Occupational Health and Safety Management in Bangladesh's Ready-Made Garment Factories: Compliance, Implementation Gaps and Injury Outcomes

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ABSTRACT

Despite being over a decade since the Rana Plaza tragedy, there is limited evidence on how well the Bangladesh ready-made garment (RMG) factories can effectively manage their occupational health and safety (OHS) or whether there is a link between the good management of OHS and the number of injuries in the factories. Based on systems and institutional theory, compliance was assessed in seven areas: OHS management system and safety committees, fire safety, structural safety, electrical safety, boiler safety, personal protective equipment (PPE), machine guarding, training, health and welfare (ventilation) and worker voice, with the level of compliance on the floor compared to management reporting. During the cross-sectional survey of 53 RMG factories purposively selected in Gazipur, Savar – Ashulia and Narayanganj (February 2025 – March 2026), an 85 item management questionnaire was filled out and some of the key items were checked against the factory documents (fire licence, drill record and accident record); meanwhile, 12 item observation checklist filled out during floor visitations in 30 factories. Non-parametric tests were used to compare domain indices across compliance frameworks (buyer-led programme, National Initiative, or none), building type and factory size, and a negative binomial regression was used to model the number of injuries as a function of the number of workers in the factory, while controlling for compliance framework, building type and factory size. The average Reported OHS Compliance Index was 75.3% (SD = 15.5). Among the factories, 24.5% had a dedicated OHS budget, with the highest percentage of factories having dedicated budget for safety training (84.9%) and the lowest percentage for the OHS management system (60.9%). The implementation results of management reporting (78.3%) were significantly better than the observed floor conditions (56.7%) (Wilcoxon $Z = -4.10$, $p < .001$). The compliance did not increase in factories where the buyer was involved in the safety programmes, and was not significantly different between the different factory types and sizes. Compliance was found to be associated with lower injury rates after adjustment (IRR = 0.71 per 10 points; 95% CI 0.65–0.78); this association does not imply cause and effect, since the study design is cross-sectional and most of the data are self-reported. The findings suggest that there is significant discrepancy between documented and actual safety. Inspection by the Department of Inspection for Factories and Establishments (DIFE) is recommended to be stronger and unannounced, injury reporting is recommended to be transparent, genuine worker participation is encouraged in the work environment, purchasing practices of the buyers that support safety is encouraged, and longitudinal studies that include worker-level data is recommended.

Keywords: Occupational health and safety, Ready-made Garments, Compliance Gap, Workplace injuries, Labour inspection, Bangladesh.

INTRODUCTION

The Ready Made Garment (RMG) sector is the pivot of the Bangladeshi economy, with annual export revenue of approximately US$39.3 billion, accounting for an overwhelming 84% of the national export earnings, and an employment base of around 2.97 million people, of which 57% are women (Dhaka Tribune,

2026). Safety issues have long been of concern to the international community. The Tazreen Fashions fire in 2012 claimed over 100 workers' lives and the Rana Plaza collapse in 2013 resulted in 1,134 deaths (ILO, 2017), highlighting that regulatory inspection has failed as well as private social auditing (Alamgir & Banerjee, 2019).

This was a response that no one had ever seen before. Thousands of factories were inspected by the Accord and the Alliance, as well as the government's National Initiative under the Department of Inspection for Factories and Establishments (DIFE), with a requirement for remediation of structures, fire and electricity (Donaghey & Reinecke, 2018). There are currently 1,881 factories covered by the RMG Sustainability Council (RSC, 2025). In 2025, Bangladesh ratified ILO Conventions No. 155, 187 and 190 (ILO, 2025), and in 2026, Bangladesh enacted the Labour (Amendment) Act, which added a right to refuse dangerous work (MiHCM, 2026). However, there are continued serious risks: 16 people died in a garment factory fire in Mirpur in October 2025 (CTV News, 2025) and 758 workers lost their lives in workplace accidents in 2024 (Safety and Rights Society, 2024).

