

Full Length Research Paper

Knowledge, attitudes and practices regarding occupational hazards among grain mill workers in Soroti City, North Eastern Uganda: A cross-sectional study

Anne Ruth Akello^{1,2*}, Oscar Omondi Donde¹ and Wilkister N. Moturi¹

¹Department of Environmental Science, Faculty of Environmental Resources Development, Egerton University, Egerton, Kenya.

²Department of Environmental and Occupational Health, Faculty of Public Health, Lira University, Lira, Uganda.

Received 30 June, 2026; Accepted 24 September, 2026

Grain milling is a hazardous occupation associated with respiratory diseases, musculoskeletal disorders, and noise-induced hearing loss. However, evidence on knowledge, attitudes, and practices (KAP) regarding occupational hazards among grain mill workers in sub-Saharan Africa is limited. This study assessed KAP regarding occupational hazards and factors associated with safety practices among grain mill workers in Soroti City, Uganda. A cross-sectional study was conducted among 384 grain mill workers from August to October 2025. Consecutive sampling was used to recruit eligible workers present during the study period, with data collected across different shifts and days to minimize selection bias. Data were collected using a structured interviewer-administered questionnaire and an observation checklist. Knowledge, attitude, and practice levels were categorized using composite scores. Modified Poisson regression with robust error variance was used to identify factors associated with good safety practices, with adjusted prevalence ratios (aPR), 95% confidence intervals (CI), and p-values reported. Most respondents had good knowledge (59.9%, n=230), while 7.3% (n=28) had poor knowledge. Attitudes were evenly distributed between positive (50.0%, n=192) and negative. Despite relatively good knowledge, 68.3% (n=262) demonstrated poor safety practices. Availability of occupational safety and health (OSH) policies was the only factor significantly associated with good safety practices; workers reporting policy availability were less likely to have good practices (aPR=0.39, 95% CI: 0.25–0.60, p<0.001). This paradoxical finding may reflect the absence of written and displayed policies, with reported availability referring mainly to verbal instructions. Grain mill workers had relatively good knowledge and mixed attitudes, but safety practices remained poor, indicating a critical implementation gap. Written and displayed OSH policies, regular inspections, enforcement of safety measures, and continuous worker training are needed to improve workplace safety.

Key words: Occupational hazards, occupational safety policies, knowledge, attitudes, practices, grain mills, Uganda. knowledge, attitudes and practices (KAP). occupational safety and health (OSH).

INTRODUCTION

Occupational hazards are potential sources of harm or adverse health effects in the workplace and represent a

significant global public health concern. The World Health Organization (WHO) and the International Labour

Organization (ILO) estimated that work-related diseases and injuries cause approximately 2 million deaths annually worldwide (WHO/ILO, 2021). Workers in low- and middle-income countries (LMICs) face disproportionately higher risks due to weak regulatory frameworks, limited resources for hazard control, and the high informality of labour markets (Rai et al., 2021; Rantanen et al., 2018). Grain milling constitutes a particularly hazardous occupation involving multiple exposure pathways. Workers are exposed to respirable grain dust, which can cause respiratory symptoms, impaired lung function, and occupational asthma (Lagiso et al., 2020; Iyogun et al., 2019; Barrera et al., 2018); excessive noise, which can lead to noise-induced hearing loss (Novikova et al., 2019); ergonomic hazards associated with heavy lifting and repetitive movements, which may result in musculoskeletal disorders (Govaerts et al., 2021; Krishnan et al., 2021); mechanical hazards from unguarded machinery, which can cause amputations and crush injuries (Bellochio and Coradi, 2022); and biological hazards associated with moulds, mycotoxins, and vermin (Wokorach et al., 2021; Alemseged et al., 2020). Although these hazards are well documented, the extent to which workers are aware of them and adopt preventive behaviours remains poorly understood in many LMIC settings, particularly within the agro-processing sector (Mukhtar et al., 2020). Despite these well-documented risks, grain milling remains an important source of employment and contributes significantly to food security across sub-Saharan Africa, including Uganda. Previous studies on occupational hazards in Uganda have primarily focused on other sectors, particularly healthcare and informal commercial establishments in Kampala, with limited evidence on knowledge, attitudes, and practices (KAP) among grain mill workers in Soroti City. Understanding KAP regarding occupational hazards among grain mill workers is important because these factors may influence the risk of occupational injuries and illnesses, and the resulting evidence could guide the development of targeted interventions. The transition from hazard exposure to worker KAP is critical because, although exposure is largely determined by the work environment, the adoption of preventive behaviors is influenced by workers' knowledge of hazards, attitudes towards safety, and the structural support available to them (Champion and Skinner, 2008). Soroti City, established in 2020 as one of Uganda's 15 new cities, serves as the commercial hub of the Teso sub-region and is home to the country's second-largest industrial park after Kampala. The city has multiple grain mills that process different grains sourced from the Lango, Karamoja, and Teso sub-regions for supply to

Eastern and Central Uganda (Uganda Bureau of Statistics, 2024). The city's rapid industrial growth, combined with its role as a major grain-processing centre, makes it an important setting for investigating occupational health risks among grain mill workers. However, to the best of the available knowledge, few studies have systematically assessed KAP regarding occupational hazards among grain mill workers in this setting. The Health Belief Model (HBM) provides a theoretical framework for understanding occupational health behaviours. The HBM posits that engagement in health-related behaviours is influenced by perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Rosenstock, 1974; Champion and Skinner, 2008). In the context of grain milling, workers' knowledge of occupational hazards may shape their perceptions of susceptibility and severity, while attitudes may influence their perceptions of the benefits and barriers associated with safety practices. Safety practices, as behavioural outcomes, are theoretically influenced by the interaction of these cognitive factors with environmental cues and self-efficacy. According to the HBM, knowledge may influence attitudes towards a particular phenomenon, and knowledge and attitudes may jointly influence practices related to behaviours intended to promote individual well-being. However, actual behavioural patterns may vary because human behaviour is dynamic and influenced by contextual factors.

A study among university students in Saudi Arabia found that participants had positive attitudes and generally good safety practices regarding occupational hazards, although notable gaps remained in formal training and knowledge, particularly concerning chemical hazards and ergonomics (Jain et al., 2026). Previous studies on KAP regarding occupational hazards in various settings have reported mixed findings. Studies from Nigeria (Aluko et al., 2016; Onowhakpor et al., 2017), Ethiopia (Esaiyas et al., 2018; Asgedom et al., 2019), and Ghana (Odonkor and Sallar, 2024) have generally reported good knowledge and positive attitudes among workers across different sectors, although safety practices often lagged behind knowledge levels. For example, Aluko et al. (2016) found that although 89% of Nigerian healthcare workers had adequate knowledge of occupational hazards, safety practices remained inadequate. Similarly, Asgedom et al. (2019) reported that knowledge and positive attitudes did not consistently translate into the use of personal protective equipment (PPE) among Ethiopian wood-board workers. In Uganda hazard identification rather than comprehensive KAP assessments. Ndejjo et al. (2015) found that 50% of healthcare workers in Kampala had experienced

*Corresponding author. E-mail: akello.0501822@student.egerton.ac.ke. Tel: +256 772849401.

occupational hazards, while Kevin (2019) reported that 93% of informal-sector workers had experienced workplace hazards. However, neither study examined the knowledge, attitudes, or practices that could inform targeted interventions. The scarcity of KAP data among grain mill workers in Uganda therefore limits the development of effective occupational safety programmes aimed at protecting workers. Therefore, this study aimed to: (1) assess the levels of knowledge, attitudes, and practices regarding occupational hazards among grain mill workers in Soroti City, Uganda; and (2) identify factors associated with safety practices among the workers.

METHODOLOGY

Study design and setting

This cross-sectional study was conducted between August and October 2025 in Soroti City, North-Eastern Uganda (Figure 1). Soroti City is one of 15 cities created by the Parliament of Uganda in April 2020, comprising two divisions (East and West). The city has a population of 134,199 (daytime population 220,698) and serves as the commercial hub for 10 Teso districts (Uganda Bureau of Statistics, 2024). The grain mills included in this study are centrally located in the Eastern Division industrial park, where 25 active grain mills were identified during the profiling exercise.

Study population and sampling

The study population comprised all workers employed in the 25 active grain mills in Soroti City's Eastern Division park. Consecutive sampling was employed to recruit all eligible workers present at the mills during the study period. This approach was chosen because the workforce was relatively stable and the number of workers was manageable. To minimize selection bias, data collection was conducted across different shifts (morning, afternoon, and evening) and days of the week (including weekends) to ensure representation of workers with varying schedules. Workers were eligible if they were aged 18 years or older, had worked in the grain mill for at least one month, and provided informed consent. Workers on leave or absent during the study period were excluded. A total of 394 workers were recruited, which exceeded the minimum sample size of 384 calculated using the Cochran formula for cross-sectional studies (assuming 50% prevalence, 5% margin of error, and 95% confidence level).

