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Occupational health and safety practices and associated factors among workers in Ethiopia's Metehara and Wonji sugar industries: a convergent parallel mixed design

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ABSTRACT

Introduction Information regarding workers' practices concerning safety measures in Ethiopia's sugar industries is inadequate.

Objectives To assess occupational health and safety practices and associated factors among workers in Ethiopia's Metehara and Wonji sugar industries.

Design A convergent parallel mixed design.

Setting Metehara and Wonji sugar industries in Ethiopia (December 2021 through May 2022).

Participants We used a stratified random sampling method to select 1648 participants for the collection of quantitative data. We employed a purposive sampling method to carry out 20 in-depth interviews in order to gather qualitative data.

Primary outcome measures We computed the extent of occupational health and safety practices using a 21-item questionnaire. Finally, results were graded as 'good' if ≥60% of them were answered correctly and 'poor' if <60% were correctly answered. We created a qualitative data interpretation from the subject's perspective.

Results The percentage of good occupational health and safety practices was 29.6% (95% CI: 27% to 32%). Inappropriate provision of personal protective equipment (adjusted OR (AOR)=1.42, 95% CI: 1.10 to 1.83), a lack of strict safety regulation (AOR=1.64, 95% CI: 1.27 to 2.12), a lack of incentives (AOR=1.31, 95% CI: 1.04 to 1.66) and inadequate management support (AOR=1.19, 95% CI: 1.04 to 1.66) were identified as associated factors. Health service usage defects, inappropriate protective equipment use and failure to follow occupational safety commands were identified as challenges.

Conclusions Occupational health and safety measures were not used effectively. The qualitative component of this study confirmed that most participants expressed undesirable practices in occupational health and safety measures. Inappropriate protective device provisions, a lack of strict safety regulation, the absence of incentives and inadequate management support were found to be linked with the use of occupational health and safety measures. The contributing factors we identified potentially indicate areas for future intervention.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Bias (possibly resulting in an underestimation of safety practices) cannot be completely ruled out because the examination of industries depended on factory managers' consent.
⇒ The convergent parallel mixed design improved the present study's internal and external validity.
⇒ Information on the percentage of occupational health and safety practices was collected at a single point in time. As a result, while measures cannot be used to determine the personal habits of specific employees, they are a good indicator of safety practices.
⇒ The study thoroughly investigated each component of safety measures with large sample sizes.

INTRODUCTION

Occupational injury is a global problem that leads to irreversible impairments and death among employees in the manufacturing industry.[1] Up to 40–50% of the industrial workforce is exposed to several occupational hazards worldwide.[2–4] Furthermore, individual health and safety, as well as organisational effectiveness, are negatively impacted by occupational hazards.[5] Although substantial efforts have been made to limit the impact of workplace hazards, occupation-related injury remain a health and safety problem for many industrial workers worldwide.[6 7] Moreover, occupational health and safety measures are strategies or standards for protecting against occupational hazards. These include the use of proper personal protective equipment (PPE), adherence to safety protocols and other dimensions of safety measures.[8 9] Thus, the primary goal in several countries is to improve workplace safety policies to implement occupational health and safety measures better. But, compliance with accepted safety

standards/practices remains unimpressive.[10] Although many studies suggest that worldwide, workers often have good knowledge, their compliance with safety practices are insufficient.[11 12] Only 40% of workers at sugar factories reported good safety practices, according to research from India.[13]

In Africa, one piece of evidence from Nigeria revealed that compliance with best practices regarding PPE is around 40%. Regarding the proportion of unsafe acts committed by the employees, 58% of employees engage in risky behaviour.[14] Furthermore, occupational health and safety practices are affected by several factors, including age, educational status and years spent in the industry.[15] One study found that failing to provide proper PPE was a factor associated with poor practices in safety measures in one study.[16] Additionally, many studies found that receiving safety training, adequate management support and the attitude toward safety measures were predictors of good practices in occupational health and safety measures.[17–19]

In the context of Ethiopia, concerning the policies in place regarding occupational health and safety measures, the Ethiopian Labour Proclamation enforces that the employer has a legal obligation to protect workers from injuries and illnesses, including the provision of occupational health services.[20 21] Next, studies have documented the heavy burden of occupation-related injuries in various industries, including the sugar industry in Ethiopia.[22–26] Moreover, Ethiopia's sugar plants are growing to help the country's economy prosper. In these industries, many thousands of workers have varying educational, professional and socioeconomic backgrounds. However, information regarding workers' practices concerning safety measures in Ethiopia's sugar industries is inadequate. We predicted that these sugar factories would be a source of several physical hazards, such as heavy dust, intense heat and noise, which could harm the workers' health and affect organisational productivity. In these contexts, this study aimed to assess occupational health and safety practices and associated factors among workers in Ethiopia's Metehara and Wonji sugar industries.

METHODS

Study setting and period

This study was carried out in the Metehara and Wonji sugar industries in the Oromia region of Ethiopia from December 2021 through May 2022. Wonji and Metehara sugar factories are two of the biggest sugar factories in the country in terms of size, type of cane being processed, factory design, daily sugarcane crushing capacity and manpower. Both sugar factories are found in the Oromia region, near Adama city, 110 and 200 km away from the capital city, Addis Ababa, Ethiopia, respectively. Wonji and Metehara factories are designed to have a crushing capacity of 6250 and 5100 tons of sugarcane per day, respectively. Regarding manpower, 9947 and 10 678 workers are currently (2021–2022) working in the Metehara and Wonji sugar factories, respectively.[27–29] We intended to enrol workers within multiple different work sections, including the boiler, power turbine, evaporation plant, vacuum plant, pan out area, mill turbine and bagasse baling (accumulation area) in our study.

Study design

We employed a convergent-parallel mixed design to collect comprehensive information on participants' behaviour and experience with occupational health and safety practices to answer the study's central questions. We collected and analysed quantitative and qualitative data during a similar time frame, weighed the methods equally, kept the data collection and analysis independent and mixed the results during overall interpretation. We used a side-by-side comparison to merge two sources of data. Then, we interpreted a discussion section presenting first one set of findings and then the other (figure 1).

