

Workforce Perceptions of Occupational Risk in Material-Handling Projects of the Indian Fertilizer Industry: A Cross-Sectional Survey of Hazard Controls, Working Conditions, and Regulatory Compliance

Subrota Ghosh^{1*} | Dr. Preeti Kulshrestha²

¹Research Scholar, Unitedworld Institute of Management, Karnavati University, Gandhinagar.

²Professor, Unitedworld Institute of Management, Karnavati University, Gandhinagar.

*Corresponding Author: 202302003@karnavatiuniversity.edu.in

Citation: Ghosh, S. & Kulshrestha, P. (2026). Workforce Perceptions of Occupational Risk in Material-Handling Projects of the Indian Fertilizer Industry: A Cross-Sectional Survey of Hazard Controls, Working Conditions, and Regulatory Compliance. International Journal of Education, Modern Management, Applied Science & Social Science, 08(02(II)), 155–162. [https://doi.org/10.62823/IJEMMASSS/8.2\(II\).9097](https://doi.org/10.62823/IJEMMASSS/8.2(II).9097)

ABSTRACT

Worker perceptions of safety provision are a recognized leading indicator of safety performance, and material-handling processes in the fertilizer sector expose workers to mechanical, chemical, and ergonomic dangers. However, there is a dearth of quantitative, perception-based data from Indian fertilizer facilities. Goals. In order to determine whether working conditions are satisfactory (H_{0_1}/H_{a_1}) and whether DISH guidelines are implemented (H_{0_2}/H_{a_2}), this study profiled the surveyed workforce and evaluated worker perceptions across three domains: hazard identification and personal protective equipment (PPE) controls, working conditions and statutory welfare, and compliance with DISH guidelines. A seven-point Likert questionnaire was utilized in a cross-sectional study of 262 employees from four factories in India (Gujarat ($n=3$), Maharashtra ($n=1$)). The main non-parametric methods were one-tailed one-sample tests against the scale midpoint for the hypotheses, Mann–Whitney and Kruskal–Wallis tests for group differences (Kruskal & Wallis, 1952), and multiple regression on age, experience, and gender because the bounded, ceiling-loaded responses violated normality. Outcomes. With a mean age of 32.4 years, the majority of respondents were men (74.4%); age and experience were nearly correlated ($r = .994$). All three domains had very good perceptions (97.5%, 96.8%, and 77.5% of the scale maximum). Both alternative hypotheses were supported: working conditions were judged satisfactory ($t(261) = 675.5$, one-tailed $p < .001$, $d = 41.7$) and DISH guidelines implemented ($t(261) = 74.9$, one-tailed $p < .001$, $d = 4.6$). Plant location differed significantly in every domain (Kruskal–Wallis $p < .01$) (Kruskal & Wallis, 1952), whereas individual demographics explained little variance. Hence, from the study it has been observed that, the workforce at all four locations has a strong, facility-variable culture of safety, welfare and regulatory compliance; site-level factors, not worker characteristics, drive the residual variation. Although the study has limitations with the samples from other geographic locations of India, it is a future perspective for further investigation.

Keywords: Occupational Safety, Material Handling, Fertilizer Industry, Safety Climate, Personal Protective Equipment, Regulatory Compliance, DISH, Likert Scale, India.

Introduction

The fertilizer industry is materials-intensive: bagged and bulk products, raw minerals, and hazardous intermediates are moved continuously by mechanical aids, conveyors, fork-lifts and manual labour (Schumacher, 1999). These material-handling operations concentrate a range of occupational hazards struck-by and caught-between mechanical events, chemical exposure, and the musculoskeletal load of manual handling and account for a substantial share of industrial injuries worldwide (Darda'u

Rafindadi et al., 2025). A century of occupational-safety research has shifted the emphasis from purely engineering controls toward the social and organisational determinants of safe behaviour (Hofmann et al., 2017; Hoyos & Zimolong, 2014).