Data collection instruments and procedures

Questionnaire development and adaptation

A structured, interviewer-administered questionnaire was developed based on a thorough literature review of KAP studies in occupational health (Aluko et al., 2016; Esaiyas et al., 2018; Mukhtar et al., 2020; Jain et al., 2026). The questionnaire was adapted specifically for the grain milling context and comprised four sections:

Section A- Socio-demographic and work-related characteristics: Age, sex, marital status, education level, household size, duration of employment, section of mill worked in, and use of back supportive devices.

Section B- Knowledge of occupational hazards: 10 items assessing awareness of occupational hazards, recognition of specific hazards (dust, noise, heavy loads, ergonomic risks, biological hazards), knowledge of health effects and awareness of safety measures. Each correct response scored 1 point, with total knowledge scores ranging from 0 to 10. Scores were categorized as: poor knowledge (≤ 4 points, $<50\%$), moderate knowledge (5-7 points, 50-70%) and good knowledge (8-10 points, $>70\%$) (Biggerstaff et al., 2018; Mohammed et al., 2025). These categories are mutually exclusive.

Section C- Attitudes toward occupational hazards and control: 11 items measured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Items assessed attitudes toward hazard seriousness, shared responsibility, importance of training and PPE, reporting of exposures, management responsibility, incentives, enforcement and policy review. Mean attitude scores were calculated, and attitudes were categorized as positive (mean ≥ 4.0) or negative (mean < 4.0), consistent with published KAP studies (Aluko et al., 2016; Nassirou-Sabo and Toudou-Daouda, 2024).

Section D- Practice of safety measures: 9 items assessing reported use of specific safety measures including wet processes (hydro-blasting), exhaust ventilation, PPE (face masks, overalls/aprons, caps, face shields), environmental controls and correct body posture. Practice scores were calculated as the percentage of applicable safety measures reportedly used. Participants were categorized as having good practice ($\geq 70\%$ of applicable safety measures used) or poor practice ($< 70\%$), consistent with established cutoffs (Aluko et al., 2016; Afework et al., 2024). Self-reported practices were validated through triangulation with observation data collected from 25 grain mills. The two measures used different denominators: individual-level questionnaire data were collected from 384 workers, while grain mill-level observational data were collected from 25 mills.

Questionnaire validation

Face validity and content validity were established through expert review by three occupational health specialists (two university supervisors and one independent expert from the Ugandan Ministry of Health). Content validity index (CVI) was 0.92. The questionnaire was pre-tested among 20 grain mill workers in a neighboring district (Kaberamaido) who were excluded from the final analysis. Based on pre-testing, minor wording modifications were made, and the time required for administration was estimated at 25 to 30 min.

Translation

The questionnaire was translated from English into Ateso, the local language of Soroti City residents by a professional translator from the office of Iteso Cultural Union (ICU). Back-translation was performed by an independent translator to verify accuracy. Discrepancies were resolved through discussion with community representatives.

Data collection procedure

Four research assistants (RAs) with prior experience in occupational health research were recruited and trained for three days. Training covered study objectives, ethical conduct, interviewing techniques, questionnaire administration and use of observation checklists. Inter-rater reliability was assessed ($\kappa = 0.85$). Face-to-face interviews were

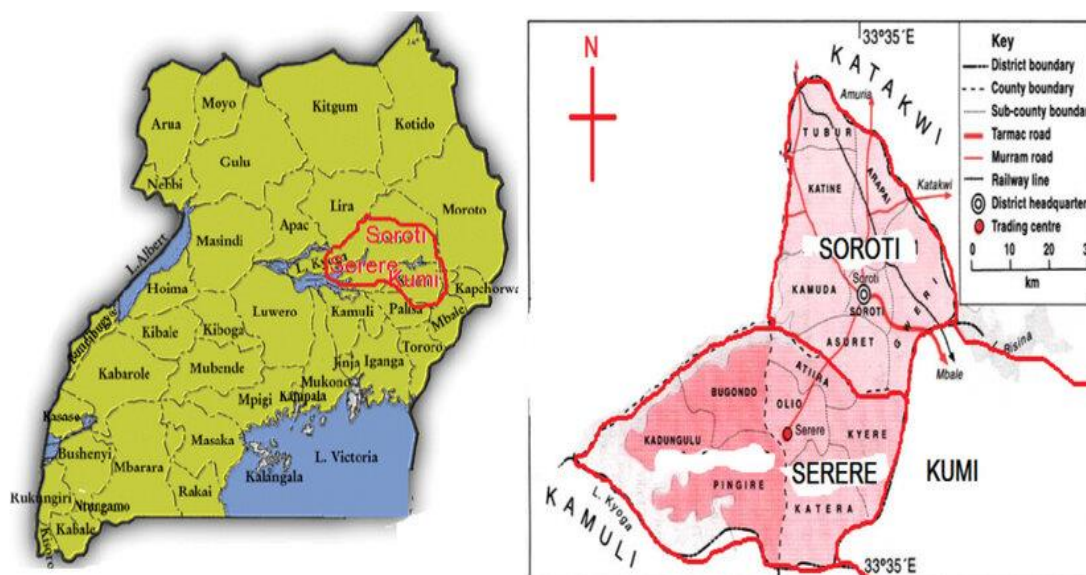


Figure 1. Map of Uganda showing Soroti City. The map shows the location of Soroti City in North-Eastern Uganda, within Soroti District.

Source: Adapted from Eilu (2019).

conducted in private locations within or near the grain mills to ensure confidentiality. Each interview lasted 25 to 30 min. Concurrently, observation checklists were completed by RAs to verify the presence of safety measures and observe work practices. Observations were conducted during regular working hours without interrupting work activities.

Observation checklist

A structured observation checklist was used to verify the presence of hazards and safety practices. The checklist included items on:

- i) Housekeeping (floors clear of dust/spillages, waste storage, spill control)
- ii) Dust control measures (wet processes, exhaust ventilation)
- iii) PPE use (face masks, overalls/aprons, caps, face shields)
- iv) Environmental controls (waste handling)
- v) Ergonomic safety practices (correct body posture)

Each item was marked as present (Yes) or absent (No). Observation data were used to triangulate self-reported practices.

Data analysis

Data were entered into Microsoft Excel (version 16.0) and exported to Stata version 18.0 (Stata Corp, College Station, TX, USA) for analysis.

Descriptive analysis

Frequencies, percentages, means and standard deviations were computed for all variables. Knowledge, attitude and practice levels were summarized using frequency distributions.

Bivariate analysis

Pearson's chi-square test (χ^2) was used to test associations between practice level (good vs. poor) and independent variables including socio-economic characteristics, work-related factors, knowledge level, attitude, availability of OSH policies, grain mill management follow-up and hazard exposure level. Fisher's exact test was used where expected cell counts were <5 .

Multivariable analysis

Modified Poisson regression with robust error variance was used to identify factors independently associated with good safety practices. This approach was chosen over logistic regression because the outcome (good safety practices) was common ($>10\%$ prevalence), and odds ratios would overestimate effect sizes (Barros and Hirakata, 2003; Zou, 2004). Variables with $p < 0.20$ in bivariate analysis were considered for inclusion in the multivariable model. A backward elimination approach was used, with variables retained if they changed the effect estimate of other variables by $>10\%$ or if $p < 0.05$. Potential confounders including age, sex, education level, and work duration were assessed but not retained in the final model as they did not meet the inclusion criteria. Model fit was assessed using Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC). Adjusted prevalence ratios (aPR) with 95% CI were reported.

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from: Egerton University Research Ethics Committee (Approval No. EUISERC/APP/477/2025, dated 8th August, 2025); Lira University Research Ethics Committee (Ref: LUREC-2025-415, dated 12th August, 2025); and Uganda

National Council for Science and Technology (Registration No. HS6278ES, dated 1st October, 2025). Administrative clearance was obtained from the office of the Town Clerk, Soroti City Council. All supportive documents have been uploaded with the submission. All participants provided written informed consent in Ateso or English according to their preference. For participants unable to read (n=33, 8.6%), the consent form was read aloud in the presence of an independent witness, and thumbprint consent was obtained. Participants were informed of their right to withdraw at any time without penalty. A time compensation of Uganda Shillings 5,000 (approximately USD 1.35) was provided to each participant. All data were anonymized using unique participant codes and confidentiality was strictly maintained throughout the study.

RESULTS

Socio-demographic and work-related characteristics

A total of 384 grain mill workers participated in the study (100%). Table 1 presents the socio-economic and work-related characteristics. The majority were male (57.0%, n=219), aged 25–34 years (47.9%, n=184), married (54.7%, n=210), and had attained secondary education (45.6%, n=175). Household size varied, with 31.0% (n=119) having 1-2 members and 20.1% (n=77) having 7 or more members. Regarding work-related characteristics, most workers had been employed for 1-5 years (44.0%, n=169). The largest proportion worked in the sales section (33.3%, n=128), followed by grinding (28.6%, n=110) and loading/off-loading (11.7%, n=45). Among loading/off-loading workers, 93.3% (n=42) did not use any back supportive devices and 51.1% (n=23) spent 3-5 hours daily on loading/off-loading tasks.

