational program on workers' knowledge, safety practices, work-related Musculo-skeletal disorders (WMSDs), & injuries incidence, the sample size was calculated using the double population proportion formula, assuming a 50% baseline prevalence due to the absence of prior intervention studies in OSP factories [24-28].

$$n = \left(\frac{r+1}{r} \right) \frac{\bar{p} (1-\bar{p}) (Z_{\beta} + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

Accordingly, the proportion of participants with adequate knowledge and safety practices in the control group (p_2) was

assumed to be 50%, while the intervention group (p_1) was expected to achieve 60%. This anticipates an absolute increase of 10% in knowledge and WRMDs preventive safety practices from baseline, resulting in an expected end-line proportion of 60% in the intervention group. The sample size ratio between the intervention and control groups (r) 1:1, was calculated based on this expectation. P is mean of p_1 and p_2 $\{ \frac{P_1+P_2}{2} \}$, the desired level of statistical significance (α) 5% and the value of the normal distribution at 5% significance level ($Z_{\alpha/2}$) 1.96 and the desired power (80%) of the study 0.84 were used ($P_{Tot}=P_1+P_2$) finally these yields 388 workers.

To account for potential non-responses, 20% was added to the calculated sample size, resulting in a total of 466 participants. Based on this adjustment, each study group included 233 workers, 233 in the intervention group and 233 in the control group yielding a combined sample of 466 participants. This final sample size will be used to meet all study objectives.

2.2.3. Sampling Distribution/Procedures

Using simple random sampling, 10 of 33 oilseed processing factories in Adama will be selected and assigned to intervention ($n=5$) or control ($n=5$) groups. From a total workforce of 1,050, 466 eligible workers will proportionally be allocated and purposively selected after excluding engineers, technicians, and supervisors. A sampling frame of eligible workers will be prepared prior to participant selection. Using computer simple random allocation will be done.

Qualitative data will be collected through direct observation, focus group discussions (FGDs), and in-depth interviews (IDIs). Purposively selected participants included community leaders, health professionals, factory managers, workers, and environmental health officers, yielding four FGDs and 24 IDIs, with females comprising 50% of participants. Sampling strategies varied by study objectives.

2.2.4. Eligibility

(i). Source Population

All Oil seed processing factories in Adama town of Oromia region and all workers in these factories.

Study Unit/Participants

All operational oilseed processing factories in Adama Town, Oromia Region, during the study period. All workers

aged ≥ 18 years employed in operational oilseed processing factories in Adama Town during the study period.

(ii). Participants' Selection

Factory recruitment: -We identified eligible factories from the local factories' registries. The inclusion criteria were (i) medium-sized OSP factories (100–500 employees); (ii) could be matched with another factory by industry and production processes; and (iii) $<30\%$ turnover rate of workers in the year before recruitment [29].

We then paired each eligible factory with another factory in the same industry with similar production processes and employment size. Using the above criteria, we invited 10 factories to participate and 466 workers (233 matched pairs) agreed to be included in the sampling frame. We randomly selected 10 factories (5 pairs of factories) for the intervention and purposively assigned by location and distance between the two groups of factories. Selection is one factory from each matched pair as the experimental and control factory. Factories that are similar work activities and product output were selected from the same area and from other different area (5) to prevent information contamination.

(iii). Recruitment of Participants

After excluding engineers, technicians, and supervisors, key hazards and relevant working sections in each factory were identified. A sampling frame, listing all eligible workers in the selected factories, will be created, and the total sample size was proportionally allocated to each factory. Study participants will be then selected using simple random sampling. For example, if a factory had 100 workers and 50 participants will be required, 50 workers will be randomly chosen using a lottery method.

Sampling distribution: Using simple random sampling, ten factories were selected from a total of 33 oilseed processing factories in Adama Town. These ten factories (total workforce = 1,050) were then randomly assigned into two groups: five factories for the intervention group and five for the control group. From each group, 233 workers were randomly selected, resulting in a total sample of 466 participants. Specifically, 233 workers were selected from the 525 employees in the five intervention factories and 233 from the 525 employees in the five control factories (Figure 1).

