

Determinants of Occupational Safety and Health Among the Workers in Micro, Small, and Medium Enterprises in Uttar Pradesh and Uttarakhand states of India: A Cross-Sectional Study

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Abstract

Background: Prevention of workplace accidents and promoting a safe working environment, is critical for the safety of workers in Micro, Small, and Medium Enterprises. Factors such as education, socio-economic background, experience and training may affect the awareness levels among the workers. This study investigates the awareness of Occupational Safety and Health among the employees working in different sectors in MSMEs across Uttar Pradesh and Uttarakhand. **Material & Methods:** A cross-sectional study was conducted in Uttar Pradesh and Uttarakhand and 600 workers from various MSMEs were selected using multi-stage sampling technique with a suitable sampling strategy at each stage. Data were collected using a structured questionnaire, which assessed socio-economic and demographic characteristics, awareness regarding OSH training and policies and their effectiveness. Statistical tools such as mean, variance, chi-square tests, median test and logistic regression were used to analyse the data. **Result:** The study found that 66.6% participants were aware of the OSH policies of their companies, 58.3% had received required OSH training, and 78% of them found the training as useful. It was found that the educational levels, socio-economic status and length of service were significantly associated with OSH awareness. Multivariate logistic regression confirmed that tenure, educational level, and prior training exerted independent positive effects on awareness. **Conclusion:** The study highlighted the role of education, length of service, and training in enhancing OSH awareness among MSME workers and suggested that even the small efforts and interventions, like regular training and policy formation can make significant improvements in OSH practices.

Keywords: Occupational safety and health (OSH), Micro, Small, and Medium Enterprises (MSME), Socio-economic background, Safety awareness, Logistic regression.

Introduction

Occupational Safety and Health (OSH) is a fundamental aspect of sustainable economic development and workplace management. The protection of employees from occupational hazards, accidents and injuries has gained significant attention in recent decades due to rapid industrialization, technological advancements and awareness of workers towards their rights. Micro, Small, and Medium Enterprises (MSME), which account for a major share of employment and economic development worldwide, play a crucial role in economic growth and poverty alleviation. According to the 2022 report of the International Labour Organization, MSMEs have a share of more than 90% of the global business and provide employment to a large proportion of workers.^[1] Despite their contributions to the economy, these MSMEs face many challenges in maintaining occupational safety and health standards among their employees. Limited financial and infrastructural resources, lack of technical knowhow and inadequate awareness about the safety regulations make these enterprises vulnerable to workplace accidents and health hazards. Safe and smooth

workplaces are increasingly recognized as prerequisites for sustainable development goals (SDGs). The World Health Organization (WHO) insists that the decent work culture and healthy work environment are indispensable for economic and social development.^[2]

The MSME sector is the backbone of Indian economy. It serves as catalyst for employment generation and economic growth. As per the Ministry of MSME Annual Report and the Economic Survey of India, India has more than 70 million registered MSMEs, employing over 300 million workers and contributing approximately 31% of the country's GDP and 48% to exports.^[3] These enterprises are indispensable components of the economic structure of India and are spread across the sectors of manufacturing, textiles, services, food processing, handicrafts etc. However, the MSMEs in India face several challenges, such as weak enforcement of safety regulations, lack of proper knowledge regarding the laws, technological limitations, lack of infrastructure, occupational hazards and lack of skill.

OSH is an essential dimension of workplace governance, encompassing the systematic protection of workers from physical, chemical, biological, and psychosocial hazards,^[4] a mandate reinforced internationally by ILO Convention No. 155 concerning Occupational Safety and Health^[5] and in the Indian context by the Factories Act, 1948^[6] and its consolidation under the Occupational Safety, Health and Working Conditions Code, 2020.^[7] In MSMEs, the development of effective OSH programs is frequently constrained by limited financial capital, the absence of dedicated safety personnel, and inconsistent awareness among the workforce.^[8-11] Researchers have consistently emphasized that sustainable developments in OSH require integrated approaches such as the commitment of management, participation of workers, proper training of safety measures and conducive work culture.^[12-15]