Knowledge of occupational hazards among grain mill workers

The majority of workers reported having heard of occupational hazards (86.7%, n=333) and recognized that grain dust is dangerous to health (91.5%, n=345) (Table 2). Awareness of specific hazards was high: ergonomic risks (67.4%, n=248), biological hazards such as rats (59.8%, n=220), accidents/cuts (50.5%, n=186), heavy loads (44.6%, n=164), dust (42.9%, n=158) and noise (32.6%, n=120). When asked about the most frequent hazards encountered, workers identified accidents/cuts (74.7%, n=268), heavy loads (69.1%, n=248), noise (63.8%, n=229) and dust from improperly sorted grains (61.3%, n=220). Regarding health effects of exposure, workers reported flu-like symptoms (94.7%, n=360), respiratory difficulties/asthma (83.9%, n=319), and throat/body pain (64.7%, n=246) as the most common effects. Awareness of safety measures was high, with workers identifying face masks/helmets (99.2%, n=365), aprons (60.1%, n=221), gumboots (50.3%, n=185) and overalls (44.8%, n=165) as protective equipment. General strategies to minimize exposure included use of masks

(87.7%, n=320), training of workers (60.6%, n=221), use of overalls/aprons/helmets (58.1%, n=212), proper ventilation (46.9%, n=171) and machine maintenance (26.9%, n=98). Details in Table 2. Composite knowledge scores showed that the majority of workers had good knowledge (59.9%, n=230), followed by moderate knowledge (32.8%, n=126), with only 7.3% (n=28) having poor knowledge.

Attitudes toward occupational hazards

Workers exhibited generally positive attitudes toward occupational hazard management (Table 3). High agreement (strongly agree or agree) was observed for: paying attention to hazards enhances workplace safety (99.8%, mean=4.42, SD=0.50); training and PPE are essential to reduce hazard exposure (97.9%, mean=4.45, SD=0.66); wearing aprons and face masks is crucial for safety (98.2%, mean=4.40, SD=0.57); and occupational hazards should be taken seriously (94.1%, mean=4.40, SD=0.80). Moderate agreement was observed for: avoiding prolonged standing to reduce fatigue (82.3%, mean=3.99, SD=0.95) and reporting/documenting exposures (85.1%, mean=4.12, SD=0.83). Areas with lower agreement included incentives to encourage adherence to safety practices (75.0%, mean=3.78, SD=1.17), with some workers stating that safety is a personal issue rather than requiring external motivation. The overall mean attitude score across for all 11 items was 4.23 (SD=0.80) on a 5-point Likert scale. Based on the predefined cutoff (mean ≥ 4.0 = positive attitude), attitudes were evenly split: 50.0% (n=192) had positive attitudes and 50.0% (n=192) had negative attitudes.

Practice of safety measures

Self-reported safety practices and observation-verified practices are presented in Table 4. Wet processes (hydro-blasting) were the most commonly reported safety measure (84.9%, n=286), followed by use of overalls/aprons (63.2%, n=213) and face masks (62.3%, n=210). Environmental controls including exhaust ventilation (60.5%, n=204) and proper waste handling (61.1%, n=206) showed moderate implementation. Correct body posture during work procedures was reported by 59.4% (n=200) of workers.

Protective items with the lowest reported use included caps (35.6%, n=120) and face shields (28.5%, n=96). Notably, observation data revealed marked discrepancies between self-reported and observed practices: while 62.3% of workers reported using face masks, observations showed <10% actually wearing masks during work. Similarly, correct body posture was reported by 59.4% but observed in <20% of workers. None use of PPE was observed in all 25 grain mills (0% observed use of face

Table 1. Socio-demographic and work-related characteristics of grain mill workers in Soroti City, Uganda (N=384).

Characteristic	Category	Frequency (n)	%
Sex	Male	219	57.0
	Female	165	43.0
Age group (years)	≤24	65	16.9
	25-34	184	47.9
	35-44	104	27.1
	45-54	20	5.2
	≥55	11	2.9
Marital status	Single	136	35.4
	Married	210	54.7
	Divorced	18	4.7
	Cohabiting	13	3.4
	Widowed	7	1.8
Education level	None	33	8.6
	Primary	150	39.1
	Secondary	175	45.6
	Tertiary	26	6.8
Household size	1-2	119	31.0
	3-4	99	25.8
	5-6	89	23.2
	≥7	77	20.1
Work duration (years)	<1 year	60	15.6
	1-5 years	169	44.0
	6-10 years	43	11.2
	>10 years	112	29.2
Section of mill	Grinding	110	28.6
	Packaging	37	9.6
	Stores	53	13.8
	Sales	128	33.3
	Cleaning	11	2.9
	Loading/Off-loading	45	11.7
Use of back supportive devices (loading/off-loading, n=45)	Yes	3	6.7
	No	42	93.3

masks, aprons or gumboots during the data collection period). Based on composite practice scores, 31.7% (n=122) of workers demonstrated good safety practices (≥70% of applicable safety measures reportedly used), while 68.3% (n=262) had poor safety practices (<70%) (Figure 2).

Figure 2 illustrates the disconnect between high knowledge levels (59.9% good) and poor safety practices (68.3% poor).

Factors associated with practice of safety measures by grain mill workers

Bivariate analysis using Pearson's chi-square test identified three factors significantly associated with practice of safety measures (Table 5): duration at work ($\chi^2 = 8.89$, $df = 3$, $p = 0.031$), attitude ($\chi^2 = 5.39$, $df = 1$, $p = 0.020$), and hazard exposure level ($\chi^2 = 10.76$, $df = 1$, $p =$ had a higher proportion of good practice (38.1%)

Table 2. Knowledge of occupational hazards among grain mill workers in Soroti City, Uganda (N=384).

Variable	Response	Frequency (n)	%
Heard of occupational hazards	Yes	333	86.7
	No	51	13.3
Is grain dust dangerous to health?	Yes	345	91.5
	No	32	8.5
Aware of safety measures	Yes	289	75.3
	No	95	24.7
Specific hazards recognized			
Accidents/Cuts		186	50.5
Dust		158	42.9
Noise		120	32.6
Heavy loads		164	44.6
Biological (rats)		220	59.8
Ergonomic hazards		248	67.4
Most frequent hazards			
Dust/Poorly sorted grains		220	61.3
Accidents/Cuts		268	74.7
Noise		229	63.8
Heavy loads		248	69.1
Health effects reported			
Flu-like symptoms		360	94.7
Breathing difficulties/asthma		319	83.9
Throat pain		246	64.7
Body pain		246	64.7

compared to those with <1 year (14.4%). Workers with positive attitudes had a lower proportion of good practice (39.8%) than those with negative attitudes (60.2%), suggesting that positive attitudes did not translate into better practices. Workers with moderate hazard exposure had higher good practice (79.6%) compared to those with low exposure (20.4%). Marital status showed borderline significance ($\chi^2 = 7.86$, $df = 4$, $p = 0.097$). Sex, age group, education level, household size, knowledge level, availability of OSH policies ($p=0.073$), and grain mill management follow-up on adherence to safety measures were not significantly associated with safety practice level in bivariate analysis.

Factors independently associated with good safety practices among grain mill workers

Due to the high prevalence of the dependent variable (good safety practices), modified Poisson regression with

robust error variance was used to identify factors independently associated with good safety practices, reporting prevalence ratios (PRs) rather than the odds ratios obtained from logistic regression (Table 6). Using a p-value cut-off of 0.20 following bivariable analysis, attitude, duration of employment, marital status, perceived health effects, and availability of occupational safety and health (OSH) policies were included in the multivariable model. Following adjustment using backward elimination, only the availability of OSH policies remained significantly associated with good safety practices. Workers in grain mills where OSH policies were reportedly available were 61% less likely to have good safety practices than those who reported that such policies were unavailable (aPR = 0.39, 95% CI: 0.25–0.60, $p < 0.001$). Attitude, which was statistically significant in the bivariable analysis, lost statistical significance after adjustment (aPR = 0.70, 95% CI: 0.46–1.06, $p = 0.089$). Duration of employment and marital status were not significantly associated with good

Table 3. Attitudes toward occupational hazards among grain mill workers (N=384).