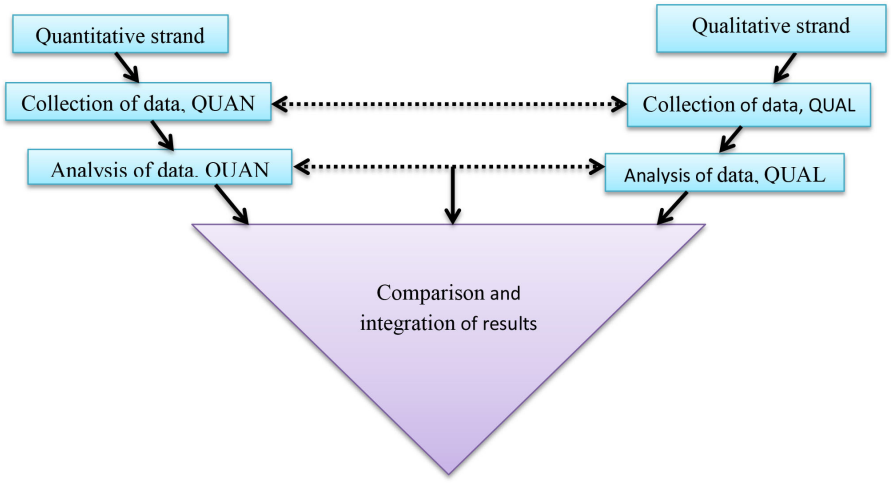

Figure 1 Diagram of convergent-parallel mixed design.

Inclusion criteria

We included the participants who were directly engaged in factory operation processes. We also included the participants who were available during the data collection period and willing to participate in the study.

Exclusion criteria

We excluded participants who were not directly involved in the sugarcane production process, such as management staff, because, by their occupation, they had less exposure to occupational hazards than others. We also excluded participants absent during data extraction, possibly due to being chronically injured and far from the workplace. Furthermore, we excluded participants with a history of hearing loss or sight problems since data collectors could not communicate with them.

Sample size determination and sampling techniques

We determined the sample size using a single population proportion formula with the following assumptions: the proportion of safety practices (p)=40%.[30] With a 5% margin of error at a 95% CI and a design effect of 1.5, the calculated sample size yielded 1648 respondents. To obtain the appropriate number of sampling units, we used stratified random sampling. For stratification, we used work sections, believing that workers in different work sections would have varied safety practices. We selected five work sections from each sugar industry through a simple random sampling technique from 17 work sections. We divided the sample size proportionally between the two sugar industries and then between each stratum (n=5). We used a list of all employees with their assigned work sections to create a sampling frame. We selected the study unit with a simple random sampling technique.

We conducted 20 in-depth interviews using a purposive sampling technique concerning qualitative data. The principle of theoretical saturation was maintained when no new information or insights could be collected by conducting further interviews. The interviews were audio-recorded, saved and encoded to ensure the anonymity and confidentiality of the participants. We also obtained informed consent from each participant to participate in and record the interview.

Operational definitions

Appropriateness of PPE

Participants self-reported and made personal observations of whether they used the proper PPE while on the job. At the time of the interview, the participants were observed using PPE just before starting the questionnaire administration for a 5-min observation.

Attitude

We computed the participants' attitudes from 5-point Likert scale questions. Each question had a 1–5 that corresponded with the scale measurement. The participants' answers were graded as 'good attitude' if the cumulative answer was ≥80% (20–25), a 'medium altitude' score if they replied correctly (60–79%) 15–24 and 'poor attitude' if <59% (0–14).[31]

Occupational health and safety practices

We graded the participant's safety practices scores out of 21 items as good if ≥60% and poor if <60%.[32] We collected the qualitative data using an in-depth interview guide, and the data interpretations were from the subject's point of view.

Knowledge

We asked the participants to complete 15 health and safety-related knowledge questions. They have given a 'good knowledge' mark if they responded appropriately (≥80%) to 7–9 questions, a 'medium level knowledge' score if they replied correctly (60–80%) to 5–6 questions and a 'poor knowledge' grade if they answered correctly (≤59%) 0–4 questions.[31]

Management support

Management support was given a score based on a 5-point Likert scale (strongly agree=5, agree=4, moderate=3, disagree=2 and strongly disagree=1).[33]

Safety regulation

Self-reported whether routine safety regulations were conducted in the working section and timely feedback was given before this study.

Incentives

Self-reported financial or non-financial rewards that motivate employees for safe behaviours like appreciation, a positive and caring attitude from the employer, meeting new challenges and job rotation.

Occupational injury

Referred to self-reported personal injury such as a cut, fracture, sprain and so forth those results from a work-related event resulting in an absence from work of at least 1 day before this study.

Data collection procedures and techniques

We collected the quantitative data using a structured, pretested, interviewer-administered questionnaire and an observational checklist adopted from past studies.[34–39] After certain modifications, additionally, we gathered qualitative data through in-depth interviews facilitated by open-ended questions that we had carefully reviewed from previous work to adapt and modify.[18 34 36 40 41] (online supplemental materials). The principal investigator (PI) conducted face-to-face, in-depth interviews using an audio recorder at a suitable location. The facilitator also assisted the PI during the interview by taking notes. We also interviewed the safety technicians, team leaders and appropriate workers. We collected data from participants until we presumed saturation of response. Participants in this study's interviews were not enrolled in the cross-sectional survey. This non-enrolment could be done to present diverse views from each strand.

Data quality assurance

Trained data collectors (n=6) with a degree in occupational health and safety gathered the data. The PI trained data collectors for 2 days. The translators (language experts) translated the questionnaires into Amharic and had them back-translated into English by an independent translator for consistency. Before data collection, we conducted pretests on 10% of the sample size outside the study area. We provided a clear introduction on the questionnaire's first page that explained the participants' purpose and objectives. We used COnsolidated criteria for REporting Qualitative research (COREQ), a 32-item checklist for interviews.[42] and Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) with 22 items for a cross-sectional study.[43] We also checked credibility through repeated data transcription, translation and coding. We maintained credibility by inviting experienced researchers to evaluate transcribed and translated data. We returned transcripts to participants for comment and/or correction. We ensured the dependability of the data during transcription, translation and interpretation using scientific procedures.

Questionnaire data reliability

We used Cronbach's alpha test to measure the question or item consistency. It is the most common method used for measuring reliability.[44 45] Cronbach's alpha values of around 0.8 are considered good.[44] The anticipated scale item's overall Cronbach's alpha coefficients were 0.75; consequently, the anticipated scales used in this investigation show great dependability, indicating that the questions or items have good internal consistency and reliability.