Central to that shift is the construct of safety climate the shared perceptions employees hold about how safety is valued and enacted in their workplace (Colley et al., 2013; Griffin & Curcuruto, 2016). Meta-analytic evidence links positive safety climate to safer behaviour and fewer incidents (Christian et al., 2009; Clarke, 2010), which makes worker perception a practical leading indicator: it can be measured before incidents occur and can reveal where management systems are, or are not, credible to the workforce (Hallowell et al., 2013). In the Indian context, the baseline obligations these perceptions concern are codified in the Factories Act, 1948 (Govt. of India, 1948), covering health provisions such as drinking water and sanitation and welfare provisions such as first-aid appliances and are enforced at the state level by the Directorate of Industrial Safety and Health (DISH) (Pingle, 2012) through communication of regulations, audits, statutory equipment inspection, and incident reporting (JAIN, 2017; Mohapatra, 2021; Saha, 2018).

Despite this framework, quantitative, perception-based evidence from material-handling operations in Indian fertilizer plants is limited (Gupta et al., 2015; Latif et al., 2026). The present study addresses that gap with a multi-site survey of front-line workers. It pursues three objectives: (i) to characterise the surveyed workforce demographically; (ii) to quantify worker perceptions across three risk-relevant domains hazard identification and PPE controls, working conditions and statutory welfare, and DISH regulatory compliance; and (iii) to test two formal research hypotheses and to examine whether perceptions vary by gender, experience, or plant location. The hypotheses, stated directionally, are:

H0₁: Working conditions of the labour workforce engaged in material-handling projects of the fertilizer industry are not satisfactory. **Ha₁:** Working conditions are satisfactory.

H0₂: Material-handling projects of the fertilizer industry do not implement DISH guidelines. **Ha₂:** Such projects do implement DISH guidelines.

Materials and Methods

• Study Design and Setting

A cross-sectional, questionnaire-based design was used. Respondents were front-line personnel engaged in material-handling activities at four fertilizer-industry plant locations in India (Jamnagar and Vadodara in Gujarat; Mangalore in Karnataka; and Raigarh in Maharashtra).

• Participants

A total of 262 valid responses were obtained. The sample was predominantly male (195; 74.4%), with a mean age of 32.4 years (SD = 8.3; range 18–56) and mean work experience of 11.9 years (SD = 8.2). Full demographic characteristics are reported in Section 3.1.

• Instrument

The questionnaire comprised 16 items grouped into three thematic sections, each rated on a seven-point Likert agreement scale (1 = strongly disagree to 7 = strongly agree; 4 = neutral). Section A (seven items) addressed hazard identification and PPE controls; Section B (five items) addressed working conditions and statutory welfare (training, first aid, drinking water, sanitation, and medical/welfare cover); and Section C (four items) addressed compliance with DISH guidelines (communication of regulations, audits, statutory equipment inspection, and incident reporting). A demographic register recorded gender, age, work experience, and plant location.

• Data Preparation

Section items were complete. Two experience values were recorded as negative (an evident data-entry error) and were floored to zero for descriptive purposes and recoded to missing for regression. For each section a composite score was formed as the sum of its items (possible ranges 7–49, 5–35, and 4–28 for A, B and C). Items with zero variance (all responses = 7) were retained in descriptive summaries but excluded from correlation, normality and regression analyses, where they are undefined.

• Statistical Analysis

Continuous variables were summarised with means, standard deviations and interquartile ranges; categorical variables with counts and percentages. Normality was assessed with the D'Agostino–

Pearson omnibus K^2 test and Q–Q plots(D'agostino et al., 1990; D'Agostino, 2017). Because the bounded, discrete and ceiling-loaded Likert data departed markedly from normality(D'Agostino, 2017), non-parametric procedures were treated as the primary inference throughout, with parametric equivalents reported for comparability (Norman, 2010). The two directional research hypotheses were tested with one-tailed one-sample tests of each composite against the neutral midpoint (one-sample t and Wilcoxon signed-rank). Gender differences were assessed with the Mann–Whitney U test and Cohen's d; differences across the four plant locations with the Kruskal–Wallis test (and one-way ANOVA / Welch's ANOVA)(Kruskal & Wallis, 1952), with Dunn and Bonferroni post-hoc contrasts. Multiple linear regression modelled each composite on age, experience and gender, with the variance inflation factor (VIF) screening for multicollinearity. Analyses were conducted with custom, reference-validated routines; the significance threshold was $\alpha = .05$ (Cohen, 2013).