However, the existing literature has notable limitations. Most of the MSME-specific studies are concentrated in Southeast Asian settings, comparable Indian evidence and evidence that contrasts adjoining but administratively distinct states remains sparse.^[16-18] This is a meaningful gap and should be taken care of. Uttar Pradesh and Uttarakhand together host a large and industrially varied MSME base, share a common industrial corridor along the Uttar Pradesh-Uttarakhand border yet differ in regulatory enforcement capacity and terrain-driven sectoral composition, making a paired comparison informative. The present study addresses this evidence gap through a systematic investigation of OSH awareness among MSME employees in the Indian states of Uttar Pradesh and Uttarakhand. The study is aimed to characterize the state of OSH awareness among MSME employees and identify the domains requiring utmost targeted interventions. This study pursued three interrelated objectives: to measure the prevailing level of OSH awareness within the MSME employee population, to evaluate the perceived effectiveness of existing OSH training provision, and to delineate the factors that independently predict awareness.

Material & Methods

Study design and setting

This investigation employed a cross-sectional analytical design to study employees across diverse MSME sectors in Uttar Pradesh and Uttarakhand, India. Data were gathered over a four-month period spanning from March to June 2025. A total of 600 employees were enrolled from MSMEs across both states via multi-stage sampling with Probability Proportional to Size Without Replacement (PPSWOR) sampling at the first two stages and stratified random sampling with proportional allocation at the third stage (see, Section 2.3). Sample size was determined using the standard statistical technique (see, Section 2.4). Each participant completed a structured questionnaire that was assessed for reliability and validity prior to its deployment (see, Section 2.5). Ethical approval was obtained from the Institutional Review Board of

Shekhar Hospital Pvt. Ltd. [Approval no. IEC/SH/2023/0015], and written informed consent was obtained from all participants before data collection. Assurance of response confidentiality, the voluntary nature of participation, and the right to withdraw at any stage without penalty or consequences for the participants of the survey were the chief features of the investigation.

Selection Criteria for the Participants

Eligible participants were defined as current employees aged 18 years or older who had held their present position for a minimum of 12 months and who were willing to participate in the survey. This criteria of minimum 12 months tenure was applied because most of the participating enterprises deliver induction and role-specific OSH training within a year of the employees joining their jobs. Making this minimum period mandatory, the untrained employees were excluded from the survey and ensured adequate familiarity with workplace hazards to answer the questionnaire meaningfully resulting to enhancing the contextual validity and reliability of the data obtained.

Sampling Frame and Strategy

Multi-stage sampling design was used to select the sample of 600 employees from the different MSMEs in Uttar Pradesh and Uttarakhand. Six districts (Lucknow, Kanpur, Noida, Unnao, Sultanpur and Jhansi) out of the total 75 districts in Uttar Pradesh and two districts (Udham Singh Nagar and Haridwar) out of the 13 districts in Uttarakhand were selected at the first stage of sampling using the technique of PPSWOR sampling, considering the number of MSMEs in each district as the size of that district. In the second stage, 24 MSMEs from UP and 6 MSMEs from Uttarakhand were selected from these selected districts, again using PPSWOR sampling. In the final stage, 600 employees were selected from the MSMEs selected in the second stage using stratified random sampling with proportional allocation. For this, the enterprises were first stratified on the basis of industry sector (manufacturing, trade/services and other) and enterprise size (micro, small, medium and large). Within each stratum further stratification was done on the basis of sex (male and female), education (primary, secondary and tertiary) and job role (administrative, technical and managerial). The sampling frame comprised MSME establishments registered under the Udyam registration portal, records of District Industries Offices and the staff rosters of the selected enterprises.

Determination of Sample Size

The minimum required sample size for a precision of $\pm 5\%$ was estimated as 580, using the standard formula for a single proportion^[19], $n = Z^2 \cdot p(1-p) / d^2$, where $Z = 2.58$ (99% confidence level), p = the anticipated prevalence of OSH awareness in Uttar Pradesh and Uttarakhand based on the pilot study = 0.68, and d = the desired absolute precision = 0.05. Considering the

non-response factor and the design effect, which may occur during the survey, it was decided to take a sample of 600 employees for the study. Out of these 600 employees, 460 were selected from Uttar Pradesh and 140 were selected from Uttarakhand, on the basis of the proportion of employees in MSMEs in the two states.