Data processing and analysis

In this study, we split the questionnaire into four parts: socio-demographic-related factors, job-related characteristics, personal/behavioral-related characteristics and the dimensions of safety measures. We analysed quantitative data using the Statistical Package for Social Sciences (SPSS) software (V.26). We also used the Hosmer and Lemeshow test with a p value >0.05 to assess model fitness. Multicollinearity was checked using a correlation matrix >0.8, variance inflation factor >10 and tolerance <0.1. We used a metric called the receiver operating characteristic curve and the area under the curve (AUC) statistic to assess the model's ability to make predictions. Accordingly, the lack of management support (AUC=0.653) was a better predictor than the inappropriate provision of PPE (AUC=0.616) and the absence of safety incentives (AUC=0.546). The forward and backward logistic regression analysis model was used to assess the impact of each independent variable on the dependent variables. Variables with a p value of ≤0.05 that had an association with the dependent variable (occupational health and safety practice) were entered into a multivariate logistic regression to control for the effect of confounders. An adjusted OR (AOR) with a 95% CI was used to express the direction and strength of the association.

In terms of the qualitative strand, we created data interpretation from the subject's perspective, which included textual and structural explanations. Qualitative data management was assisted by using qualitative data analysis software, OpenCode software V.4.02. We reviewed the recorded, transcribed, validated and processed qualitative data. We also thematically analysed and synthesised participants' insights into themes that emerged from the texts and quotes. We recorded and transcribed it verbatim and translated it into English for the subsequent analysis. The transcribed data were then analysed inductively using thematic analysis, as recommended by the literature.[46] We checked the transcribed data for consistency with the recordings by listening and reading repeatedly. PI did data coding sentence by sentence to create themes with similar ideas. We used a contiguous narrative method to report and integrate the results. That is reporting results of the quantitative strand followed by results of the qualitative strand in different subsections.[47]

Theoretical framework

The study briefly discussed the literature on occupational health and safety practices in the introduction section to provide context for interpreting the results. Several driving factors that positively and negatively influenced the outcome variables in this study were suggested. The study assumed that no particular variable is responsible for workers' good safety practices, rather than multiple variables' collective impact.

According to our quantitative data analysis findings, the key contributing factors associated with using occupational health and safety measures were socio-demographic, job-related and personal or behavioural characteristics. Similarly, from the qualitative thematic analysis output, the identified challenges to practices of occupational health and safety measures include defects in occupational health service use, failure to follow occupational safety commands, inappropriate PPE use, lousy behaviour in personal cleanliness and access to facility-related practices. They are interdependent on the dependent variable in the present study. This combined effect summed up associated factors and, as stated below, evaluated the relationship between outcome variables and independent variables. The present study followed this conceptual structure to define factors and challenges associated with occupational health and safety practices (figure 2).

Patient and public involvement

We did not involve patients or the public in the design or conduct of this study. We made study findings publicly available to participants and the general public by producing study reports and open-access articles. The study web pages provided contact details for the research team if any individual wished to request publications directly.

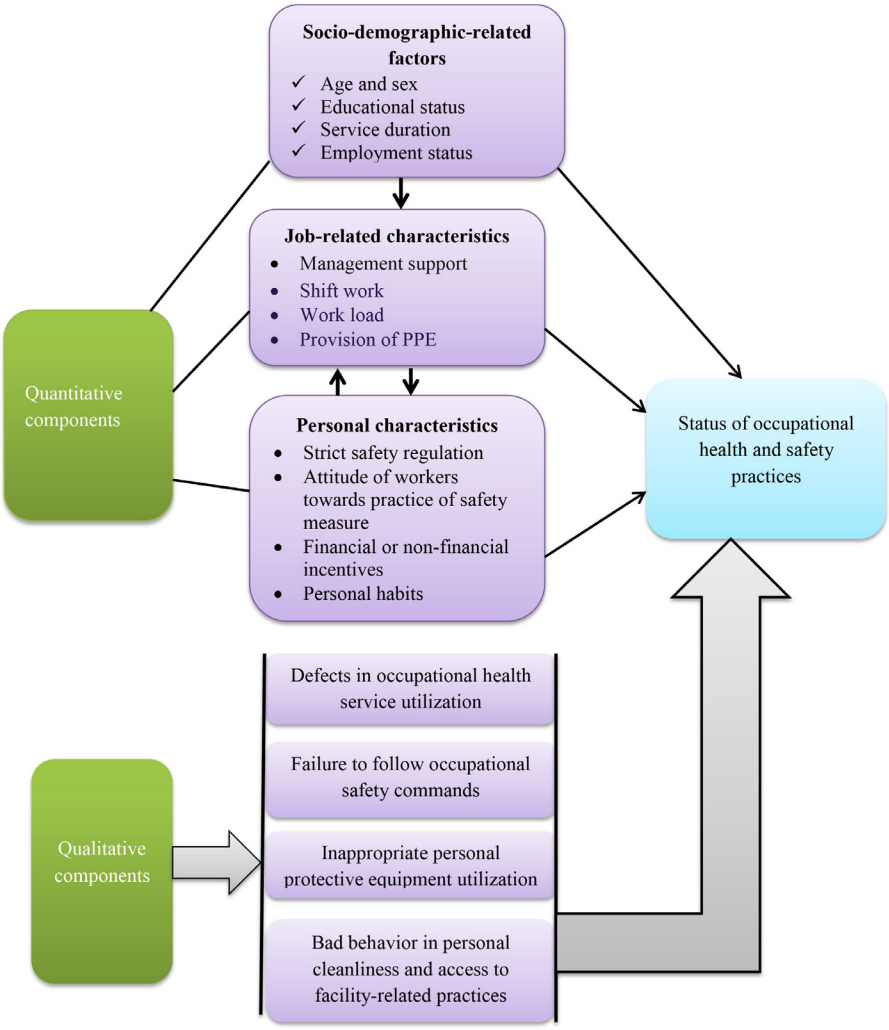

Figure 2 A theoretical framework on the pathways of factors and challenges associated with occupational health and safety practices. PPE, personal protective equipment

RESULTS

Quantitative strand: socio-demographic characteristics

We included 1648 respondents, yielding a 100% response rate. This high response rate in this study was secured by well-trained and experienced interviewers working under close supervision. Further, we clarified questions and asked them through the appropriate channel. Additionally, because our study's design was institution-based, we were trusted by those being interviewed. In terms of sex distribution, men accounted for 87.1%. About 644 (39.08%) were diploma holders. The mean±SD of the monthly salaries of participants was 3928±41 Ethiopian birr. Regarding work experience, 54.98% of respondents had work experience of more than 11 years, and 67.1% of respondents were permanent employees in their job (table 1).

Job/environmental-related characteristics

In this study, 1093 (66.3%) participants described the absence of occupational health and safety standards at the industry level. Almost 73.3% of the study participants reported inadequate management support while on the job (table 2).