Statement	SA	A	NS	D	SD	Mean	SD
	n (%)	n (%)	n (%)	n (%)	n (%)		
Occupational hazards should be taken seriously	198 (51.6)	163 (42.5)	12 (3.1)	1 (0.3)	10 (2.6)	4.40	0.80
Preventing hazards is a shared responsibility	182 (47.4)	172 (44.8)	2 (0.5)	16 (4.2)	12 (3.1)	4.29	0.92
Paying attention to hazards enhances safety	162 (42.2)	221 (57.6)	1 (0.3)	0 (0)	0 (0)	4.42	0.50
Training and PPE are essential	194 (50.5)	182 (47.4)	1 (0.3)	2 (0.5)	5 (1.3)	4.45	0.66
Wearing aprons/face masks is crucial	165 (43.0)	212 (55.2)	4 (1.0)	2 (0.5)	1 (0.3)	4.40	0.57
Avoid prolonged standing to reduce fatigue	113 (29.4)	203 (52.9)	30 (7.8)	28 (7.3)	10 (2.6)	3.99	0.95
Exposures should be reported/document	126 (32.8)	201 (52.3)	40 (10.4)	10 (2.6)	7 (1.8)	4.12	0.83
Management should provide safety procedures/equipment	134 (34.9)	213 (55.5)	20 (5.2)	11 (2.9)	6 (1.6)	4.19	0.79
Incentives should be provided	103 (26.8)	185 (48.2)	42 (10.9)	18 (4.7)	36 (9.4)	3.78	1.17
Consistent enforcement ensures safety	151 (39.3)	208 (54.2)	9 (2.3)	10 (2.6)	6 (1.6)	4.27	0.77
Policies should be reviewed regularly	154 (40.1)	197 (51.3)	14 (3.7)	10 (2.6)	9 (2.3)	4.24	0.83
Average						4.23	0.80

SA=Strongly Agree, A=Agree, NS=Not Sure, D=Disagree, SD=Strongly Disagree.

Table 4. Self-reported and observed safety practices among grain mill workers.

Safety practice	Self-reported (N=384), Frequency (n)	Self-reported (N=384), Percent	Observed (N=25 mills), % of mills with any use
Wet processes (Hydro-blasting)	286	84.9	76.0
Exhaust ventilation (Chimney)	204	60.5	68.0
Face masks	210	62.3	8.0
Overalls/Aprons	213	63.2	4.0
Caps	120	35.6	0
Face shields	96	28.5	0
Environmental control (waste handling)	206	61.1	52.0
Correct body posture	200	59.4	16.0

safety practices in the adjusted model (Figure 3). The forest plot displays adjusted prevalence ratios (aPR) from modified Poisson regression with robust error variance. Only the availability of OSH policies was significantly associated with good safety practices after adjustment (aPR = 0.39, 95% CI: 0.25-0.60, $p < 0.001$), with workers in mills reporting availability of OSH policies being 61% less likely to have good practices, a paradoxical finding reflecting the absence of written, displayed policies. Reference categories: Attitude (Negative), Work duration (<1 year), Marital status (Single), OSH policies (Not available).

DISCUSSION

This study provides the first comprehensive assessment of knowledge, attitudes, and practices regarding occupational hazards among grain mill workers in Soroti

City, Uganda. The findings reveal a critical disconnect: despite good knowledge and mixed attitudes towards occupational hazards, safety practices remained poor, while the reported availability of occupational safety and health (OSH) policies was paradoxically associated with poorer safety practices, possibly reflecting the observed absence of written and displayed policies. These findings should be interpreted with caution because of the cross-sectional study design, which allows associations to be identified but does not establish causality. The paradoxical association between reported OSH policy availability and poorer safety practices may also have been influenced by reporting or social desirability bias, as discussed.

Knowledge of occupational hazards among grain mill workers

The finding that 59.9% of workers had good knowledge

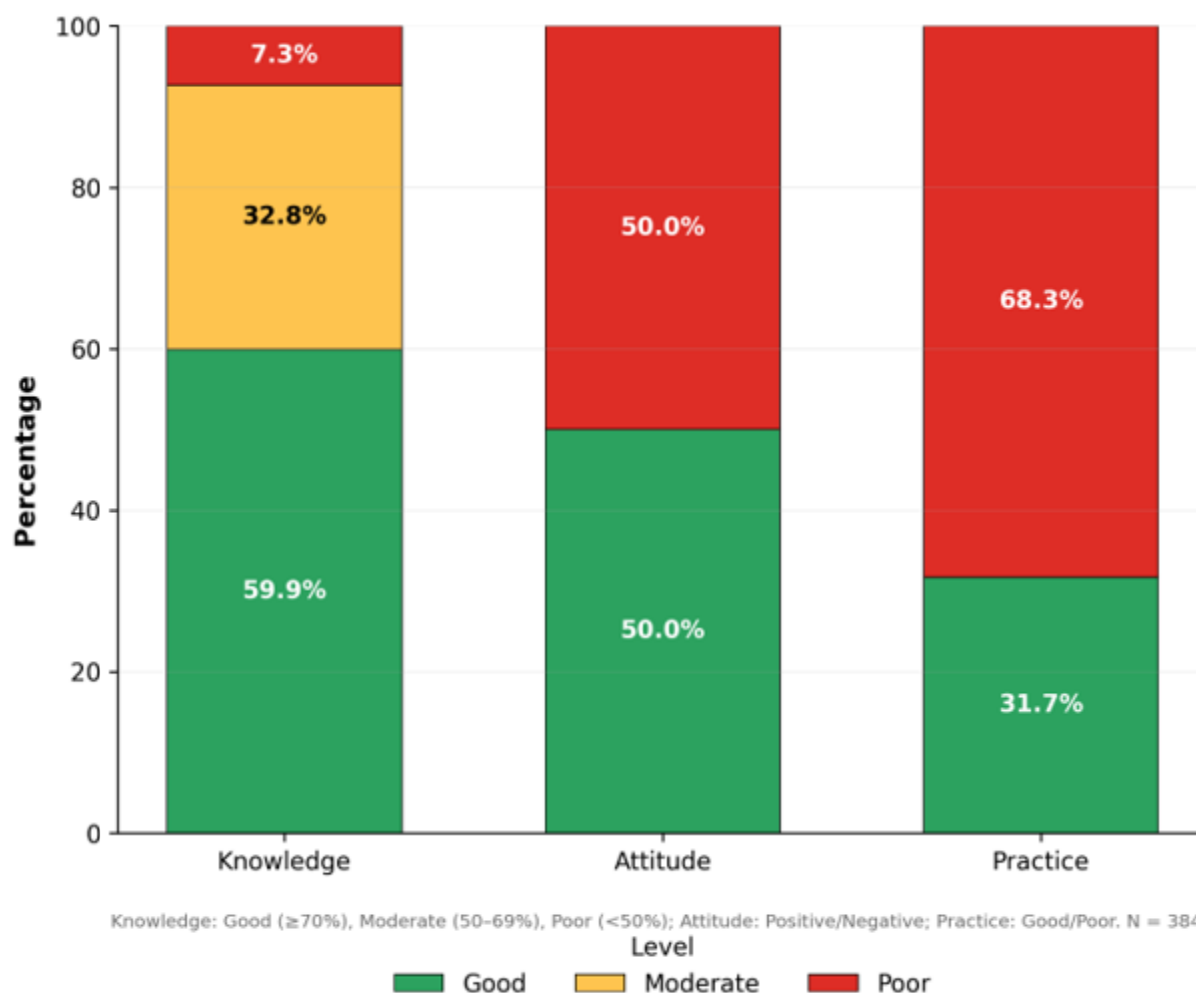


Figure 2. Knowledge, attitudes, and practices levels among grain mill workers in Soroti City, Uganda (N=384).

and 32.8% had moderate knowledge of occupational hazards is consistent with findings from other LMIC settings. Studies from Nigeria reported good knowledge among 67.7% of workers at Kogi State Specialist Hospital (Jonah and Dahiru, 2024), 89% of healthcare workers (Aluko et al., 2016; Olorunfemi et al., 2022), and 71% of sawmill workers (Onowhakpor et al., 2017). In other settings, Shaukat et al. (2020) reported that 77% of textile workers in Pakistan had good OSH knowledge, while Degavi et al. (2021) reported a good knowledge level among 64% of sanitary workers. Tadesse et al. (2016) found that 86.5% of welders had good OSH knowledge, and Esaiyas et al. (2018) reported that 83.1% of wood and metal workers in Ethiopia had good OSH knowledge. Similarly, Odonkor and Sallar (2024) reported very high OSH knowledge among 95.9% of healthcare workers in Ghana. In contrast, the review by Almutairi et al. (2020), as well as studies by Marahatta et al. (2017) in Nepal, Agbana et al. (2016) in Nigeria, and Geleta et al. (2021) in

Ethiopia, reported lower levels of knowledge regarding occupational hazards among workers in various occupational settings, including solid waste handlers and flower farm workers. The high level of awareness of specific hazards, particularly dust (91.5% recognized it as dangerous), ergonomic risks (67.4%), and biological hazards (59.8%), may reflect workers' direct and frequent exposure to these hazards. During grinding operations, grain dust was visibly present on floors, walls, and in the air. Workers also experienced physical strain from repeatedly lifting heavy sacks. Such experiential learning may enhance awareness of common and visible hazards but may not translate into comprehensive understanding of less visible or slowly developing hazards, such as noise-induced hearing loss or chemical exposure from fumigants. The gap between knowledge and practice observed in this study has also been documented elsewhere. Degavi et al. (2021) reported that only 8.9% of sanitary workers in Ethiopia demonstrated good practices

Table 5. Bivariate associations between practice of safety measures and worker-related factors (N=384).