Results

• **Respondent Profile**

The workforce was young-to-middle-aged, heavily male, and geographically concentrated in the two Gujarat sites, which together contributed three-quarters of the sample (Table 1, Figure 1). Age and work experience were almost perfectly correlated (Pearson $r = 0.994$), indicating that workers enter the industry young and accumulate tenure in step with age a feature with direct consequences for the regression models below.

Table 1: Demographic characteristics of respondents (N = 262)

Characteristic	Category	n	%
Gender	Male	195	74.4
	Female	67	25.6
Plant location	Jamnagar	118	45.0
	Vadodara	83	31.7
	Mangalore	40	15.3
	Raigarh	21	8.0
Age (years)	Mean \pm SD	32.4 \pm 8.3	18–56
Experience (years)	Mean \pm SD	11.9 \pm 8.2	0–36

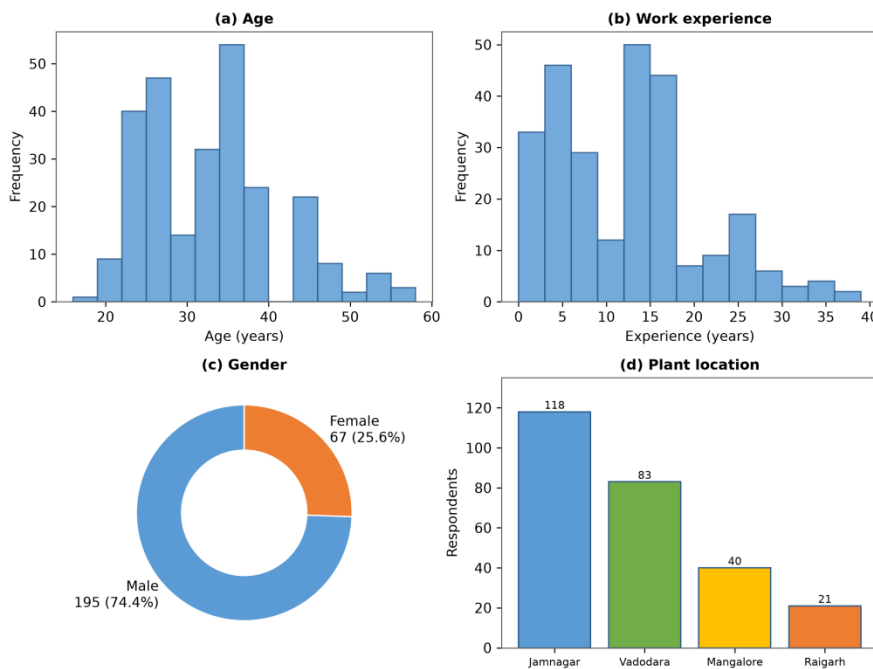


Figure 1: Demographic profile of respondents: (a) age, (b) work experience, (c) gender, and (d) plant location

Perceptions and Distributions

Across all three domains, perceptions were strongly positive and concentrated near the top of the scale. Composite means reached 97.5%, 96.8% and 77.5% of the scale maximum for Sections A, B and C respectively. Every one of the 16 items had a mean significantly above the neutral value of 4, as shown by the confidence intervals in Figure 2; the DISH items of Section C (particularly communication of regulations and statutory equipment inspection) were the closest to neutral, marking that domain as the least uniformly endorsed. Two Section A items (PPE use) and four Section B items were invariant at the maximum, producing a pronounced ceiling effect; all composites departed significantly from normality (D'Agostino–Pearson, $p < .001$). Descriptive statistics and the formal hypothesis tests are summarised in Table 2.