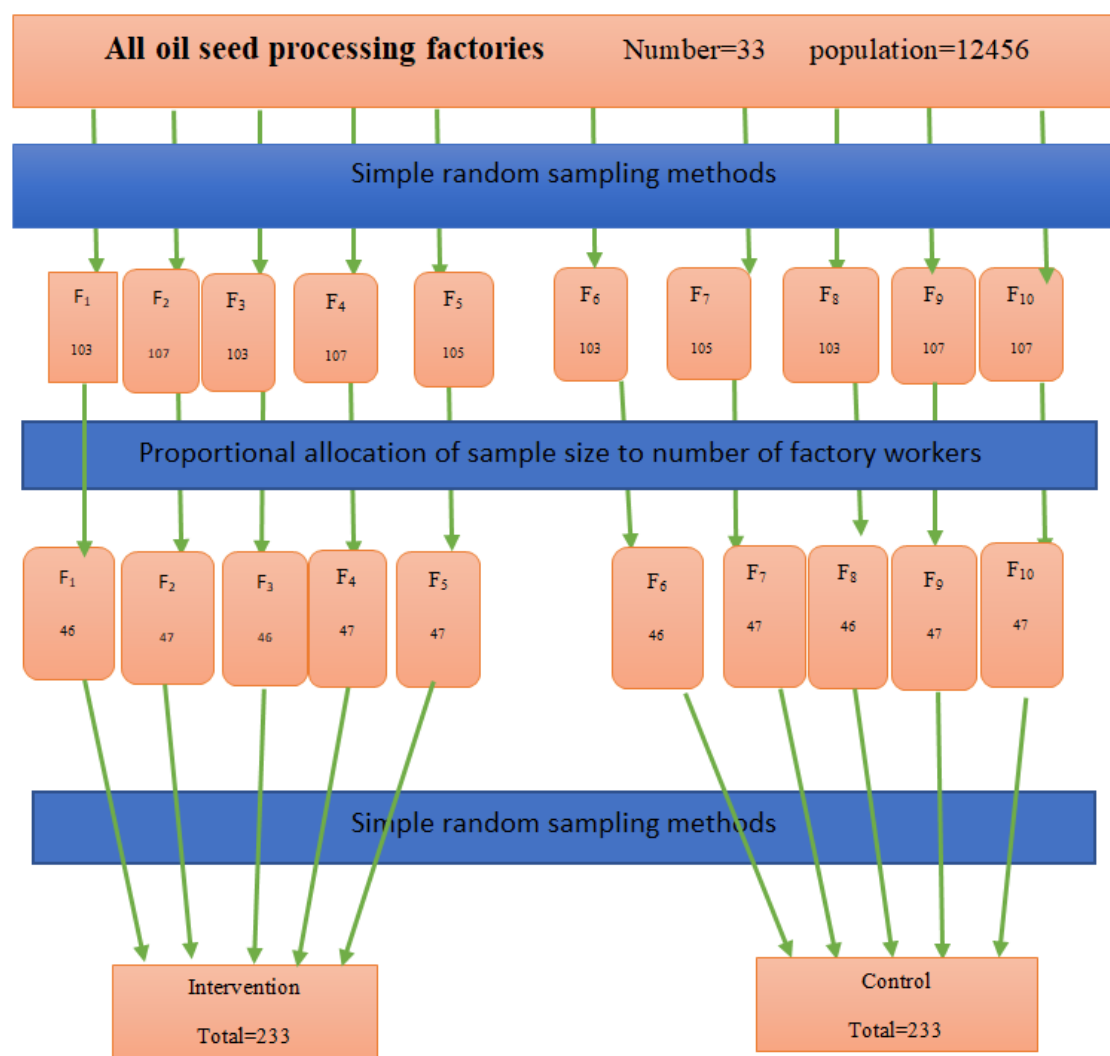


Figure 1. Sampling distribution.

The following *inclusion criteria* will be used;

All oilseed processing factories operational for ≥ 1 year and all workers aged ≥ 18 years with ≥ 1 year of service in Adama Town during the study period.