Personal characteristics of the study participant

We found that 64.8% of participants had not received ongoing safety training. In addition, 60.2% of participants said the PPE provided was inappropriate. In this study, six attitude-testing questions were also asked of the participants. Thus, 26% had positive or good attitudes toward occupational health and safety measures. We assessed the participants' knowledge of occupational health and safety measures using 15 knowledge-consideration questions. Accordingly, 30.3% of participants understood occupational health and safety measures (table 3).

Occupational health and safety practices

The percentage of good practices in occupational health and safety measures was 29.6% (95% CI: 27% o 32%). Regarding the extent of the use of each safety measure's specific dimensions, PPE use was rated as good practice at 540 (32.8%). Additionally, 1208 (73.3%) of the participants did not follow safety rules or protocols. Similarly, the usage of occupational health services was also reported as being poor by 59.6% of participants (table 4).

Table 1 Socio-demographic characteristics of participants in Metehara and Wonji sugar industries in Ethiopia, 2022

Variables		Frequency	Percent
Sex of participants	Male	1436	87.1
	Female	212	12.9
Age in years	18–32	194	11.77
	33–47	797	48.36
	Above 48	657	39.87
Marital status	Single	560	33.98
	Married	1054	63.96
	Others	34	2.06
Religion	Orthodox	1100	66.75
	Muslim	361	21.91
	Protestant	129	7.83
	Others	58	3.52
Educational background	Read and write	138	8.37
	Primary (1–8 grade)	354	21.48
	Secondary (9–12 grade)	293	17.78
	Certificate	135	8.19
	Diploma (level-4)	644	39.08
	Degree and above	84	5.10
Work experience	≤5 years	255	15.47
	6–10 years	487	29.55
	>10 years	906	54.98
Employment status	Permanent	1106	67.1
	Temporary	542	32.9
Weekly working hours	<48 hours	408	24.8
	≥ 48 hours	1240	75.2

Table 2 Job-related characteristics of participants in Metehara and Wonji sugar industries in Ethiopia, 2022

Variables		Frequency	Percent
Having history of injuries in the last 12 months	Yes	1168	70.9
	No	480	29.1
Possible reason for injuries	Inappropriate PPE	1182	25.9
	Unsafe act	1161	25.4
	Blunt/obsolete tools/ machines	1077	23.6
	Inadequate knowledge	1144	25.1
Visit health institutions for injuries	Yes	1001	60.7
	No	647	39.3
Presence of occupational health and safety standards	Yes	555	33.7
	No	1093	66.3
Presence of shift work	Yes	1502	91.1
	No	146	8.9
Presence of work overload	Yes	694	42.1
	No	954	57.9
Adequacy of management support	Adequate	440	26.7
	Inadequate	1208	73.3
Work sections	Boiler section	938	56.92
	Power turbine	347	21.06
	Evaporation plant	179	10.86
	Vacuum plant	89	5.40
	Pan out	95	5.76

PPE, personal protective equipment.

Factors associated with occupational health and safety practices

Information about confounding factors such as the presence or absence of the workload, work experiences and personal habits such as khat chewing was collected and adjusted using a multivariate regression model. After controlling for confounding variables, the following factors were associated with occupational health and safety practices in the fully adjusted model: inappropriate provision of PPE (p value=0.01), lack of strict safety regulation (p value=0.01), lack of financial or non-financial incentives (p value=0.01), inadequate management support (p value=0.02), the favourable attitude of workers towards occupational health and safety measures (p value=0.01) and presence of shift work (p value=0.01) (table 5).

We found that inappropriate PPE provision reduced the odds of good practice of occupational health and safety measures by 42% among the participants who used it compared with their counterparts (AOR=1.42, 95% CI: 1.10 to 1.83) (table 5). Similarly, the absence of strict safety regulations decreased the participants odds of good practice of occupational health and safety measures by 64% more than their peers (AOR=1.64, 95% CI: 1.2 to 2.12). We also found that workers who did not receive support from the top management had 19% lower odds of reporting good practice in occupational health and safety measures than individuals who believed they did (AOR=1.19, 95% CI: 1.04 to 1.66).

Furthermore, workers who had not received financial or non-incentives had a 31% drop in the odds of being reported the good practices of occupational health and safety measures compared with workers who had received incentives (AOR=1.31, 95% CI: 1.04 to 1.66). In contrast, employees with a good attitude toward occupational health and safety measures had 23% higher odds of reporting good practices in occupational health and safety measures than employees with a poor attitude and a favourable attitude (AOR=0.87, 95% CI: 0.77 to 0.95). Finally, the presence of shift work raised the odds of good practices in occupational health and safety measures for benefitted employees by 41% higher than their peers (AOR=0.59, 95% CI: 0.41 to 0.87) (table 5).

Qualitative strand: individual interviews

The trained interviewers interviewed a total of 20 participants. The sex distribution was such that 90% were men, and participants' mean±SD age was 37±6 years. About 45% of the interviewed participants had a diploma.

Table 3 Personal characteristics of participants in Metehara and Wonji sugar industries in Ethiopia, 2022

Variables		Frequency	Percent
Drinking alcohol	Yes	431	26.15
	No	1217	73.85
Khat chewing	Yes	695	42.17
	No	953	57.83
Appropriateness of personal protective equipment	Yes	656	39.8
	No	992	60.2
Occupational health and safety training was received in the last 12 months	Yes	597	36.2
	No	1051	63.8
Financial or non-financial incentives or rewards ever received	Yes	552	33.50
	No	1096	66.50
Presence of strict safety regulation	Present	616	37.4
	Absent	1032	62.6
The attitude of workers toward occupational health and safety measures	Poor attitude	685	41.6
	Medium attitude	535	32.5
	Favourable attitude	428	26.0
Knowledge of workers on occupational health and safety measures	Poor knowledge	630	38.2
	Medium knowledge	518	31.4
	Good knowledge	500	30.3

Concerning working service duration, the participants' mean±SD work experience was 10±3 years. The mean±SD duration of the interview was 20±5 min (table 6).

Table 4 Occupational health and safety practices and dimensions of practice among participants in Metehara and Wonji sugar industries in Ethiopia, 2022

Variable		Frequency	Percent
Occupational health and safety measures			
Good practice		488	29.6
Poor practice		1160	70.4
Dimensions of practices	Personal protective equipment use		
	Good practice	540	32.8
	Poor practice	1108	67.2
	Adherence to safety rules/ protocols		
	Good practice	440	26.7
	Poor practice	1208	73.3
	Hygiene and sanitation		
	Good practice	542	32.9
	Poor practice	1106	67.1
	Occupational health service use		
	Good practice	665	40.4
	Poor practice	983	59.6

Themes

In this study, four main themes emerged from the qualitative thematic analysis. These include occupational health service use defects, failure to follow occupational safety commands, inappropriate PPE use and bad behaviour in personal cleanliness and access to facility-related practices (table 7).