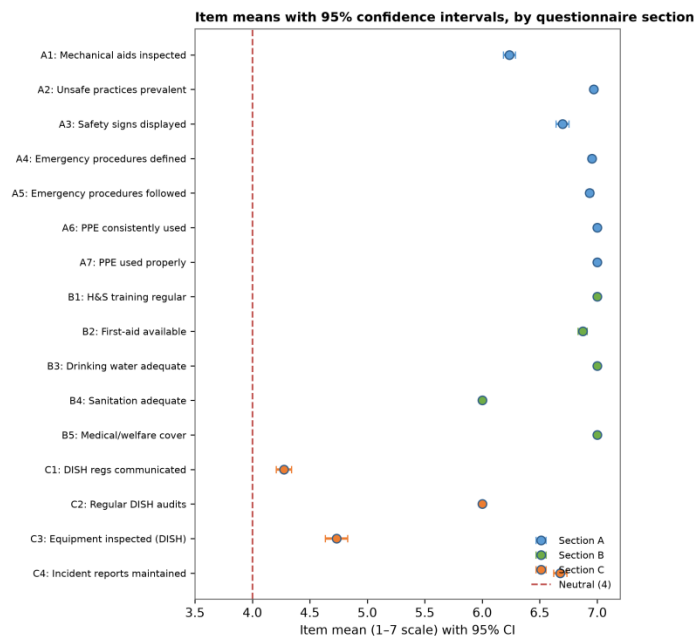


Figure 2: Item means with 95% confidence intervals for all 16 items, colour-coded by section. The dashed line marks the neutral scale value (4); every item mean lies significantly above it.

Hypothesis Tests

Both directional research hypotheses were tested with one-tailed one-sample tests of the relevant composite against its neutral midpoint (Table 2). For working conditions (Section B), the composite mean of 33.87/35 had a 95% confidence interval of [33.83, 33.91] lying entirely above neutral (20); the test was decisive ($t(261) = 675.5$, one-tailed $p < .001$, Cohen's $d = 41.7$; Wilcoxon $p < .001$). H_{01} was rejected and H_{a1} accepted: working conditions are satisfactory. For DISH compliance (Section C), the composite mean of 21.69/28 had a 95% confidence interval of [21.54, 21.84], again entirely above neutral (16) ($t(261) = 74.9$, one-tailed $p < .001$, $d = 4.6$). H_{02} was rejected and H_{a2} accepted: the projects do implement DISH guidelines.

Table 2: Composite descriptive statistics, one-sample tests against the neutral midpoint, and hypothesis decisions.

Section	Items	Composite M ± SD	% of max	Neutral	t(261)	1-tailed p	d	Hypothesis decision
Section A	7	47.79 ± 0.73	97.5%	28	439.2	< .001	27.1	—
Section B	5	33.87 ± 0.33	96.8%	20	675.5	< .001	41.7	Reject H_{01} ; accept H_{a1}

Section C	4	21.69 ± 1.23	77.5%	16	74.9	< .001	4.6	Reject H0 ₂ ; accept Ha ₂
-----------	---	--------------	-------	----	------	--------	-----	---

• **Inter-item Correlations**

Inter-item associations were generally weak, consistent with range restriction in high-agreement items. In Section A the strongest links were a modest positive association between clear safety signage and adherence to emergency procedures ($r = .23, p < .001$) and a small negative association between equipment inspection and the prevalence of unsafe practices ($r = -.21$). In Section C, statutory equipment inspection and incident-report maintenance were moderately correlated ($r = .37, p < .001$), plausibly because both flow from the same audit discipline. Section B admitted no correlation matrix, as only one of its five items varied.

• **Group Comparisons**

Gender and plant-location differences are summarised in Table 3 and Figure 3. Gender did not differ in Section A but did in Sections B and C, where male respondents reported modestly more favourable perceptions (Section C $d = 0.81$, a large effect). Plant location differed significantly in every domain (Kruskal–Wallis $p < .01$ throughout), and these between-site differences were the most reliable source of systematic variation in the data (Figure 4).

Table 3: Group comparisons of composite scores by gender (Mann–Whitney) and plant location (Kruskal–Wallis)

Section	Male M ± SD	Female M ± SD	Gender p (MW)	d	KW H(3)	Location p	ε ²
Section A	47.84 ± 0.69	47.67 ± 0.82	ns	0.23	15.7	.001	0.06
Section B	33.93 ± 0.26	33.72 ± 0.45	< .001	0.66	25.2	< .001	0.10
Section C	21.93 ± 1.22	20.99 ± 0.96	< .001	0.81	26.7	< .001	0.10

Cross-Section Comparison of Risk-Perception Profiles (Sections A-C)