The following *exclusion criteria* was considered;

Oilseed processing factories operating for < 1 year, workers aged ≥ 18 years with < 1 year of service, and administrative staff were excluded. The exclusion criteria were not voluntary to participate, age below 18 years, previous history of training on OHS, WRMDs, Hygiene and PPE use. We excluded employees in design or logistics positions, or those who were illiterate or seasonal migrant workers. Following baseline data collection, factories will be classified and purposively assigned to either the intervention or control group. A total of 466 eligible factory workers were selected for the study. To

minimize bias, field data collectors, the research team, other workers, and participants were remaining unaware of the study mission assignments. Among ten factories in Adama Town, five were randomly selected for the intervention group, creating the intervention and control arms. Each study arm was pre-assigned to a random number, sealed in an envelope, and revealed only after baseline assessments are completed. Simple random with a 1:1 allocation ratio will be used, and the person overseeing randomization will inform the research team of each participant's group.

The personnel responsible for subsequent data collection will be blinded to group mission assignments. There will be no change to the method after the intervention began (See [Figure 2](#)).

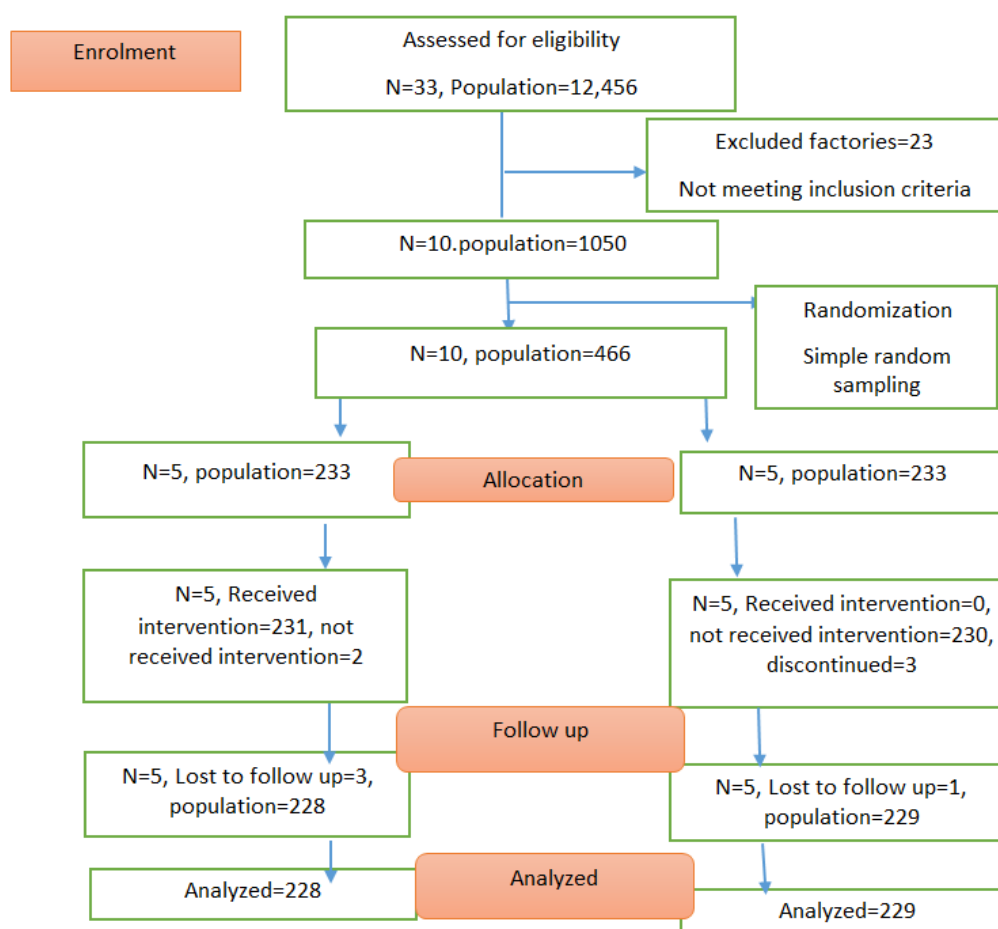


Figure 2. Consolidated study distribution flow diagram.