Data Sources, Instrument Development and Measurement of Variables

The structured questionnaire captured four domains of information: socio-economic, demographic and occupational characteristics, OSH policy knowledge and training participation, perceptions of OSH program effectiveness and health status and lifestyle factors. The instrument was delivered electronically via an online survey platform, and the response data were exported to a structured spreadsheet for analysis.

Instrument development: The questionnaire was adapted from previously validated OSH awareness instruments used in comparable MSME settings^[16,17], with items revised for relevance to the Indian context. Part I of the questionnaire was descriptive with 12 theoretical questions regarding the personal, socio-economic, demographic and occupational details of the respondents. This part was not used for further quantitative analysis, but certain qualitative and comparative results were drawn from this part on the basis of the information provided by the respondents. Part II of the questionnaire was analytical, which initially contained 21 questions and for which scorings was done on the basis of right/correct response. The available information from the 21 questions of the analytical part was then tested for reliability and validity with the help of a pilot survey of 60 employees, drawn from the MSMEs not included in the main study. Item validity for these 21 questions was determined with the help of Point Bi-serial coefficient of correlation (rpbis). Six questions for which rpbis were found to be insignificant at 5% level of significance, were dropped from the questionnaire. The reliability of the questionnaire containing these 15 valid questions was determined by the three techniques, namely (i) Split-Half technique, (ii) Kuder-Richardson-I reliability coefficient and (iii) Cronbach's Alpha coefficient. The computed values of these three reliability coefficients were obtained as 0.4860, 0.5249 and 0.5190, respectively. Out of these 15 questions in Part II of the questionnaire, first six questions (Q.No. 1 to 6) were about the OSH policy knowledge and training participation, five questions (Q.No. 7 to 11) were about the perceptions of OSH program effectiveness while the remaining four questions (Q.No. 12 to 15) were about the health status and lifestyle factors.

Operational definition of OSH awareness: For the bivariate and regression analysis, the OSH awareness was defined as a composite of first six questions in Part II of the questionnaire, summed to a score of 0-6. Participants scoring 3 or more were

defined as 'OSH aware' whereas those scoring less than 3 were considered to be 'not OSH aware'. This definition was based on the previous studies and the opinion of the subject experts^[2-15].

Socio-economic status: The socio-economic status (SES) of the household was determined with the help of three factors, namely education of the head of the family, occupation of the head of the family and the monthly family income, at 0-29 scale using the modified Kuppuswamy scale^[20]. For the sake of convenience in analysis, we had categorised the socio-economic status into three classes, namely Upper (having score 26-29), Middle (having score 11-25) and Lower (having score 0-10), instead of five classes in the original scale.

Key socio-economic and demographic variables included age, sex, occupation, family income and educational attainment, while the work-related variables included job designation, organizational tenure, and average daily working hours. The training and policy domain assessed whether respondents were aware of a written OSH policy at their workplace, had completed the OSH training specified for their role, and perceived that the training improved their understanding of safety and health matters.

Statistical analysis

All analyses were conducted using IBM SPSS Statistics, applying both descriptive and inferential methods.^[21] Descriptive statistics were used to characterize the demographic profile and OSH awareness of the sample. Categorical variables were summarized as frequencies and proportions with 95% confidence intervals calculated using the normal approximation to the binomial distribution while continuous variables were expressed as means and standard deviations. Bivariate associations between OSH awareness and candidate determinants - including tenure, educational level, socio-economic status and receiving mandatory training - were evaluated using chi-square test for categorical variables and two sample median test for continuous variables. A multivariable binary logistic regression model was constructed to examine the simultaneous contributions of tenure, educational level, socio-economic status, age, sex, daily working hours and job designation to OSH awareness after adjusting for potential confounders. Model fit was assessed using the McFadden's Pseudo-R² (R²McF) goodness of fit test and Nagelkerke R². Effect estimates are presented as adjusted odds ratios (AOR) with accompanying 95% confidence intervals (CI), representing the independent association of each factor with awareness.