Theme I: occupational health service use-related defects

Incomplete (insufficient) pre-employment medical surveillance

Most respondents interviewed said that they used incomplete or insufficient pre-employment medical surveillance. We made considerable efforts to understand incomplete pre-employment medical surveillance. Later, 'incomplete pre-employment medical surveillance' refers to a medical examination that did not capture all body parts that were likely to be affected by numerous hazards before workers started working. One respondent stated:

> I've spent over 11 years working in power turbines, where numerous health concerns exist. This department has many specks of dust, heat and noise. But I didn't complete my medical tests before beginning the job, which means that a medical exam is limited to an eye exam. Before starting the job, I ensured that no comprehensive medical examination was done. (Participant No.2).

> The respondent added: As you can see [pointed to interviewer], I'm in a high-risk situation (hazardous area). My clothes, head and eyebrows were plastered with dust for more than 8 hours. I constantly worry about my health as a result. Over a year ago, I started coughing sporadically. I started having this cough when I started working here. I'm not sure if my current employment [job] has anything to do with this issue. (Participant No.17).

> Another participant added: When employed, I make incomplete medical examinations limited only to eye [vision] screening—otherwise, no X-rays, ear tests [audio] or urine testing.' The doctors assured me that I was disease-free without conducting an in-depth laboratory examination. (Participant No.13).

Irregular periodic medical surveillance

Moreover, many participants interviewed had expressed irregularities in periodic medical surveillance after employment. We attempted to establish irregular, periodic medical surveillance. Later, it became clear that the irregular, periodic medical surveillance referred to the absence of a clear time interval for conducting medical examinations before someone got sick. A participant described:

> I have been working for over 15 years in the boiler section, but I don't get health check-ups regularly after employment. I have little knowledge of how often I can visit the doctor before getting sick. This is due to limited training and monitoring for medical exams in the industry. (Participant No.19).

Table 5 Bivariate and multivariable analysis of factors associated with occupational health and safety practices among participants in Metehara and Wonji sugar industries in Ethiopia, 2022

Associated factors	The practices of OHS measures		COR (95% CI)	AOR (95% CI)	P value
	Poor (n)	Good (n)			
PPE provisions status					
Appropriate	342	205	1		
Inappropriate	818	283	1.73 (1.39 to 2.15)*	1.42 (1.10 to 1.83)†	0.01
Strict safety regulation					
Present	363	253	1	85	
Absent	797	235	2.36 (1.70 to 2.73)*	1.64 (1.27 to 2.12)†	0.01
Financial or non-financial incentives					
Present	357	195	1		
Absent	803	293	1.49 (1.20 to 1.86)*	1.31 (1.04 to 1.66)†	0.01
Management support					
Adequate	244	311	1		
Inadequate	849	244	2.72 (2.19 to 3.40)*	1.98 (1.57 to 2.52)†	0.03
Presence of work load					
Yes	245	432	1.69 (1.37 to 2.10)*	1.08 (0.80 to 1.47)†	0.59
No	243	728	1		
Work experiences					
≤5 years	148	107	1		
6–10 years	347	140	1.79 (1.30 to 2.46)*	0.46 (0.26 to 0.80)†	0.06
>10 years	241	665	1.99 (1.49 to 2.66)*	0.84 (0.507 to 1.41)†	0.52
Khat chewing habit					
Yes	176	519	1		
No	312	641	1.43 (1.15 to 1.78)*	1.06 (0.78 to 1.44)†	0.67
The attitude of workers towards health and safety measures					
Poor	486	199	1		
Favourable	398	137	1.19 (0.92 to 1.53)*	0.32 (0.15 to 2.54)†	0.01
Good	152	276	0.74 (0.57 to 0.96)*	0.87 (0.77 to 0.95)†	0.01
Shift work					
Yes	427	1075	0.55 (0.39 to 0.78)*	0.59 (0.41 to 0.87)†	0.01
No	61	85	1		

*Significant at 0.05 in bivariate binary logistic regression analysis.
†Significant at 0.05 in multivariate binary logistic regression analysis.
AOR, adjusted OR; COR, crude OR; OHS, occupational health and safety; PPE, personal protective equipment.

Another participant added: I have been working in an evaporation plant for 11 years. I haven't had any health issues up to this point.' As a result, I only go to the clinic when I'm sick; otherwise, I haven't done any regular medical screening since starting my job in this industry. (Participant No. 3).

Furthermore, respondents stated they were unsure which type of medical disease screening was required. One respondent stated: I'm not sure what kind of work-related disease a regular health check-up is required for. This is because no regular work-related disease training is provided for me; this is also true for other workers in this industry. (Participant No.4).

Theme II: failure to follow occupational safety commands

Unsafely followed work procedures or instructions

Most interviewed participants explained that they were following work instructions unsafely. We strived to appreciate unsafe work instructions. It became clear that the participants did not work according to the steps taken and the positions to be held in a very hazardous work area.

A participant said: It is impossible to carry out the specified job instructions regularly. I, therefore, don't always adhere to task-specific instructions. The issue is that I don't have anyone checking how I'm doing at work, and the workload is heavy. The industry keeps track of working hours, not whether work

Table 6 Participants' socio-demographic characteristics and interview information in Metehara and Wonji sugar industries in Ethiopia, 2022 (n=20)

S. no	Name of work sections (sampled work sections)	Age in years	Sex	Marital status	Educational information	Work experiences in years	Duration of interview (in min)
1	Boiler section	42	Male	Married	Primary	7	30
2	Power turbine 4	50	Male	Married	Degree	6	25
3	Evaporation plant	45	Male	Married	Diploma	11	25
4	Vacuum plant	39	Male	Married	Certificate	9	16
5	Pan out	35	Male	Married	Diploma	7	16
6	Boiler section	38	Male	Married	Diploma	15	16
7	Milling section	33	Male	Married	Diploma	21	15
8	Pan out	40	Female	Married	Secondary	8	23
9	Sulpher station	27	Female	Single	Diploma	8	23
10	Vacuum plant	32	Male	Single	Diploma	9	18
11	Evaporation plant	30	Male	Single	Diploma	10	22
12	Workshop	49	Male	Married	Diploma	11	28
13	Boiler section	37	Male	Married	Certificate	13	20
14	Milling section	34	Male	Married	Secondary	10	33
15	Evaporation plant	41	Male	Married	Secondary	8	16
16	Vacuum plant	29	Male	Single	Degree	6	18
17	Power turbine 4	35	Male	Married	Degree	11	20
18	Maintenance	38	Male	Married	Diploma	7	20
19	Boiler section	34	Male	Married	Primary	15	15
20	Chemical station	36	Male	Married	Certificate	10	18