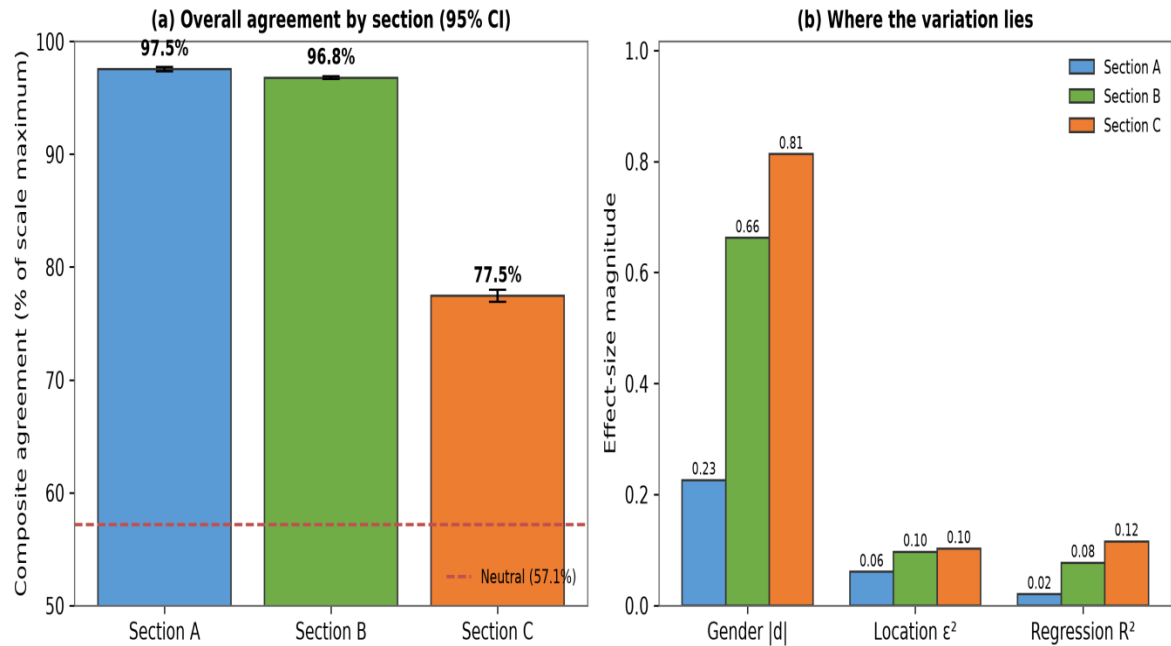


Figure 3: Cross-section comparison: (a) composite agreement (% of scale maximum) with 95% CIs against the neutral reference (57.1%); (b) gender, location and regression effect sizes by section.

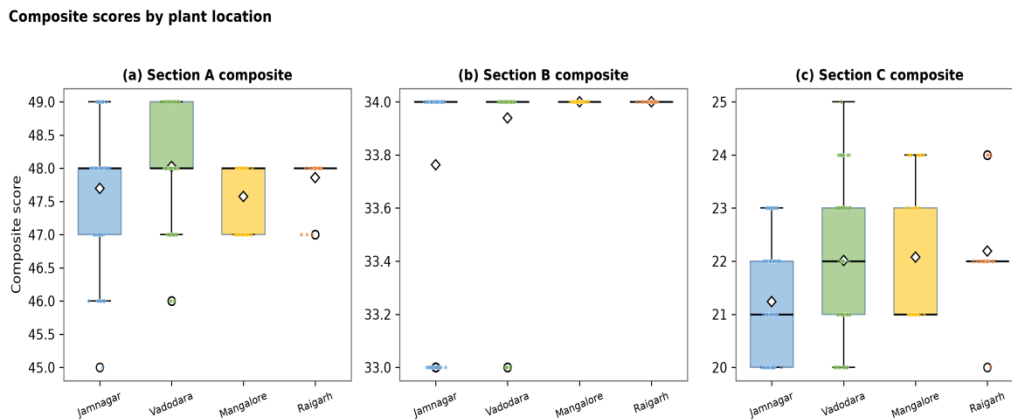


Figure 4: Composite scores by plant location for each section. Boxes show medians and interquartile ranges; diamonds mark group means; points are individual respondents.