Result

The participant's socio-economic and demographic characteristics are summarized in Table 1. The 600 enrolled individuals were broadly distributed across the demographic, socio-economic and occupational variables of interest. The

mean participant age was 33.8 years (SD = 9.6); male participants accounted for 65% (n = 390) of the sample, and females accounted for 35% (n = 210). Tertiary education was the most prevalent attainment level (55%, n = 330), followed by secondary (40%, n = 240) and primary education (5%, n = 30). Regarding job designation, 45% (n = 270) held administrative roles, with technical and managerial positions accounting for 35% (n = 210) and 20% (n = 120), respectively. The mean organizational tenure was 8.2 years (SD = 5.4), and participants reported an average working day of 8.6 hours (SD = 1.3).

The OSH awareness and training data are presented in Table 2. Of the 600 participants, 400 (66.6%) reported familiarity with their organization's written OSH policy, 350 (58.3%) had fulfilled the OSH training requirements pertaining to their role, and 273 (78% of 350) them rated the training they received as effective or very effective in enhancing their understanding of occupational safety and health.

Table 1: Socio-economic and Demographic characteristics of participants

Characteristic	Frequency (%)	Mean (SD)
Age (years)	-	33.8 (9.6)
Gender		
Male	390(65%)	-
Female	210(35%)	-
Education Level	-	-
Primary	30(5%)	-
Secondary	240(40%)	-
Job Role		
Administrative	270 (45%)	-
Technical	210(35%)	-
Managerial	120 (20%)	-
Tenure (years)	-	8.2(5.4)
Daily Working Hours	-	8.6 (1.3)

Table 2: OSH awareness and training outcomes among the participants

OSH Awareness and Training	Frequency (%)	95% CI
Aware of OSH Policy	400 (66.6%)	62.8% -70.4%
Received OSH Training	350 (58.3%)	54.4% -62.2%
Rated Training as Effective/Very Effective	273 (78% of 350)	73.7% -82.3%

The results of the bivariate analyses are presented in Table 3. Chi-square testing demonstrated that educational level, socio-economic status, organisational tenure and mandatory OSH training were significantly associated with OSH awareness ($p < 0.001$ for each), whereas awareness of written OSH policies was not significantly associated with OSH awareness ($p = 0.327$).

Table 3: Bivariate analysis of the factors related with OSH awareness

Variable	OSH Aware (%)	Not OSH Aware (%)	Value of χ^2	p-value
Education Level:				
Primary	10 (33.3%)	20(66.7%)	17.039	< 0.001
Secondary	158(65.8%)	82(34.2%)		
Tertiary	232(70.3%)	98(29.7%)		
Socio-economic Status:				
Upper	162(81%)	38(19%)	113.10	< 0.001
Middle	209(73.3%)	76(26.7%)		
Lower	29(25.2%)	86(74.8%)		
Tenure (years):				
< 5 years	90(44.1%)	114(55.9%)	70.72	< 0.001
≤ 5 years	310(78.3%)	86(21.7%)		
Received Mandatory OSH Training:				
No	69(27.6%)	181 (72.4%)	294.34	< 0.001
Yes	331 (94.6%)	19(5.4%)		
Aware of Written OHS Policies:				
No	128(64%)	72(36%)	0.96	0.327
Yes	272(68%)	128(32%)		

Two sample median test was used to compare effect of OSH training on safety practices and OSH awareness of the MSME employees of UP and Uttarakhand. The results of two sample median test are summarised in Table 4 and Table 5.

Table 4: Effect of OSH Training on Safety Practices

Characteristic	No. of employees Below Median score on safety practices	No. of employees Above Median score on safety practices	Value of χ^2	p-value
Received OSH Training	92	258	110.86	< 0.001
Not Received OSH Training	174	76		

Table 5: Difference between OSH awareness of the MSME employees of Uttar Pradesh and Uttarakhand

State	No. of employees Below Median score on safety practices	No. of employees Above Median OSH score	Value of χ^2	p-value
Uttar Pradesh	148	312	0.1054	0.9012
Uttarakhand	43	97		

Two sample median test revealed that employees who had received OSH training reported significantly higher perceived effectiveness of safety practices than their untrained counterparts ($p < 0.01$). Using two sample median test, it was also found that there was no significant difference between the MSME employees of UP and Uttarakhand in their OSH awareness.

Multivariate logistic regression analysis was carried out to predict the OHS awareness status (dependent variable) using independent variables including age, gender, tenure, educational status, status of OHS training, jobrole, socio-economic status and awareness of OHS policy as independent

variable. The findings of the logistic regression analysis are presented in Table 6, 7 and 8.