Table 7 Themes, subthemes and formulated meanings emerged from interviews with workers in Metehara and Wonji sugar industries on occupational health and safety measures in Ethiopia, 2022

Themes	Theme I Occupational health service use defect	Theme II Failure to follow occupational safety-commands	Theme III Inappropriate personal protective equipment use	Theme IV Bad behaviour of personal cleanliness and access to facility-related practices
Subtheme	► Pre-employment testing. ► Periodic medical examination.	► Work procedure. ► Safety rules. ► Extra precautions.	► Respiratory protection. ► Eye protection. ► Head protection. ► Ear protection. ► Hand-leg protection.	► Sanitation practices. ► Hygiene practice.
Code	► Incomplete pre-employment medical screening. ► Irregular health checkups. ► Low awareness of medical examination. ► Not receiving training on health checkups. ► Absence of medical checkup. ► Not knowing the time interval to conduct medical checkups.	► Lack of experience in following work procedures. ► Lack of enforcement. ► Incorrectly followed work procedure. ► Not respect safety rules. ► Irregular obey of safety rules. ► Unaware of safety precaution. ► Use of improper work cloth. ► Intentionally stopping the work machine. ► Absence of rewards.	► Attitude on PPE. ► Inconsistent use of PPE. ► Lack of enforcement of PPE use. ► PPE provision delay. ► Incorrect PPE. ► Insufficient PPE. ► Irregular use of PPE. ► Uncomfortable PPE. ► Not used PPE. ► Unfitted PPE. ► Resistant to the use of PPE. ► Limited training on PPE use and disease. ► Lack of motivation factors.	► Bad behaviour in hand washing. ► Improper handling of damaged materials. ► Infrequent hand washing. ► A limited waste disposal site. ► Insufficient supply of soap. ► Lack of pipe water facility. ► Limited clean water and toilet facility. ► No good hand washing behaviour. ► No hand wash practice. ► No showering.

PPE, personal protective equipment.

instructions are followed. So I carry out my duties as I see fit. (Participant No.19).

Another participant stated: I perform the task near the rotating machine, inadequately guarded. Usually, I focus on the task at hand rather than the actions to be taken or the position I hold. Also, I don't always check the functionality of work materials on a routine basis because of work burdens and little support [non-financial incentives] from the industry. (Participant No.1).

Another participant added: I work near the most explosive sources without giving attention to job-specific work instructions should be followed. I only inspect the parts of the machine when it stops working. This can be due to a lack of rewards [financial or non-financial incentives]. (Participant No.19).

One participant said: It is impossible to work solely according to a workshop manual. I irregularly follows the correct steps during work. As a result, I lost one of my fingers. Even though no rewards [financial or non-financial incentives] have been given to reduce mistakes and improve safety performance. (Participant No.5).

Lack of compliance with the recommended safety measures

In this study, interviewees lacked compliance with the recommended measures. We tried to understand the deeper meaning of the lack of compliance with the recommended measures. It means that they disregarded compliance with the recommended safety measures, such as respecting the safety rules posted on the board, and took extra measures in the absence of other interventions.

One participant stated: Normally, I don't read the safety rules printed on the board and in the work section, including whether additional action is necessary. I, for one, wear loose cloth around heavy machinery. This is because there are no stringent monitoring mechanisms in place, and the industry has never given me the proper protective gear to keep me safe from danger [hazards]. (Participant No.3).

Another participant added: I mixed different chemicals without using the correct protective materials, like chemical-resistant clothes. Sometimes, I use my regular clothes as protective material. Due to the work burdens, I don't usually give special consideration to the safety rules and when action should be taken. (Participant No.20).

Another participant said: As a mobile worker in the vicinity of where these tools are utilized, I operate vibrating work machines without anti-vibration. These anti-vibration tools are not always convenient to use, and they can make my job more difficult. I don't report a condition that negatively impacts my health or the industry because I believe doing so would be detrimental to both. This is due to the lack of a good safety culture in the sector that encourages taking prompt corrective action when terrible things happen. (Participant No.12).

Theme III: PPE use-related practices

Inappropriate and inconsistent use of respiratory protection devices

In this study, most participants described inappropriate and inconsistent use of respiratory protective devices. We tried hard to understand respiratory protection gear's inconsistent and inappropriate use. Thus, inappropriate and inconsistent use of protective devices refers to the occasional use of respiratory protective devices that are ineffective enough to provide adequate protection from dust.

One of the participants remarked: Sincerely, I don't use any masks during the entire shift. This is because the mask does not meet the requirements and cannot offer complete protection against various risks. I do my duties during the whole work shift without donning the appropriate safety equipment. I will use personal protective equipment without restrictions if I can access it. However, the industry has neither a strategy nor motive to offer the proper protective clothing' *(Participant No.7)*.

Another participant added: Sometimes I use masks, other times I don't. This could be related to the industry's providing masks made up of pieces of clothing, which is wrong and uncomfortable to use. My industry doesn't take action, which motivates me to use protective devices without interruption while on the job. What should I use if the appropriate materials [respiratory protection devices] are unavailable? *(Participant No.8)*.

Eye protection

Most participants expressed that they occasionally used eye protection devices.

One participant stated: I don't usually use eyeglasses since the equipment is uncomfortable, especially in hot work sections, even though my company [the sugar industry] doesn't give all forms of material that protect my eyes from various threats. (Participant No.11)

Another participant said: I use eyeglasses for a limited time because it exposes me to accidents, especially when they are covered by fog. (Participant No.10)

Head and ear protection

In this study, most interviewed participants said they rarely used head protection devices.

A participant said: In this institution, I work in every department, especially tall buildings. But because a hard hat is made of cotton, which isn't sturdy enough to protect my skull from accidents, I hardly ever wear one. Furthermore, the sector does not offer headgear like helmets. (Participant No.9)

Additionally, most participants stated they used insufficient ear protection devices.

A participant said: 'I'm working in a section where old work machines are making a lot of noise [extreme noise]. Because of the limited availability and lack of comfort, I do not use ear protection devices such as earplugs.' (Participant No.15)

Hand-arm protection

Most respondents expressed that they irregularly use unsuitable hand-arm protective devices. An irregularly used, unsuitable hand-arm protective device is understood as using an improper device only for a few hours.