2.2.5. Information Contamination Reduction

At least two administrative kebeles and three clusters will be maintained as buffer zones between any two groups that do not share a common boundary. Participants in the intervention groups will be informed about the study design and requested to refrain from sharing information or messages from the OHS health education programme with members of other groups or clusters until the intervention period has ended.

2.2.6. Description of Core Intervention

This mixed study with cohort evaluated the effectiveness of a workplace health education intervention among workers aged ≥ 18 years using intervention and control groups. The intervention comprised a 12-week evidence-based OHS education program with 20 sessions (35–60 minutes each), delivered at least four times monthly and tailored to workplace-specific risks identified through baseline assessment and job-task analysis. Educational content focused on OHS practices, ergonomics, WMSDs prevention, hygiene, and PPE utilization. Outcomes, including OHS practices, PPE use, and occupational disease symptoms. The intervention was implemented by a multidisciplinary team comprising an occupational hygienist, a health promotion specialist, a sociologist,

an environmental health professional, a clinical nurse, two MPH-qualified health officers, and a medical doctor.

(i). Detail About Field Work

The study will be conducted in four sequential phases: assessment, program development, implementation, and evaluation. The intervention comprised a 12-week, evidence-based health education program developed from the baseline assessment and job task analysis. Twenty structured sessions (35–60 minutes each) will be delivered by a multidisciplinary team, and post-intervention data will be collected one month later (February 21–March 21, 2026). The overall study workflow is presented in [Figure 2](#).

- 1) *Assess the current situation:* Start with a thorough evaluation of the current occupational health, safety, and hygiene conditions in the oilseed processing factory. This assessment should pinpoint critical areas for improvement and identify potential hazards to which workers are exposed.
- 2) *Develop a tailored intervention plan:* Using the assessment findings, design a targeted intervention plan that addresses the identified gaps and workplace hazards. The plan should be tailored to the specific needs of the oilseed processing factory and its workforce.

- 3) *Provide on job training and health education program:* Implement training programs and workshops to educate workers on occupational health, safety, and hygiene. Training should cover topics such as safe machinery handling, OHS, proper use of PPE, and best hygiene practices.
- 4) *Enhance engineering controls:* Identify opportunities to enhance engineering controls within the factory, such as upgrading tools, modifying machinery, implementing ventilation systems, or introducing automation to minimize workers' exposure to hazards.
- 5) *Encourage active worker participation:* Engage workers in the decision-making process by encouraging their active participation in hazard identification, proposing improvements, and implementing safety measures. This can be facilitated through regular safety meetings, feedback sessions, and the formation of worker committees.
- 6) *Provide adequate PPE for workers by factory owner:* Ensure that workers are provided with appropriate PPE, including gloves, goggles, masks, and protective clothing, and are trained in its correct use. Continuously monitor PPE effectiveness and provide feedback or make adjustments as needed to maintain safety standards.
- 7) *Regular monitoring and evaluation:* Implement a system for continuous monitoring and evaluation of the intervention's effectiveness, including regular inspections, collection of worker feedback, and analysis of relevant occupational health and safety data.
- 8) *Foster a culture of safety:* Foster a positive safety culture in the factory by acknowledging and appreciating safe behaviors, increasing awareness of occupational health and safety, and addressing obstacles or resistance to change.
- 9) *Collaborate with relevant stakeholders:* Collaborate with key stakeholders, including factory management, worker representatives, government agencies, and occupational health and safety experts, to secure support, resources, and expertise for implementing sustainable workplace improvements.

This mixed-methods study used intervention and control groups among workers aged ≥ 18 years. A cohort with baseline and follow-up assessments will be applied to evaluate occupational health and safety (OHS) practices, personal protective equipment uses, and occupational disease symptoms. The intervention group received a three-month health education program (≥ 4 sessions/month) on OHS, ergonomics, WMSDs, hygiene, and PPE use, while the control group received no intervention. Outcomes will be assessed over six months, and the study processes and intervention steps are summarized in Table 1.

Table 1. Summary of intervention description and level of compliance to the intervention package among the study participants.