Table 6: Measures of Fitting the Logistic Regression Model

Model	Sample size (N)	Deviance	AIC	R ² _{McF}	R ² _N
Binomial Logistic Regression	600	649	675	0.157	0.252

Table 7: Model Coefficients for the Logistic Regression Model

Predictor	Estimate	SE	Z	p-value	Odds Ratio	95% Confidence Interval	
						Lower	Upper
Intercept	-3.1504	1.0080	-3.125	0.002	0.0428	0.0059	0.309
Age	0.00997	0.0114	0.8749	0.382	1.0100	0.9877	1.033
Tenure:							
More than 5- less than 5	0.66341	0.2039	3.2542	0.001	1.9414	1.3019	2.895
Education Level:							
Secondary- Primary	1.37476	0.6589	2.0865	0.037	3.9541	1.0869	14.385
Tertiary-Primary	1.61731	0.6383	2.5338	0.011	5.0395	1.4424	17.608
Received OHS Training:							
Yes - No	1.76446	0.2013	8.7657	<.001	5.8384	3.9351	8.662
Socio-economic Status:							
Upper-Lower	0.02175	0.4709	0.0462	0.963	1.0220	0.4061	2.572
Middle-Lower	0.11096	0.5013	0.2213	0.825	1.1173	0.4183	2.985
Daily Working Hours	0.01364	0.0850	0.1605	0.873	1.0137	0.8581	1.198
Gender:							
Male-Female	0.23520	0.2042	1.1519	0.249	1.2652	0.8479	1.888
Job Role:							
Managerial- Administrative	0.15310	0.2636	0.5807	0.561	1.1654	0.6951	1.954
Technical- Administrative	-0.0237	0.2315	-0.103	0.918	0.9766	0.6204	1.537
Aware of Written OHS Policy:							
Yes – No	0.16488	0.2082	0.7920	0.428	1.1792	0.7842	1.773

Table 8: Assumption Checks and Collinearity Statistics for the Logistic Regression Model

Predictor	VIF	Tolerance
Tenure	1.02	0.985
Education Level	1.96	0.511
Received OSH Training	1.01	0.988
Gender	1.02	0.982
Job Role	1.04	0.964
Aware of Written OSH Policy	1.03	0.975
Socio-economic Status	2.01	0.498
Daily Working Hours	1.01	0.987

After adjusting for potential confounders, three variables demonstrated independent positive associations with OSH awareness: organizational tenure of five or more years (AOR = 1.9414, p = 0.001, 95% CI = 1.3019-2.895), tertiary educational attainment (AOR = 5.0395, p = 0.011, 95% CI = 1.4424-17.608), and having received OSH training (AOR = 5.8384, p < 0.001, 95% CI = 3.9351-8.662).The model explained 25.2% variability (NagelkerkeR2 = 0.252). McFadden's Pseudo-R2 (R2McF) was used to measure the goodness-of-fit of the logistic regression model. The value of R2McF was found to be 0.157, which indicates a satisfactory fit of the model. It was pre-assured that the model satisfies all the assumptions of the binomial logistic regression. The values of Variance Inflation Factor (VIF) and tolerance in Table 8 suggest that there is no evidence of significant multicollinearity among the predictor variables. The independent variables are sufficiently independent of each other, satisfying one of the key assumptions of binomial logistic regression.

Discussion

The findings of this study demonstrate a consistent relationship between socio-economic, demographic and occupational characteristics and OSH awareness among MSME workers. Specifically, higher socio-economic status, higher educational attainment, greater organizational tenure, and prior participation in OSH training emerged as positive correlates of awareness.

Educational Attainment levels and OSH Awareness

The pronounced association between educational level and OSH awareness aligns with the observations of Rahman and Kamil (2022), who identified a similar pattern and attributed it to better access to safety information and a more developed capacity to comprehend and apply safety protocols among more formally educated workers^[16]. In Indian context, Gupta and Rani (2024) and Tewari and Verma (2025) also emphasized the role of educational attainment in OSH awareness^[22,23].A plausible mechanism is health-literacy, in which the formal education builds the reading comprehension, numeracy and abstraction skills needed to interpret written safety instructions, hazard labels and policy documents, so that its effect on OSH awareness may operate largely through general literacy rather than any safety-specific instruction.