A participant said: In practice, I suppose that the industry is unaware of the precise equipment required for the task. If not, then why offer such poor materials? Since they are made of plastic, gloves are inappropriate for my job, and I don't use them frequently. (Participant No.18)

Another participant added: Since the department [the industry] doesn't provide the correct working materials [hand-arm protection devices], I don't use gloves made of plastic in a hot section because the hands' sweat is exposed to accidents. (Participant No.13)

Foot-leg protection

Moreover, most participants interviewed said they did use improper foot-leg protection devices. We worked hard to understand improper safety devices thoroughly. It was assumed that 'improper safety devices' referred to incorrect or inappropriate devices that did not provide better protection.

One of the participants stated: I don't wear the correct safety shoes anymore because they are given only to particular supervisors. I asked every day, but the industry does not provide it. As a result, I wear my regular shoes, which do not provide adequate protection. (Participant No.13)

Theme IV: bad behaviour regarding personal cleanliness and access to facility-related practices

Limited use of sanitation

Even though most of those interviewed have a positive attitude toward sanitation and hygiene, their habits were shockingly poor. Most of the participants interviewed expressed that limited sanitation facilities were available. We made every effort to understand the reasons for this. It was accepted that limited use of sanitation facilities refers to insufficient soap, clean water and toilet services near the work section.

A respondent said: I frequently encounter insufficient sanitation facilities for hand washing after completing work or when in contact with dirty material. This is because the industry only supplies a few numbers of soaps. (Participant No.6)

Another participant added: I observed that access to clean water and restroom facilities is limited and far from my work section. (Participant No.12)

Another participant described: I notice a lack of piped drinking water facilities. Also, the industry has poor disposal sites for liquid waste. Predominantly liquid wastes are released into factor compounds and the environment. This is because the industry is ancient. (Participant No.14)

Poor culture of hygiene practices

In this study, most participants described having a poor culture of hygiene that could affect personal cleanliness. We did our best to comprehend the reasons behind this. We understood that a poor culture of hygiene refers to the fact that they did not have good behaviour in properly handling damaged work equipment or maintaining personal hygiene.

A respondent expressed: I recognize the importance of maintaining personal hygiene at work for my health. Therefore, occasionally I merely wash my hands with water. But after finishing my activity, going to the bathroom, and coming in contact with harmful chemicals, I frequently forget to wash my hands with soap. This is due to the facilities' limitations, including a lack of supervision. (Participant No.11)

Another respondent stated: I never properly handle the damaged equipment. Usually, I go to the cafeteria and administrative office with very contaminated work clothes because nobody pays attention. (Participant No.16)

Another participant said: I know poor housekeeping also leads to disease and reduces the quality of the sugar products. But, there is no safe storage of raw materials or proper emergency evacuation procedures with demarcated safe areas. (Participant No.5)

Observational checklist

During observation, we confirmed that most workers did not use PPE. Workplace health and safety inspections were not performed regularly. A minimal ongoing preventive health programme was in place to educate employees on safe levels of exposure, the effects of hazards on exposure, and the use of automatic machine control.

DISCUSSION

An evidence-based understanding of occupational health and safety practices and related factors is crucial to develop effective interventions that encourage the consistent application of safety measures. This study aimed to assess occupational health and safety practices and associated factors. Our quantitative component found that a small proportion of participants performed well in the use of occupational health and safety measures, despite

the danger inherent in their line of work. Our qualitative strand also verified that most participants interviewed had undesirable practices in the use of occupational health and safety measures. The most frequently mentioned challenges (obstacles) to implementing safety measures by interviewees were incomplete use of occupational health services, inappropriate use of PPE, failure or disregard to follow occupational safety commands (instructions) and poor performance of personal hygiene-related tasks.

In our search, little literature has investigated occupational health and safety practices among employees in the sugar industries using a convergent-parallel mixed design. However, we were compelled to compare our findings with those of prior studies. Thus, the present study found that good practice of occupational health and safety measures was lower than the results reported from Ethiopia,[48] Nigeria,[49] Iran,[50] Nepal,[51] India,[52] Pakistan,[53] Canada[54] and China.[55] The possible explanation for the incongruity may be related to differences in the study location, the target population, the nature of the firms studied, the factory safety infrastructures and the accessibility of occupational health and safety measures. Second, compared with past studies, the organisation's inability to implement the recommended safety measures is evident in the present study location. In the present study, there is a lack of motives that foster supportive working conditions that enable the employees to adhere to safety protocols. Our qualitative strand shows that there were insufficient health and safety programmes in place at the industry level. Furthermore, industries are playing unsatisfactory roles in enforcing occupational health and safety measures implementation and provision of safety resources.

In contrast, according to our study findings, the proportion of workers reporting good occupational health and safety practices was higher than in previous studies conducted in Ethiopia,[34 56] Ghana,[57] Nigeria,[58–60] Sri Lanka,[61] Poland,[62] Bangladesh[63] and India.[41 64] The dissimilarities could be explained by the study design employed, the period and the dimensions of safety measures explored, all of which could be factors in this mismatch. The present study used a convergent parallel mixed design with larger sample sizes than prior studies, which could be expected to increase the discrepancy. It was unacceptable that the study's participants had such good safety practices. The majority of individuals surveyed or interviewed did not adhere to the appropriate occupational health and safety procedures, according to our qualitative strand's findings. Furthermore, the finding of our study implies that occupational health and safety practices were a distressing concern for both employees and the studied industries. Empirical evidence showed that inadequate safety practices and workers' reduced working capacity are accountable for economic losses of up to 10–20% of a country's gross national product.[65] Additionally, occupational health has not been paid much attention in the sustainable development agenda, especially in developing countries where safety enforcement is weaker. Although the right to health and safety at work is included in the constitutions of the WHO and the International Labour Organisation and reinforced by several other United Nations instruments, no country has succeeded in fulfilling it.[66]

Moreover, this study demonstrates that several contributing factors positively or negatively influenced occupational health and safety practices. So, the inappropriate provision of PPE negatively impacted good safety practices. Workers who did not get the appropriate PPE scored poor safety practices. This could be because workers may not be motivated to use them. After all, the devices do not meet the required standards. Further, participants in our qualitative interviews expressed that the improper provision of PPE affected their good safety practices. This finding is consistent with Ethiopia's finding, which reported that inappropriate provision of PPE reduced good safety practices.[67 68] In addition, many participants in our study did not consistently use PPE. The possible reason for this may be that using inappropriate PPE increases the risk of injury. Additionally, most respondents in our qualitative strand stated that they did not consistently use PPE due to a lack of proper provisions and a lack of fitness, which was a worrying concern. These statements imply that employees disregard it when PPE is inappropriate since it fails to provide enough protection from occupational risks.