Type or nature of the intervention	Dosage	Frequency	Duration	Compliance parameter
Brochure guided participants OHS Education	30-45 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Risk reduction methods: Elimination, Substitution, Enhancing work methods/patterns, Reduced time exposure, Engineering controls (isolation, insulation and ventilation).	30-45 minute intervention	Four rounds in a month	Three months	No of participants educated and given feedback. 99% full compliance to the intervention package
Work place ventilation	30-45 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Personal hygiene	30-45 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Brochure guided participants PPE use Education	30-45 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
How PPE can used: When PPE is needed, What PPE is needed, how to properly wear and adjust the PPE, Limitation of the PPE, clean PPE, Proper care, maintenance and disposal of PPE.	30-45/60 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Hazards in work place: Fall hazards, Impact, Penetration, Compression (roll-over), Chemical, Heat/cold, Harmful dust, Light (optical) radiation, and Biologic, Noise	30-45/60 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back

Type or nature of the intervention	Dosage	Frequency	Duration	Compliance parameter
Ergonomic hazards: Uncomfortable chair, to twist or bend, Lifting done above shoulder height, elbows raised while work done, work table adjustable, pain or discomfort while working, sharp edge put pressure on the skin	30-45/60 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Brochure guided Participants ergonomic risk /WRMDs Education	30-45/60 minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Brochure guided participants with ergonomic risk to practice physical exercise, for only participants with WRMDs illness	30-45minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Man, and machine: Unguarded machines, protruding and moving parts, poor electrical and machinery installation of the plant, and lack of safety measures	30-45minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Work and interaction with in environment: The employees, The tool, The process, The work environment	30-45minute intervention	Four rounds in a month	Three months	No of participants educated and given feed back
Participants were provided completion slip and advice after completion of brochure guided participants OHS Education				

(ii). Methods of Factory Health Education Program Intervention

1) The way Health education delivered

Based on baseline findings, the intervention group received a three-month health education program comprising four sessions (35–60 minutes each) on occupational health and safety, PPE use, hazard control, and injury prevention. The program employed lectures, group discussions, and illustrated handouts, while the control group received no intervention. Outcomes related to workers' knowledge, OHS and PPE practices, musculoskeletal disorder prevention, and performance were evaluated using structured questionnaires at six-month follow-up.

2) Factory health education program intervention

A multidisciplinary technical committee developed and implemented a workplace health education program in intervention factories from April 10 to July 10, 2025. The program

delivered 35–60-minute sessions using presentations, discussions, and question-and-answer approaches to improve workers' occupational health and safety (OHS) knowledge and practices. It addressed OHS risks, ergonomic hazards, and safe work practices through structured training, teaching guidelines, and stakeholder coordination, with implementation monitored through regular supervisory reports.

3) How to deliver intervention

A baseline assessment informed the development of a literature-guided occupational safety and health (OSH) educational program in collaboration with experts in occupational medicine, environmental health, and health education. The intervention addressed workplace hazards, personal protective equipment (PPE), occupational injuries and diseases, musculoskeletal disorders, workplace hygiene, and ergonomic risk reduction. Participants in the intervention group attended 35–60-minute small-group sessions (12–30 workers) delivered through interactive lectures, discussions, and educational pamphlets by an occupational medicine specialist (Table 2).

Table 2. Key messages of occupational health interventions used in the study.

Intervention	Key messages	Methods	Tools used
Making Safe work environment/cover machine	Clean environment, hands body, PPE (Gowan), waste management Make attractive and planted environment There are machines with unprotected start up There are machines with unprotected moving parts	Pamphlet Demonstration Instruction	Locally available materials/observation
Hand washing with soap and	Wash your hand after toilet	Pamphlet	Water and soap