Characteristic	Good practice n (%)	Poor practice, n (%)	χ^2 (df)	p-value
Sex			0.04 (1)	0.834
Male	66 (55.9)	153 (57.5)		
Female	52 (44.1)	113 (42.5)		
Marital status			7.86 (4)	0.097
Single	48 (40.7)	88 (33.1)		
Married	65 (55.1)	145 (54.5)		
Divorced	3 (2.5)	15 (5.6)		
Cohabiting	2 (1.7)	11 (4.1)		
Widowed	0 (0)	7 (2.6)		
Duration at work			8.89 (3)	0.031
<1 year	17 (14.4)	43 (16.2)		
1–5 years	47 (39.8)	122 (45.9)		
6–10 years	9 (7.6)	34 (12.8)		
>10 years	45 (38.1)	67 (25.2)		
Education level			1.34 (3)	0.720
None	9 (7.6)	24 (9.0)		
Primary	46 (39.0)	104 (39.1)		
Secondary	53 (44.9)	122 (45.9)		
Tertiary	10 (8.5)	16 (6.0)		
Knowledge level			0.02 (1)	0.884
Knowledgeable (good/moderate)	72 (61.0)	164 (61.7)		
Not knowledgeable (poor)	46 (39.0)	102 (38.3)		
Attitude			5.39 (1)	0.020
Negative	71 (60.2)	121 (45.5)		
Positive	47 (39.8)	145 (54.5)		
OSH policies available			3.21 (1)	0.073
No	60 (50.8)	114 (42.9)		
Yes	58 (49.2)	152 (57.1)		
Management follow-up			0.62 (1)	0.431
Yes	65 (89.0)	168 (92.3)		
No	8 (11.0)	14 (7.7)		
Hazard exposure level			10.76 (1)	0.001
Low	20 (20.4)	91 (39.1)		
Moderate	78 (79.6)	142 (60.9)		

for preventing occupational health hazards despite having good knowledge and positive attitudes. Similarly, Onowhakpor et al. (2017) found that although 83.1% of Nigerian sawmill workers had positive attitudes, 57.9% demonstrated poor safety practices. Aluko et al. (2016)

likewise reported that knowledge and positive attitudes did not necessarily translate into adherence to safe practices among Nigerian healthcare workers. This phenomenon suggests that knowledge is necessary but insufficient for behavioural change, which is consistent with the Health

Table 6. Modified Poisson regression analysis of factors associated with good safety practices among grain mill workers (N=384).

Variable	cPR (95% CI)	p-value	aPR (95% CI)	p-value
Attitude				
Negative	1.00 (ref)	-	1.00 (ref)	-
Positive	0.70 (0.51-0.95)	0.022	0.70 (0.46-1.06)	0.089
Duration at work				
<1 year	1.00 (ref)	-	1.00 (ref)	-
1-5 years	0.99 (0.62-1.59)	0.982	0.77 (0.43-1.40)	0.393
6-10 years	0.73 (0.36-1.47)	0.375	0.82 (0.37-1.81)	0.621
>10 years	1.47 (0.93-2.33)	0.098	1.43 (0.83-2.48)	0.202
Marital status				
Single	1.00 (ref)	-	1.00 (ref)	-
Married	0.87 (0.64-1.18)	0.365	0.72 (0.48-1.08)	0.109
Divorced	0.33 (0.11-0.97)	0.044	0.27 (0.03-2.19)	0.222
Cohabiting	0.45 (0.13-1.65)	0.230	0.68 (0.13-3.61)	0.652
Perceived health effects				
1-2 effects	1.00 (ref)	-	1.00 (ref)	-
≥3 effects	0.39 (0.11-1.42)	0.153	0.59 (0.16-2.20)	0.431
OSH policies available				
No	1.00 (ref)	-	1.00 (ref)	-
Yes	0.76 (0.57-1.03)	0.074	0.39 (0.25-0.60)	<0.001

cPR = crude prevalence ratio; aPR = adjusted prevalence ratio; CI = confidence interval; ref = reference category.

Belief Model, in which perceived barriers, cues to action, and self-efficacy may mediate the relationship between knowledge and practice (Rosenstock, 1974; Champion and Skinner, 2008).

Attitudes toward occupational hazards

The finding that attitudes were evenly split (50% positive and 50% negative) despite generally high levels of knowledge is noteworthy. This suggests that although workers were aware of existing hazards and the safety measures that should be used, they did not uniformly perceive these measures as beneficial or feasible within their specific work contexts. The mean attitude score of 4.23 (SD = 0.80) on a 5-point Likert scale indicates generally favourable attitudes; however, the equal distribution of positive and negative attitudes suggests considerable variation in workers' perceptions. The lowest-scoring attitude item concerned incentives for adherence to safety measures (mean = 3.78, SD = 1.17). Several workers explicitly stated that safety is a personal responsibility rather than something that requires external motivation. This finding reflects the individualization of

safety responsibility described in qualitative studies from Uganda (Atusingwize et al., 2019) and other LMICs (Johanes et al., 2023; Herrera-Sanchez et al., 2017), in which workers perceive safety as their own responsibility even when employers fail to provide PPE or safe working conditions. Within the HBM framework, this perception may reflect substantial perceived barriers, including inadequate PPE provision, PPE discomfort, and time constraints, which may outweigh the perceived benefits of safety practices (Rosenstock, 1974). The finding that workers with positive attitudes were less likely to demonstrate good safety practices (39.8% versus 60.2% among those with negative attitudes) in the bivariate analysis is counterintuitive. This paradoxical finding may be partly explained by social desirability bias, whereby workers who provide socially acceptable responses regarding safety attitudes may also over-report their knowledge and attitudes without necessarily demonstrating corresponding practices. Alternatively, workers with negative attitudes may have been more candid in reporting poor practices, whereas those with positive attitudes may have experienced a knowledge–attitude–practice gap in which favourable intentions did not translate into the desired behaviours. Similar paradoxical

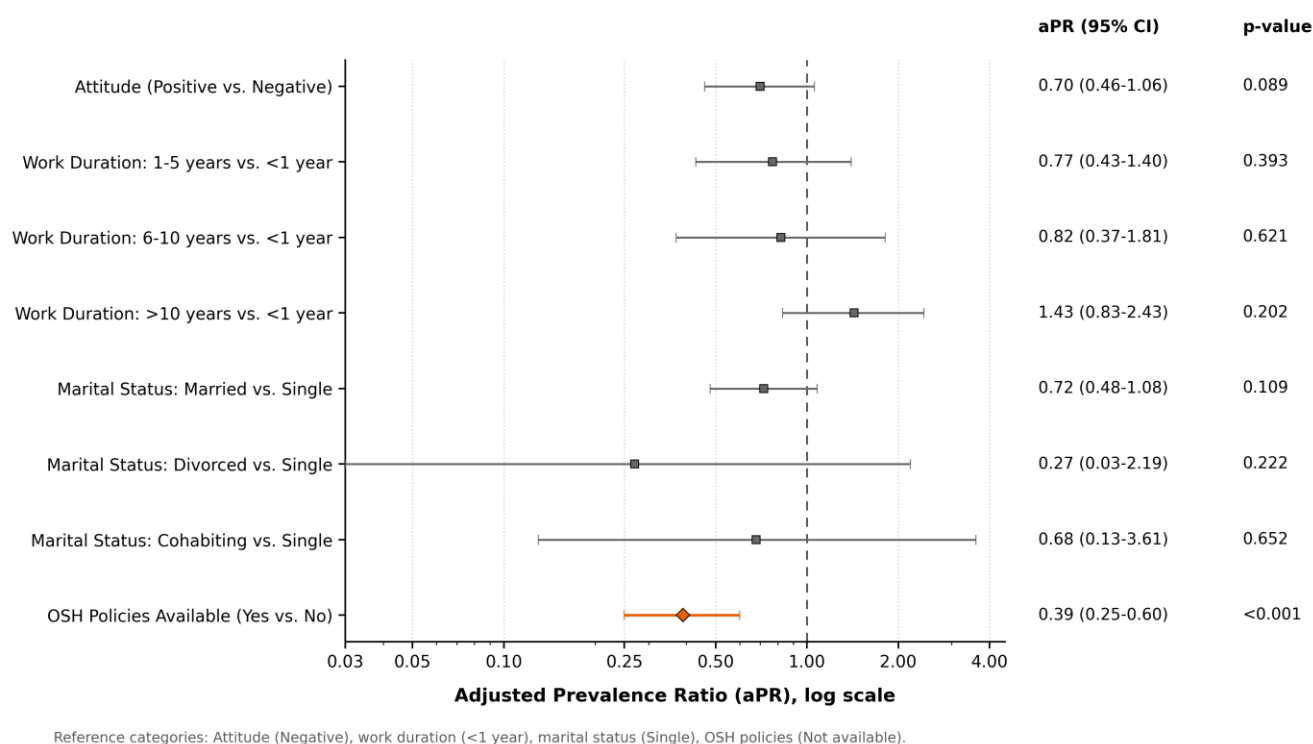


Figure 3. Factors associated with good safety practices among grain mill workers: adjusted prevalence ratios with 95% confidence intervals.

findings have been reported in occupational health studies in Ethiopia (Asgedom et al., 2019) and Nigeria (Onowhakpor et al., 2017). These findings should therefore be interpreted cautiously, given the potential for social desirability bias inherent in self-reported data.