• Multiple Regression

Multiple regression of each composite on age, experience and gender explained little variance: $R^2 = 0.020$ (Section A, ns), 0.077 (Section B, $p < .001$) and 0.115 (Section C, $p < .001$) (Table 4). Where the models were significant, gender was the sole contributing predictor ($p < .001$); age and experience were never significant and were severely multicollinear ($VIF \approx 86$), reflecting the near-perfect age–experience correlation noted above. Demographic characteristics therefore add little to the explanation of perception, the bulk of which is either uniform (ceiling) or organised at the facility level rather than the individual level.

Table 4: Multiple regression of each section composite on age, experience and gender

Section	R^2	Adj. R^2	F(3, 258)	p	Sig. predictor	VIF (Age, Exp.)
Section A	0.020	0.009	1.74	.158	none	≈ 86
Section B	0.077	0.066	7.11	$< .001$	Gender**	≈ 86
Section C	0.115	0.105	11.14	$< .001$	Gender**	≈ 86

Discussion

This multi-site survey yields a clear and internally consistent picture: front-line workers in these fertilizer material-handling operations perceive hazards as controlled, statutory welfare provisions as met, and DISH regulatory requirements as implemented (Darda'u Rafindadi et al., 2025; Hofmann et al., 2017; JAIN, 2017; Mohapatra, 2021). Both formal hypotheses were resolved in favour of the alternative working conditions are perceived as satisfactory and DISH guidelines (Pingle, 2012) as implemented each supported by composite means whose confidence intervals lay entirely above neutral and by very large effect sizes (Mohapatra, 2021). Read through the lens of safety-climate theory, this convergent endorsement is consistent with a strong overall safety climate, the kind repeatedly associated with safer behaviour and lower incident rates (Hofmann et al., 2017). Three features qualify and enrich that headline. First, the agreement was so uniform in the hazard/PPE and working-conditions domains that the data were ceiling-bound, with several items' invariant at the maximum. Such compression is the classic signature of acquiescence and social-desirability responding to positively worded safety statements (Podsakoff et al., 2003); it both flatters the picture and attenuates the associations the data can reveal, which is why inter-item correlations were weak and the regression models explained little variance (Field, 2018). The DISH domain (Section C) retained the most genuine variance and is therefore the most informative: its lower endorsement of regulation communication and statutory equipment inspection points to the specific compliance activities most worth strengthening.

Second, the consistent differentiator across all three domains was plant location, not individual demographics. Between-site differences were significant everywhere (Kruskal-Wallis $p < .01$) (Kruskal & Wallis, 1952), whereas age and experience never mattered and gender mattered only modestly, and only where variance existed. This pattern aligns with the established view of safety climate as primarily an organisational- and facility-level property, shaped by local leadership, resourcing and enforcement rather than by worker characteristics (Hofmann et al., 2017; Zohar, 1980). For practice, it implies that inter-site disparities and the specific site pairs identified in the post-hoc analyses are the most promising targets for both explanation and intervention. Third, the near-perfect coupling of age and experience ($r = .994$) is itself a substantive finding about a stable workforce that enters the industry young and remains in it; methodologically, it dictates that only one of the two be used as a seniority measure in any future model.

The practical implication is not complacency. Perceived compliance is a necessary but insufficient condition for actual safety; the value of a strongly positive climate lies in sustaining it and in directing attention to the few areas, notably DISH communication and equipment inspection at specific sites, where perceptions are comparatively weaker. The findings are consistent with a regulatory environment in which the Factories Act, 1948 (Govt. of India, 1948) baseline is broadly perceived to be met.

Conclusions

Among 262 workers across four Indian fertilizer plants, perceptions of hazard control, working conditions and DISH regulatory compliance were strongly positive. Both research hypotheses were supported: working conditions are perceived as satisfactory and DISH guidelines as implemented. Systematic variation in perception was organised at the facility level rather than by individual demographics, identifying inter-site differences as the principal lever for further improvement.