Moreover, in our study, the absence of strict safety regulations badly affected good safety practices, mainly using PPE and following safe work instructions. When the industrial safety inspectors could not regulate these workers, unsafe acts predominated and impacted compliance with the recommended safety measures. The majority of the participants in our interviews indicated a lack of health and safety regulations, which our qualitative strands also confirmed. Most participants pointed out that they disregarded the safety rules. For instance, they did not use anti-vibration devices when operating vibrating work instruments. This implies that the organisation's safety infrastructure is fragile in terms of conducting regular inspections (and industrial hygiene monitoring) to ensure that engineering controls are operating as designed. Empirical research also reported similar results as we did.[40 68] Unsafe work practices, a lack of technical and material assistance, a failure to follow safety standards, and risky workers' actions impact good safety practices.[69–71]

Furthermore, the present study revealed the detrimental impacts of inadequate managerial support on workers' good safety habits. Workers are less likely to achieve good safety performance when a supportive managerial attitude does not provide executives with a setting where their work will be recognised and rewarded. Most qualitative interviewees confirmed the lack of management support for achieving high safety performance. Further, industrial managers have shown an insufficient willingness to implement safety measures. Our findings that prominent industry managers pay

insufficient attention are documented and backed up by the literature.[72 73] Furthermore, our study established that employees who go through shift work experienced fewer poor safety practices compared with employees who do not go through shift work. The reason could be that shift work schedules may minimise fatigue, which may enhance workers' good safety practices, depending on the rate of shift work rotation. Additionally, if they do their duties where shift work is well designed, less experienced workers may receive good safety performance from more experienced workers. In contrast to our findings, numerous studies have found that working rotating shifts is associated with poorer safety performance outcomes, and shift work increases the risk of occupational injury significantly.[74–76]

Moreover, we found that the absence of non-financial incentives negatively influenced the good safety practices. Employee desire to maintain excellent occupational health and safety practices is significantly influenced by a lack of incentives or rewards, which negatively influences acceptable behaviours. Most interviewees stated the absence of non-financial incentives for strong safety performance in the qualitative strands. Interviewees in the qualitative strands claimed the absence of any incentives or rewards for following recommended safety procedures. Incentives alone will not change behaviour unless there is a proper safety context to ensure that the behaviour remains safe. Our findings agree with the related literature.[77 78] Additionally, the findings of our study illustrated that positive attitudes toward safety precautions had a positive impact on good safety practices. The employees with a good attitude toward safety measures reported using good safety practices, possibly as a result of correctly following safety protocol. The majority of respondents to our qualitative interviews confirmed a positive attitude toward safety measures. Our result is closely similar to the empirical literature.[79 80] Finally, we discovered unsafe worker safety practices, which were one of the critical causes of poor practices. The management of individuals from various educational and socioeconomic backgrounds needs appropriate safety intervention strategies to enhance employees' safety behaviours.

In Ethiopia, governing safety and health at work on a legal basis dates back to the 1940s, when the first legal instrument, Proclamation No. 58/1945, which was replaced by Proclamation 232/1964, was publicised.[81 82] Parts of the labour administration proclamation were copied from the developed world as a result of the immaturity of the development of the labour administration system. Currently, the Ministry of Labor and Social Affairs oversees occupational health and safety issues in Ethiopia.[83 84] The Ministry assigns inspectors to assess the workplace situation regarding health and safety practices. The ministry developed an occupational health and safety policy and strategy in 2014 to ensure tripartite cooperation and a healthy and safe work environment. The policy generally has provisions for preventive actions and gaps in the existing actions toward implementing occupational health and safety practices.[24 85]

Strengths and limitations

This is the first convergent-parallel mixed-design study examining occupational health and safety practices among workers in the sugar industries in Ethiopia. So, our study has considerable strengths: We employed a convergent-parallel mixed design, which helped us understand the topic numerically and narratively. This study ensured the trustworthiness of the qualitative strand through repeated data transcription, translation and coding. Additionally, the transcribed and translated data were given to professional researchers for evaluation. Transcripts were sent back to participants for review or revision. In the qualitative strand, participants' body language was monitored during interviews. The COREQ and STROBE in our qualitative and quantitative strands were followed, respectively.

But, a few limitations of the analysis should be noted, including: small-scale sugar industries and the sugarcane harvesters in Ethiopia were not included in the study, which could have affected how representative our sample was and how generalisable or transferable our findings were. Additionally, transportability bias may influence how much a study that is internally valid and done in two sampled sugar industries may tell us about the expected safety practices in a particular target population. Even though we included factories that were representative of sugarcane processing and the participants were randomly selected, there is a slight but not to be ignored possibility that the selection bias may affect the study's outcome. The other limitation of the study was that information bias may have entered the study participants' interviews. In this study, the tendency of survey participants to provide responses that will be seen favourably by others may also contribute to social desirability bias. We expected the participants to under-report negative or undesirable conduct while over-reporting positive activity. Another limitation of this study was that it did not examine the relationship between management commitment, the design of the working units, the structure of the working unit and ergonomic factors and occupational health and safety practices because we did not have the standard tools to measure management commitment, the design of the working units, the structure of the working unit and ergonomic factors. As a result, variable selection bias may occur in this study, as these variables are essential variables expected to influence workplace occupational health and safety practices.

Conclusion

The results of our research offer new insight into the body of knowledge about how to enhance workplace health and safety procedures. This study revealed that occupational health and safety measures were not used effectively, as good practice in occupational health and safety measures was shockingly low among workers in the sugar industries in Ethiopia. The study's qualitative component supported the finding that the majority of participants expressed undesirable practices in the use

of occupational health and safety measures. Next, inappropriate PPE provisions, a lack of strict safety regulation, financial or non-financial incentives and inadequate management support were associated with use of occupational health and safety measures. On the other hand, the presence of shift work and the favourable attitude of the employees were positively linked with use of occupational health and safety measures.

Hence, the contributing factors we identified potentially indicate areas for future intervention to improve workers' occupational health and safety practices and enhance organisational productivity. To obtain a complete picture of the issues under investigation, interventional studies and concrete motivational methods that can encourage workers to adopt good practices in safety measures voluntarily will be necessary.

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