Practice of safety measures

The finding that only 31.7% of workers demonstrated good safety practices, while 68.3% demonstrated poor practices, is concerning from a public health perspective. This indicates that more than two-thirds of grain mill workers were inadequately protected against occupational hazards, potentially increasing their risk of respiratory diseases, musculoskeletal disorders, hearing loss, and occupational injuries. The discrepancy between self-reported and observed practices was particularly striking: although 62.3% of workers reported using face masks, observations showed that fewer than 10% were actually wearing masks. This discrepancy may indicate over-reporting due to social desirability bias, whereby workers are aware that PPE should be used and therefore report doing so, while direct observations reveal poor adherence to safety measures. Similar discrepancies have been documented among workers in Ethiopia (Degavi et al., 2021; Geleta et al., 2021; Alemseged et al., 2020), Nigeria

(Okafoagu et al., 2017), and Kenyan rice mills (Njue, 2021). The magnitude of the discrepancy (62.3% reported use versus <10% observed use) is substantial and underscores the importance of incorporating observational data to validate self-reported safety practices in occupational health research.

Several factors may explain the poor safety practices observed among grain mill workers. First, the provision of personal protective equipment (PPE) was inadequate. Observation data showed that PPE was unavailable in most mills, and where it was available, workers reported discomfort, describing masks as "hot" and as making breathing difficult. Second, written occupational safety and health (OSH) policies were completely absent, with 0% of mills having displayed policies, leaving workers without formal guidelines to follow. Third, training was informal and inconsistent, as revealed through key informant interviews. Fourth, economic pressures may have led workers to prioritize earning an income over safety concerns, consistent with findings from other LMIC settings (Nordlöf et al., 2017; Zambrano and Mendoza, 2021).

Factors associated with safety practices among grain mill workers

The finding that the availability of OSH policies was

significantly associated with poorer safety practices (aPR = 0.39, 95% CI: 0.25–0.60, $p < 0.001$) requires careful interpretation. This paradoxical association should not be interpreted causally, given the cross-sectional study design. Rather, it may reflect the discrepancy between workers' perceptions and the observed availability of formal OSH policies. Although 55.7% of workers reported that OSH policies were available, observational data showed that none of the 25 mills had written and displayed policies. Thus, "availability," as reported by workers, likely referred to verbal instructions from management, as indicated by key informant interviews, rather than formal, documented policies. Verbal instructions can be easily forgotten, inconsistently applied, and difficult to enforce (Akbar and Ahsan, 2019). Therefore, the paradoxical association may indicate that workers who believed that OSH policies existed, when formal written policies were actually absent, did not have better safety practices and may have had poorer practices than those who correctly reported that no such policies were available. This interpretation is supported by the observational data, which showed a complete absence of written and displayed OSH policies across all 25 mills surveyed.

This finding is consistent with implementation science literature demonstrating that policy availability alone does not ensure changes in practice. For policies to influence behaviour, they need to be written, accessible, communicated, enforced, and reinforced through training and supervision (International Labour Office, 2001; Politakis, 2023). The absence of written and displayed policies in all 25 grain mills surveyed represents a significant gap in OSH governance in Soroti City, Uganda. Other factors, including knowledge, attitude, duration of employment, and sociodemographic characteristics, were not significantly associated with good safety practices after adjustment. This finding suggests that structural and environmental factors, such as the availability of written policies, provision of PPE, engineering controls, and workplace supervision, may be more important determinants of safety practice implementation than individual-level factors alone. This has important implications for intervention design, as interventions focused solely on individual behaviour change, such as health education, may have limited effectiveness without concurrent structural interventions addressing the development and enforcement of written OSH policies, provision of PPE, and implementation of appropriate engineering controls (Friend and Kohn, 2023; Nampala et al., 2025).

Comparison with other studies

The prevalence of good safety practices (31.7%) in this study was lower than that reported in some LMIC settings but consistent with findings from others. A study among

Ethiopian metal workers found that 39.3% demonstrated good compliance with safety measures (Afework et al., 2024). Studies from Nigeria reported that 57.9% of sawmill workers (Onowhakpor et al., 2017) and 42.1% of construction workers (Oluwafemi et al., 2017) had poor safety practices. This variability likely reflects differences in work settings, types of hazards, regulatory environments, and approaches to measuring safety practices. The finding that knowledge levels were high but safety practices were poor mirrors findings from Thailand, where healthcare workers had adequate knowledge but low PPE use (Nankongnab et al., 2021), and from Ghana, where very high levels of knowledge did not translate into good utilization of preventive measures (Odonkor and Sallar, 2024). This consistency across diverse LMIC settings suggests a common challenge: the knowledge–practice gap in occupational safety may be influenced more by structural factors than by individual-level knowledge alone.

Implications for policy and practice

Several implications emerge from this study. First, written OSH policies should be developed, provided to all grain mills, displayed in accessible locations, and communicated to all workers. Verbal instructions alone are insufficient. The Ministry of Health should take responsibility for providing standardized OSH policies for grain mills, given the current fragmentation of responsibilities among the Uganda National Bureau of Standards (UNBS) for product safety, the Ministry of Gender, Labour and Social Development (MOGLSD) for worker safety, and the Ministry of Health for health protection. Second, PPE should be provided to workers free of charge, and its use should be reinforced through regular supervision and inspection. Discomfort, including heat and breathing difficulties, should be addressed through the selection of appropriate and comfortable PPE and through acclimatization training.

Third, training programmes should be formalized, documented, and provided to all workers before they begin work, with regular refresher training thereafter. Informal, peer-based training alone is insufficient to ensure adequate comprehension and retention of safety information.

Fourth, engineering controls, including dust collection systems, machine guards, mechanical lifting devices, and noise-control measures, should be prioritized over reliance on PPE and individual behaviour change. Structural interventions may be more effective and sustainable than interventions focused solely on individual-level behaviour (Waters et al., 2015).

Fifth, given that 68.3% of workers demonstrated poor safety practices, urgent intervention is warranted. The government should consider a phased approach,

beginning with the immediate provision of written OSH policies and PPE, followed by the implementation of engineering controls as resources permit. Small-scale grain mills may require subsidies or low-interest loans to support the implementation of appropriate engineering controls. **Strengths and Limitations.** This study has several strengths. The large sample size ($n = 384$) and high response rate (100%) minimized the potential for non-response bias. The use of both self-reported and observational data enabled triangulation and revealed discrepancies between reported and observed safety practices. The theoretical grounding in the Health Belief Model provided a framework for understanding the findings.

The use of composite scoring for knowledge, attitudes, and practices also provided a systematic approach to measurement.

Several limitations should be acknowledged. First, the cross-sectional design prevents assessment of changes over time and does not permit causal inference. Therefore, the association between OSH policy availability and safety practices should be interpreted as an association rather than a causal relationship. Second, social desirability bias may have affected self-reported practices, although the use of observational data helped mitigate this limitation. The substantial discrepancy between self-reported and observed PPE use suggests that self-reported data should be interpreted with caution. Third, the study was conducted in one Ugandan city, which may limit the generalizability of the findings to other regions with different regulatory environments or grain mill characteristics. Fourth, the study did not assess the content of the "policies" reported by workers; future studies should examine the specific guidelines provided to workers. Fifth, the use of consecutive sampling may have introduced sampling bias if workers present during data collection differed systematically from those who were absent. However, data collection across different shifts and days helped minimize this potential bias. Sixth, the observation data were collected at the mill level ($n = 25$) and could not be directly linked to individual workers, limiting the ability to quantify individual-level discrepancies between self-reported and observed practices precisely. The prevalence of good safety practices (31.7%) in this study was lower than that reported in some LMIC settings but comparable to findings from others. A study among Ethiopian metal workers found that 39.3% demonstrated good compliance with safety measures (Afework et al., 2024). Studies from Nigeria reported that 57.9% of sawmill workers (Onowhakpor et al., 2017) and 42.1% of construction workers (Oluwafemi et al., 2017) had poor safety practices. This variability may reflect differences in work settings, types of hazards, regulatory environments, and approaches to measuring safety practices. The finding that knowledge levels were high but safety practices were poor mirrors findings from Thailand, where healthcare

workers had adequate knowledge but low PPE use (Nankongnab et al., 2021), and from Ghana, where very high levels of knowledge did not translate into good utilization of preventive measures (Odonkor and Sallar, 2024). This consistency across diverse LMIC settings suggests a common challenge: the knowledge–practice gap in occupational safety may be influenced more by structural factors than by individual-level knowledge alone.