Intervention	Key messages	Methods	Tools used
water Hand washing near toilet	Wash your hand before eating Wash your hand after child defecation Keep hand washing near toilet Keep soap near toilet	Demonstration Instruction Demonstration Instruction	Locally available Jeri cans were used as demonstration
Body washing Safe waste disposal messages	Wash your body after work Dispose liquid waste properly Dispose solid waste properly	Demonstration instruction Instruction	Nearby shower
There is safety instruction in the work place Safety precaution	Safety instruction posted Using safety guide line Safety precaution posted	Pamphlet Instruction	Use of safety precaution sign image
Use of vibrating tool	Reduce or avoid vibrating tools	Instruction	
There is noise source that are not damped, enclosed effectively or placed in separate room	Use helmet to prevent hearing loss Loading machine must buried/separated/isolated	Demonstration instruction	
Workers are exposed to organic bags of dust like oil seeds, cotton seeds.	Use mask Reducing dust source emission	Demonstration instruction	PPE available
Good light in work place	Enough light in work place	instruction	
Slippery surface of the work place	Take care of slippery surface to reduce accidents/fails Make it un-slippery	Pamphlet instruction	
OHS safety	Occupational health and safety in industries Prevalence of occupational diseases	Instruction	
OHS safety in practice	Prevention of occupational illness and injury in industries Health and safety practice in industries	Instruction	
Ventilation of work place and prevention of exposure	Prevention of occupational illness and injury in industries Health and safety practice in industries	Instruction	
Importance of ventilation at work place	Definition and use of ventilation	Demonstration instruction	
PPE use	Definition and use of PPE	Demonstration instruction	PPE available
Importance of PPE	Prevention methods of occupational diseases PPE is one of methods of occupational diseases prevention	Instruction	
Ergonomic risks	Ergonomic risks that lead to WRMDs, How to prevent WRMDs	Instruction	
Prevention of WRMDs	Definition of WRMDs Cause of WRMDs Prevention methods of WRMDs	Demonstration instruction	Video and images

Participants will be followed for six months. The intervention group received a three-month educational program followed by reinforcement training during the subsequent three months to strengthen knowledge and address emerging needs.

The control group will receive no intervention during the study and will be assessed at baseline and six months using the same structured questionnaire. To ensure equity, the con-

trol group received the educational intervention after completion of the endline assessment.

Compliance parameter. Participants' attendance records across the 12 intervention contact sessions will be used to assess adherence to the intervention (Table 1).

Primary outcome variables: - The incidence of occupational injuries, work-related musculoskeletal disorders (WMSDs) and diseases will be determined through factory surveys and record reviews at baseline and endline. Intervention effectiveness will be evaluated using a difference-in-differences analysis comparing changes in incidence between the intervention and control groups.

Secondary outcomes: - Occupational health and safety (OHS) knowledge, attitudes, and practices will be assessed at baseline and endline to evaluate intervention effects.

(iv). Activity Schedule

Participants enrollment, intervention and assessment schedule is summarized as follows (Table 3).

Table 3. Participants time line of enrolment, intervention and assessment.

Activity	Time schedule in months												
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Participant enrolment													
Baseline assessment													
Intervention													
Follow up													
End line assessment													

Note: M1-Month one, M2-Month two....

(v). Data Collection Methods

Factory-based surveys will be conducted using pretested, structured questionnaires. Baseline data will be collected after participant recruitment is completed, and endline data will be collected at the conclusion of the intervention. The assessments will cover sociodemographic characteristics, knowledge, attitudes, safety practices, and the incidence of occupational injuries and diseases.

Knowledge will be measured using dichotomous (Yes/No) items, with scores above the median classified as good knowledge. Attitudes will be assessed using a five-point Likert scale, with median-based scores indicating favorable attitudes. Between-group changes will be compared to determine the effectiveness of the intervention.

(iii). Reliability of Measures

Data collection instruments were adapted from validated studies and contextualized to the study setting to enhance reliability. Internal consistency was assessed using Cronbach's alpha (acceptable threshold ≥ 0.70), and necessary revisions were made. Data collectors received standardized training to ensure consistent and high-quality data collection.

(vi). Confidentiality

The confidentiality of study participants will be maintained throughout the study. After data collection, participant identifiers will be removed from the questionnaires, and each questionnaire will be assigned a unique code to protect participants' identities. The completed checklists containing identifying information will be stored securely until they are appropriately disposed of. The assigned codes will be used to identify participants during data processing and analysis. A summary of the intervention protocol is presented in Table 4.

Table 4. Summary of the intervention protocol.