Impact of Service Length on OSH Awareness

The positive relationship between length of service and awareness is consistent with the premise that cumulative workplace experience facilitates gradual internalization of OSH norms and procedures. Marzuki et al. (2022) reported analogous findings, observing that employees with longer service in SME settings demonstrated greater familiarity with

risk-management approaches, implicating experiential learning as a meaningful contributor to safety behaviour^[17]. This is broadly consistent with experiential learning theory, in which repeated exposure to workplace hazards and informed peer correction over time builds tacit safety knowledge that is not fully captured by formal training alone.

OSH Training and its Perceived Effectiveness

Participants who had undergone OSH training reported greater awareness and more positive perceptions of safety practice effectiveness. This finding is consistent with Pratiwi (2022) and Tewari and Verma (2025), who demonstrated that a well-established, training-reinforced safety culture exerts a significant formative influence on employees' awareness and safety-related behaviour^[18,23]. Sustained investment in well-designed training provision by the MSME management is likely to produce measurable improvements in workforce safety.

Socio-economic Status and OHS Awareness

The present study demonstrated a statistically significant association between socio-economic status (SES) and occupational safety and health (OSH). This finding is consistent with the broader literature on the social determinants of health. Marmot (2005) and the WHO Commission on Social Determinants of Health (2008) contend that individuals occupying lower socio-economic positions experience greater exposure to health risks throughout their lives because they have fewer economic and social resources to avoid hazardous environments and obtain timely healthcare^[24,25]. These inequalities extend to the workplace, where socio-economic disadvantage often translates into increased occupational vulnerability.

4.5. Policy and Practice Implications

The results have meaningful implications for OSH governance and programmatic practices within the MSME sector. As Orosz et al. (2022) acknowledged, resource constraints commonly restrict smaller enterprises' capacity to implement comprehensive safety measures^[26]. Nonetheless, the present data indicate that even relatively modest and well-targeted training investments can yield substantial gains in awareness. This supports the position advanced by Rahman and Adnan (2016) that strengthened safety-management frameworks-encompassing regular training cycles and systematic policy reinforcement-can materially reduce unsafe workplace behaviours, a perspective also reflected in the work of Choudhry and Fang (2008) and Ng et al. (2005)^[27,28,29]. Specifically, within India this could be operationalised through periodic OSH self-audits linked to the compliance obligations already established under the Factories Act, 1948 and the Occupational Safety, Health and Working Conditions Code, 2020, rather than requiring MSMEs to build entirely new evaluation infrastructure^[6,7].

Study Limitations and Future Scope

The present study is subject to several limitations. The cross-sectional design does not permit causal inferences regarding the observed associations. Reliance on self-reported responses introduces the possibility of recall and social desirability biases. The test-retest reliability of the questionnaire could not be assessed, which may be a limitation of the study. Some other limitations of the study may be selection bias (Restricting enrolment to employees with 12 months' tenure), online questionnaire bias (electronic delivery of the survey may have under-represented employees with limited digital literacy or device access, non-response bias which could not be assessed for the present study, recall bias, residual confounding (unmeasured factors such as organisational safety climate, supervisory commitment to safety, and enterprise-level OSH investment could confound the observed associations between individual-level determinants and awareness), lack of objective OSH assessment, no workplace observation, absence of exposure assessment and limited external validity (as findings are drawn from MSMEs in two north Indian states and may not generalise to other regions, industry mixes, or regulatory environments within India). Longitudinal research designs would be better suited to examine how awareness evolves over time, and future studies should also consider additional explanatory variables, such as organizational culture, leadership commitment to safety, and sector-specific occupational hazard profiles.

Conclusion

Despite their substantial contribution to boost Indian economy and generation of employment, the MSMEs in India face inadequate occupational safety and health practices. This study demonstrates that educational attainment, organizational tenure, and OSH training participation are central determinants of safety awareness among MSME employees. The findings provide compelling evidence for targeted, differentiated interventions that account for the specific characteristics and constraints of the MSME workforce. Strengthening both the quality and regularity of OSH training and embedding robust policy communication structures are recommended as practical strategies with the potential to meaningfully reduce the incidence of occupational injuries and illnesses across this economically critical sector.

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