Implications for policy and practice

Several implications emerge from this study. First, written OSH policies should be developed, provided to all grain mills, displayed in accessible locations, and communicated to all workers. Verbal instructions alone are insufficient. The Ministry of Health should take responsibility for providing standardized OSH policies for grain mills, given the current fragmentation of responsibilities among the UNBS for product safety, the MOGLSD for worker safety, and the Ministry of Health for health protection. Second, PPE should be provided to workers free of charge, and its use should be reinforced through regular supervision and inspection. Discomfort, including heat and breathing difficulties, should be addressed through the selection of appropriate and comfortable PPE and through acclimatization training. Third, training programmes should be formalized, documented, and provided to all workers before they begin work, with regular refresher training thereafter. Informal, peer-based training alone is insufficient to ensure adequate comprehension and retention of safety information. Fourth, engineering controls, including dust collection systems, machine guards, mechanical lifting devices, and noise-control measures, should be prioritized over reliance on PPE and individual behaviour change. Structural interventions may be more effective and sustainable than interventions focused solely on individual-level behaviour (Waters et al., 2015). Fifth, given that 68.3% of workers demonstrated poor safety practices, urgent intervention is warranted. The government could consider a phased approach, beginning with the immediate provision of written OSH policies and PPE, followed by the implementation of engineering controls as resources permit. Small-scale grain mills may require subsidies or low-interest loans to support the implementation of appropriate engineering controls.

Strengths and limitations

This study has several strengths. The large sample size ($n = 384$) and 100% response rate helped minimize the potential for non-response bias. The use of both self-reported and observational data enabled triangulation and revealed discrepancies between reported and observed

safety practices. The theoretical grounding in the Health Belief Model provided a framework for interpreting the findings. In addition, the use of composite scoring to assess knowledge, attitudes, and practices provided a systematic approach to measurement. Several limitations should also be acknowledged. First, the cross-sectional design prevents assessment of changes over time and does not permit causal inference. Therefore, the association between reported OSH policy availability and safety practices should be interpreted as an association rather than a causal relationship. Second, social desirability bias may have affected self-reported practices, although the use of observational data helped mitigate this limitation. The substantial discrepancy between self-reported and observed PPE use suggests that self-reported data should be interpreted with caution. Third, the study was conducted in a single Ugandan city, which may limit the generalizability of the findings to other regions with different regulatory environments or grain mill characteristics. Fourth, the study did not assess the content of the "policies" that workers reported as available; future studies should examine the specific guidelines provided to workers. Fifth, the use of consecutive sampling may have introduced sampling bias if workers present during data collection differed systematically from those who were absent. However, data collection across different shifts and days helped minimize this potential bias. Sixth, observational data were collected at the mill level ($n = 25$) and could not be directly linked to individual workers. Consequently, the study could not quantify individual-level discrepancies between self-reported and observed practices with precision.

Conclusions

Grain mill workers in Soroti City, Uganda, possessed good knowledge and mixed attitudes regarding occupational hazards, yet safety practices remained poor for the majority (68.3%). Availability of OSH policies paradoxically associated with poor practices reflects the absence of written, displayed policies despite worker reports of policy existence. This reveals a critical implementation gap: policies existed in name only, not in practice. These findings should be interpreted with caution given the cross-sectional design and potential reporting bias.

RECOMMENDATIONS

Urgent interventions are needed to: (1) provide written OSH policies to all grain mills; (2) ensure that these policies are displayed and communicated to workers; (3) provide PPE and enforce its use; (4) formalize safety training programmes; (5) implement appropriate engineering controls; and (6) assign clear responsibility for

OSH oversight to the Ministry of Health. Without these interventions, grain mill workers will continue to face preventable occupational diseases and injuries, while Uganda may face challenges in meeting its obligations under international labour standards and the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 8 (Decent Work and Economic Growth).

ACKNOWLEDGEMENTS

The authors thank all grain mill workers who participated in the study and the grain mill managers who provided access to their facilities. Appreciation is extended to the research assistants, Maureen Nagudi, Joshua Ilukor, Timothy Opio, and Rogers Imoko, for their dedicated support during data collection. David Otim is also acknowledged for providing financial and logistical support during the study.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ABBREVIATIONS

aPR, Adjusted prevalence ratio; **CI**, confidence interval; **CVI**, content validity index; **HBM**, health belief model; **ILO**: International Labour Organization; **KAP**, knowledge, attitudes, and practices; **LMIC**, low- and middle-income countries; **MOGLSD**, Ministry of Gender, Labour and Social Development; **MOH**, Ministry of Health; **OSH**, occupational safety and health; **PPE**, personal protective equipment; **SD**, standard deviation; **UNBS**, Uganda National Bureau of Standards; **WHO**, World Health Organization.

REFERENCES

- Afework A, Tamene A, Tafa A (2024). Compliance with standard occupational health and safety measures and associated factors among small-scale metal industry workers in Central Ethiopia. *Risk Management and Healthcare Policy* 31:399-409.
- Agbana BE, Joshua AO, Daikwo MA, Metiboba LO (2016). Knowledge of Occupational Hazards Among Sawmill Workers in Kwara State, Nigeria. *Nigerian Postgraduate Medical Journal* 23(1):25-32.
- Akbar S, Ahsan K (2019). Workplace safety compliance implementation challenges in apparel supplier firms. *Journal of Cleaner Production* 232:462-73.
- Alemseged EA, Takele AK, Zele Y, Abaya SW, Kiros KG, Mehari M, Bezabh YA, Atsbaha AH, Awoke TY, Goyteom MH (2020). Assessment of chronic respiratory health symptoms and associated factors among flour mill factory workers in Addis Ababa, Ethiopia, 2019: a cross-sectional study. *Journal of Asthma and Allergy* 14:483-92.
- Almutairi NS, Tamrin SB, Guan NY, How V (2020). Review of Knowledge,