No	Packages of intervention	Dosage	Frequency	Duration	Compliance parameter
1	Base line data collection			1month	

No	Packages of intervention	Dosage	Frequency	Duration	Compliance parameter
2	Group health education (+leaf-lets)	35-60min	Once in a week	3months	No of participants educated and given feed back
3	Visiting and follow up	30-45min	One in a month	3months	No of participants contacted and given feed back
4	Cohort follow up			6months	
5	Endline data collection			1month	

(vii). Intervention Fidelity

Intervention fidelity was ensured through a standardized protocol implemented across all intervention factories. Facilitators received pre-intervention training, and 20 structured sessions were delivered over 12 weeks using uniform materials and schedules. Supervisors monitored adherence with a standardized fidelity checklist, while attendance records, interactive discussions, and regular supervision ensured consistent implementation and strengthened the study's internal validity.

2.2.7. Data Management

Clusters and participants will be assigned unique codes to maintain confidentiality. Data will be entered into Epi Info version 7.2.7, checked and cleaned, and then exported to SPSS or Stata for statistical analysis.

(i). Statistical Analysis

Data will be entered into Epi-info transferred to IBM SPSS Statistics version 26 and analyzed using STATA version 16.1. Descriptive statistics will summarize participant characteristics and study variables. Between-group comparisons will be performed using independent t-tests, Mann-Whitney U tests, chi-square tests, and Pearson correlation, as appropriate. Intervention effects will be estimated using generalized estimating equations (GEE) with a difference-in-differences approach, accounting for clustering, repeated measurements, and potential confounders. Binary and multivariable logistic regression will identify factors associated with study outcomes. Qualitative data will be analyzed using thematic content analysis, and all analyses will follow the intention-to-treat principle. Results will be reported as odds ratios (ORs) with 95% confidence intervals (CIs), with statistical significance set at $p < 0.05$.

(ii). Data Monitoring

The researchers will form a group of supervisors to monitor and audit the data-gathering process at baseline and endline evaluations.

(iii). Plan of Dissemination

The trial findings will be disseminated to participating factories, relevant government and non-government stakeholders, and the scientific community through publications and conference presentations. To ensure equity, the control group received the same three-month educational intervention after completion of the trial.

The highlight for review is also explained in supplemental materials (Highlight for review).

3. Discussion

Occupational health and safety challenges remain an important concern in Ethiopian industries, where workplace risks may vary by sector, region, and working conditions. Despite international recommendations emphasizing evidence-based approaches to occupational injury prevention, evidence on the effectiveness of structured OHS educational interventions among industrial workers in Ethiopia remains limited. This study therefore aims to address an important evidence gap by evaluating a structured OHS educational intervention among workers in oilseed processing factories in Eastern Ethiopia.

The intervention is designed to improve workers OHS knowledge, attitudes, and practices and to reduce occupational injuries and work-related musculoskeletal disorders (WMSDs). By combining educational components with assessment of worker-level outcomes, the study is expected to provide practical evidence on whether targeted OHS education can contribute to safer workplace behaviors and improved occupational health. The findings may also help identify areas where education alone is insufficient and where complementary organizational, engineering, and administrative measures are required.

The study has potential relevance for factory managers, occupational health professionals, policymakers, and other stakeholders responsible for workplace safety. Evidence generated from this intervention may support the development of context-specific OHS programs and contribute to strengthening occupational health services in Ethiopia. At the time of reporting, the intervention had been completed and post-intervention data collection was nearing completion; therefore, the effectiveness outcomes will be reported following completion

and analysis of the study data.

4. Conclusion

This study protocol describes an intervention designed to evaluate the effectiveness of structured OHS education in improving workers' knowledge, attitudes, and practices and reducing occupational injuries and WMSDs in oilseed processing factories. The study is expected to generate context-specific evidence that can inform workplace OHS policies and guide the development of feasible, evidence-based interventions for industrial workers in Ethiopia.

Abbreviations

FGDs	Focus Group Discussions
GEE	Generalized Estimating Equations
IDIs	In-depth Interviews
ILO	International Labor Organization
OHS	Occupational Health and Safety
ORs	Odds Ratios
OSP	Oilseed Processing
PPE	Personal Protective Equipment
WMSDs	Work-related Musculo-skeletal Disorders

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Author Contributions

Bizuneh Ayano: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing, Data curation & Formal Analysis

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Conflicts of Interest

The authors declare no conflicts of interest.

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