Limitations and Future Research

Several limitations bound these conclusions. The measures are perceptual and self-reported and, given the ceiling effect, discriminate weakly among respondents; future instruments should use behaviourally anchored or reverse-keyed items and, ideally, objective audit and incident data to counter acquiescence. The design is cross-sectional, precluding causal inference, and the sample is predominantly male and concentrated in two Gujarat sites, limiting generalisation. Finally, the documented non-normality and variance heterogeneity mean the rank-based results, rather than their parametric equivalents, should be regarded as definitive. Longitudinal, multi-method designs that pair perception surveys with audited safety outcomes would substantially strengthen the evidence base.

References

1. Government of India. (1948). The Factories Act, 1948 (Act No. 63 of 1948). Ministry of Labour and Employment.
2. Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of applied psychology, 94*(5), 1103-1127. <https://doi.org/10.1037/a0016172>
3. Clarke, S. (2010). An integrative model of safety climate: Linking psychological climate and work attitudes to individual safety outcomes using meta-analysis. *Journal of Occupational and Organizational psychology, 83*(3), 553-578.
4. Cohen, J. (2013). <https://doi.org/10.4324/9780203771587>
5. Colley, S. K., Lincolne, J., & Neal, A. (2013). An examination of the relationship amongst profiles of perceived organizational values, safety climate and safety outcomes. *Safety science, 51*(1), 69-76.
6. D'agostino, R. B., Belanger, A., & D'Agostino Jr, R. B. (1990). A suggestion for using powerful and informative tests of normality. *The American Statistician, 44*(4), 316-321.
7. D'Agostino, R. B. (2017). Tests for the normal distribution. In *Goodness-of-fit-techniques* (pp. 367-420). Routledge.
8. Darda'u Rafindadi, A., Kado, B., Gora, A. u. M., Dalha, I. B., Haruna, S. I., Ibrahim, Y. E., & Ahmed Shabbir, O. (2025). Caught-in/between accidents in the construction industry: A systematic review. *Safety, 11*(1), 12.

10. Griffin, M. A., & Curcuruto, M. (2016). Safety climate in organizations. *Annual review of organizational psychology and organizational behavior*, 3(1), 191-212.
11. Gupta, V. V., Asawa, K., Bhat, N., Tak, M., Bapat, S., Chaturvedi, P., . . . Shinde, K. (2015). Assessment of oral hygiene habits, oral hygiene practices and tooth wear among fertilizer factory workers of Northern India: A Cross sectional study. *Journal of Clinical and Experimental Dentistry*, 7(5), e649.
12. Hallowell, M. R., Hinze, J. W., Baud, K. C., & Wehle, A. (2013). Proactive construction safety control: Measuring, monitoring, and responding to safety leading indicators. *Journal of construction engineering and management*, 139(10), 04013010.
13. Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of applied psychology*, 102(3), 375.
14. Hoyos, C. G., & Zimolong, B. (2014). *Occupational safety and accident prevention: behavioral strategies and methods* (Vol. 11). Elsevier.
15. JAIN, D. (2017). HEALTH SAFETY AND WELFARE AS PER THE FACTORIES ACT 1948 DEVI AHILYA VISHWAVIDYALAYA].
16. Kruskal, W. H., & Wallis, W. A. (1952). Use of Ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association*, 47(260), 583. <https://doi.org/10.2307/2280779>
17. Latif, M. B., Ali, M. F., & Tuly, S. J. (2026). Assessment of Risks Related to Health and Industrial Effluents: Study of Physical and Occupational Risks within Jamuna Fertilizer Company Limited. *Journal of Bio-Science*, 34(1), 63-73.
18. Mohapatra, B. (2021). Corporate social responsibility in India: Rethinking Gandhi's doctrine of trusteeship in the twenty-first century. *Asian Journal of Business Ethics*, 10(1), 61-84.
19. Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education*, 15(5), 625-632. <https://doi.org/10.1007/s10459-010-9222-y>
20. Pingle, S. (2012). Occupational safety and health in India: now and the future. *Industrial health*, 50(3), 167-171.
21. Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of applied psychology*, 88(5), 879-903. <https://doi.org/10.1037/0021-9010.88.5.879>
22. Saha, R. K. (2018). Occupational health in India. *Annals of global health*, 84(3), 330.
23. Schumacher, K. (1999). India's Fertilizer Industry: Productivity and Energy Efficiency.
24. Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of applied psychology*, 65(1), 96-102. <https://doi.org/10.1037/0021-9010.65.1.96>