- Attitude, and Practice Among Laboratory Workers Towards Occupational Safety and Health. *Malaysian Journal of Medicine and Health Sciences* 16(1):297.
- Aluko OO, Adebayo AE, Adebisi TF, Ewegbemi MK, Abidoye AT, Popoola BF (2016). Knowledge, attitudes and perceptions of occupational hazards and safety practices in Nigerian healthcare workers. *BMC research notes* 9(1):71.
- Asgedom AA, Bråttveit M, Moen BE (2019). Knowledge, attitude and practice related to chemical hazards and personal protective equipment among particleboard workers in Ethiopia: a cross-sectional study. *BMC public health* 19(1):440.
- Atusingwize E, Musinguzi G, Ndejo R, Buregyeya E, Kayongo B, Mubeezi R, Mugambe RK, Ali Halage A, Sekimpi DK, Bazeyo W, Wang JS (2019). Occupational safety and health regulations and implementation challenges in Uganda. *Archives of environmental and occupational health* 74(1-2):58-65.
- Barrera C, Wild P, Dorribo V, Savova-Bianchi D, Laboissière A, Pralong JA, Danuser B, Krief P, Millon L, Reboux G, Niculita-Hirzel H (2018). Exposure to field vs. storage wheat dust: different consequences on respiratory symptoms and immune response among grain workers. *International archives of occupational and environmental health* 91(6):745-57.
- Barros AJ, Hirakata VN (2003). Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC medical research methodology* 3(1):21.
- Bellochio SD, Coradi PC (2022). Systematic review of occupational hazards at postharvest grain operations. *Injury prevention* 28(2):165-74.
- Biggerstaff M, Kniss K, Jernigan DB, Brammer L, Bresee J, Garg S, Burns E, Reed C (2018). Systematic assessment of multiple routine and near real-time indicators to classify the severity of influenza seasons and pandemics in the United States, 2003-2004 through 2015-2016. *American journal of epidemiology* 187(5):1040-50.
- Champion VL, Skinner CS (2008). The health belief model. *Health behavior and health education: Theory, research, and practice* 4:45-65.
- Degavi G, Dereso CW, Shinde S, Adola SG, Kasimayan P (2021). Prevention of occupational hazards among sanitary workers: knowledge, attitude, and practice survey in Bulehora, West Guji zone, Oromia, Ethiopia. *Risk Management and Healthcare Policy* 31:2245-52.
- Eilu E (2019). Anticipated user experience (AUX) framework for implementing electronic participation in a developing country context. Doctoral dissertation, Ph. D. Thesis, Makerere University, Kampala, Uganda.
- Esaiyas A, Sanbata H, Mekonnen Y (2018). Occupational health and safety related knowledge, attitude and practice among wood and metal workers in Hawassa, Ethiopia. *Annual Research and Review in Biology* 22(6):1-9.
- Friend MA, Kohn JP (2023). *Fundamentals of occupational safety and health*. Bloomsbury Publishing USA.
- Geleta DH, Alemayehu M, Asrade G, Mekonnen TH (2021). Low levels of knowledge and practice of occupational hazards among flower farm workers in southwest Shewa zone, Ethiopia: a cross-sectional analysis. *BMC public health* 21(1):232.
- Govaerts R, Tassignon B, Ghillebert J, Serrien B, De Bock S, Ampe T, El Makrini I, Vanderborcht B, Meeusen R, De Pauw K (2021). Prevalence and incidence of work-related musculoskeletal disorders in secondary industries of 21st century Europe: a systematic review and meta-analysis. *BMC musculoskeletal disorders* 22(1):751.
- Herrera-Sánchez IM, León-Pérez JM, León-Rubio JM (2017). Steps to ensure a successful implementation of occupational health and safety interventions at an organizational level. *Frontiers in psychology* 8:2135.
- International Labour Office (2001). *Guidelines on occupational safety and health management systems: ILO-OSH 2001*. Geneva: International Labour Office.
- Iyogun K, Lateef SA, Ana GR (2019). Lung function of grain millers exposed to grain dust and diesel exhaust in two food markets in Ibadan Metropolis, Nigeria. *Safety and Health at Work* 10(1):47-53.
- Jain S, Mansoori R, Nezami Z, Kandanattu B, Sharma S, Singh P, Sivadas A (2026). Knowledge, Attitude, and Practice Regarding Occupational Hazards in Dentistry Among Undergraduate Dental Students: A Cross-Sectional Study. *Saudi journal of oral and dental research* 11(2):79-86.
- Johanes M, Mark M, Steven J (2023). A global review of implementation of occupational safety and health management systems for the period 1970-2020. *International Journal of Occupational Safety and Ergonomics* 29(2):821-836.
- Jonah EB, Dahiru T (2024). Knowledge and practice of occupational health hazard among healthcare workers in kogi state specialist hospital. *Saudi Journal of Nursing and Health Care* 7(03):60-8.
- Kevin NU (2019). The occurrence of workplace hazards among selected workers in the informal sector Kampala Uganda. *Occupational Diseases and Environmental Medicine* 7(4):164-175.
- Krishnan KS, Raju G, Shawkataly O (2021). Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. *International journal of environmental research and public health* 18(17):9361.
- Lagiso ZA, Mekonnen WT, Abaya SW, Takele AK, Workneh HM (2020). Chronic respiratory symptoms, lung function and associated factors among flour mill factory workers in Hawassa city, southern Ethiopia: "comparative cross-sectional study". *BMC Public Health* 20(1):909.
- Marahatta SB, Katuwl D, Adhikari S, Rijal K (2017). Knowledge on occupational health hazard and safety practices among the municipal solid waste handler. *Journal of Manmohan Memorial Institute of Health Sciences* 3(1):56-72.
- Mohammed MA, Shaibo RS, Hassan SS, Mohamed Salah ET (2025). Implementing Clinical Audit in a Aesource-Limited Setting; Pediatricians Perceptions and Perspectives. *BMC Health Services Research* 25(1):1506.
- Mukhtar MY, Yusof AM, Isa ML (2020). Knowledge, attitude and practice on occupational safety and health among workers in petrochemical companies. *IniOP Conference Series: Earth and Environmental Science IOP Publishing*. 436(1):012029
- Nampala MP, Ssali R, Mwanani C, Massa-Makuma H, Kakuuku A (2025). integrating international hazard classification systems into Uganda's environmental and occupational health frameworks. *African Journal of Emerging Issues* 7(25):102-13.
- Nankongnab N, Kongtip P, Tipayamongkhogul M, Silpasuwan P, Kaewboonchoo O, Luksamijarulkul P, Woskie S (2021). Occupational hazards, health conditions and personal protective equipment used among healthcare workers in hospitals, Thailand. *Human and Ecological Risk Assessment: An International Journal* 27(3):804-24.
- Nassirou-Sabo H, Toudou-Daouda M (2024). Assessment of knowledge, attitudes, and practices of occupational risks and diseases among healthcare providers of the Regional Hospital Center of Dosso, Niger. *SAGE Open Medicine* 12:20503121231224549.
- Ndejo R, Musinguzi G, Yu X, Buregyeya E, Musoke D, Wang JS, Halage AA, Whalen C, Bazeyo W, Williams P, Ssempebwa J (2015). Occupational health hazards among healthcare workers in Kampala, Uganda. *Journal of environmental and public health* (1):913741.
- Njue RM (2021). Assessment of the level of awareness in occupational safety and health among rice mill workers in central Kenya (Mwea). *International Journal of Innovation Research and Advanced Studies* 6:24-8.
- Nordlöf H, Wiitavaara B, Högberg H, Westerling R (2017). A cross-sectional study of factors influencing occupational health and safety management practices in companies. *Safety science* 95:92-103.
- Novikova TA, Aleshina YA, Danilov AN, Spirin VF (2019). Contemporary working conditions and assessment of occupational health risk for workers employed at flour-grinding productions. *Health Risk Analysis* (1):50-7.
- Odonkor ST, Sallar AM (2024). Occupational health and safety knowledge, attitudes and practices among healthcare workers in Accra Ghana. *Scientific African* 24: e02130.
- Okafogbu NC, Oche M, Awosan KJ, Abdulmulmuni HB, Gana GJ, Ango JT, Raji I (2017). Determinants of knowledge and safety

- practices of occupational hazards of textile dye workers in Sokoto, Nigeria: a descriptive analytic study. *Journal of Public Health in Africa* 8(1):664.
- Olorunfemi O, Osunde NR, Ilaboya IE, Oko-Ose JN, Ehidiame-Edobor OR, Akpor OA (2022). Knowledge of occupational hazards and their perceived effects among operating theatre workers. *Indian Journal of Occupational and Environmental Medicine* 26(1):29.
- Oluwafemi FS, Abiola A, Akingbade AM, Faeji CO, Oni IO (2017). Knowledge of occupational hazards, attitude and practice of occupational safety measures among construction workers in different building sites located in Ibeju-Lekki Local Government Area of Lagos State, Nigeria. *Online Journal of Health and Allied Sciences* 16(4):10.
- Onowhakpor A, Abusu G, Adebayo B, Esene H, Okojie O (2017). Determinants of occupational health and safety: Knowledge, attitude, and safety practices toward occupational hazards of sawmill workers in Egor Local Government Area, Edo State. *African Journal of Medical and Health Sciences* 16:58.
- Politakis G (2023). The recognition of occupational safety and health as a fundamental principle and right at work. *International and Comparative Law Quarterly* 72(1):213-232.
- Rai R, El-Zaemey S, Dorji N, Rai BD, Fritschi L (2021). Exposure to Occupational Hazards among Health Care Workers in Low and Middle-Income Countries: A Scoping Review. *International Journal of Environmental Research and Public Health* 18(5):2603.
- Rantanen J, Lehtinen S, Valenti A, Iavicoli S (2018). Occupational health in developing countries with special reference to Africa. *International Journal of Environmental Research and Public Health* 15(4):799.
- Rosenstock IM (1974). Historical origins of the health belief model. *Health Education Monographs* 2(4):328-335.
- Shaukat N, Tahir H, Jamali T, Hassan M, Nafees A (2020). Determinants of occupational hazards knowledge and safety practices among textile workers in Karachi, Pakistan: A cross-sectional study. *Journal of the Pakistan Medical Association* 70(6):958-963.
- Tadesse S, Bezabih K, Destaw B, Assefa Y (2016). Awareness of occupational hazards and associated factors among welders in Lideta Sub-City, Addis Ababa, Ethiopia. *Journal of Occupational Medicine and Toxicology* 11(1):15.
- Uganda Bureau of Statistics (2024). The National Population and Housing Census 2024: Final Report. Volume I: Main. Kampala: Uganda Bureau of Statistics.
- Waters M, McKernan L, Maier A, Jayjock M, Schaeffer V, Brosseau L (2015). Exposure estimation and interpretation of occupational risk: enhanced information for the occupational risk manager. *Journal of Occupational and Environmental Hygiene* 12 Suppl 1: S99-S111.
- World Health Organization (WHO)/International Labour Organization (ILO) (2021). WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury, 2000-2016. Geneva: World Health Organization.
- Wokorach G, Landschoot S, Anena J, Audenaert K, Echodu R, Haesaert G (2021). Mycotoxin profile of staple grains in northern Uganda: Understanding the level of human exposure and potential risks. *Food Control* 122:107813.
- Zambrano CMM, Mendoza DJ (2021). Analysis of the implementation of occupational safety and health standards at manufacturing companies in the city of Valledupar. *Revista Brasileira de Medicina do Trabalho* 19(3):290-298.
- Zou G (2004). A modified poisson regression approach to prospective studies with binary data. *American journal of epidemiology* 159(7):702-6.