Previous studies post-Rana, generally focused on building and fire safety in programme factories or governance of the programmes (Reinecke & Donaghey, 2025). There is far less knowledge about the extent to which factories have occupational health and safety (OHS) as a system, whether management levels of compliance are indicative of floor levels and whether higher levels of management compliance are linked to fewer work injuries. These questions are important because most injuries in the garment industry are caused by routine conditions like unguarded machines, poor housekeeping, absence of protective equipment, and long working hours, which require routine management but not a single engineering solution to resolve the problems (Kabir et al, 2019). However, the extent to which the factory self-reports and audit documents reflect actual practice is relevant to how compliance is monitored, since both these documents and the compliance monitoring process are essential for policy makers, buyers and inspectors. Existing assessments also tend to lack triangulation between the audit documents and external sources; few assessments look at the differences in compliance by different factory sizes, subcontracting status, and the compliance framework under which a factory operates; and few assessments take into account the enforcement and labour-relations context, such as DIFE's inspection capacity, presence of trade unions, and buyer purchasing practices, that may account for the lack of compliance.

This study aims to fill these gaps by conducting a survey of 53 RMG factories and floor observation. This has four aims: (1) to compare the extent of compliance with the OHS programmes in management, implementation and welfare domains (RQ1: How comprehensively do factories manage OHS?); (2) to see if compliance varies according to compliance framework , building type, factory size and subcontracting status (RQ2; H1–H3); (3) to test if compliance is related to injuries after adjustment for potential confounders (RQ3; H4); and (4) to determine if reported compliance is a reflection of actual conditions (RQ4; H5). It provides a multi-domain OHS Compliance Index, which is one of the first assessments at the factory level in Bangladesh which compares reported and observed compliance, and new associational (not causal) evidence of the connection between compliance and injuries.

LITERATURE REVIEW

OHS Management and Theory

An occupational health and safety management system (OHSMS) is a system designed, implemented and maintained to manage the cost, scope, and complexity of the associated health and safety risks and hazards while ensuring compliance with the standards (ILO, 2001; ISO, 2018; HSE, 2013). Whereas, its importance is in combining these in the process of detecting hazards before they can cause injury and learning from incidents contribute to prevention. The results of a systematic review indicate that overall, OHSMS interventions were effective in improving safety outcomes, although they were most effective when the OHSMS was implemented, not just documented (Robson et al., 2007). Therefore, the difference between documented and implemented safety is of great importance to this study.

The Swiss cheese model of Reason, 1997 and Leveson, 2004, is based on systems theory, which considers safety to be an emergent property of interactions between humans, technology, organisations and regulators, as weaknesses align across multiple layers of defence to create an accident. Both anticipate that there should be linkages between compliance in domains and outcomes. The institutional theory provides an explanation for why factories adopt practices under the pressure of regulation and buyers, but notes that under buyers' pressure, there is a possibility of symbolic compliance, where documents are adequate for auditors and practices lag behind (Locke, 2013; Alamgir & Banerjee, 2019). It thus suggests a discrepancy between reported and actual safety.

Regulation and Safety Governance in Bangladesh

Under the Bangladesh Labour Act 2006 and Labour Rules 2015 fire safety, machinery guarding, welfare facilities and safety committees are compulsory and enforced by DIFE (Government of the People's Republic of Bangladesh 2006, 2015). However, the enforcement capacity is still weak: DIFE has 311 labour inspectors in post and the prescribed posts are 575 for over half a million factories and establishments (Munni, 2022). In addition to Rana Plaza, the binding, union-involving Accord was a powerful institution that remediated over 93% of hazards identified (Reinecke & Donaghey, 2025), and international scrutiny led to improvements in working conditions, but did not cut wages (Bossavie et al., 2023). On the other hand, workers experienced less change in daily conditions, in their voices, and buyer purchasing practices exert production pressure. (Kabeer et al., 2020; Anner, 2020). The ratification of the ILO Conventions No. 155 and 187 in 2025 will require the government to create a national OHS policy, system and programme for all workplaces, including factories outside the buyer-led initiatives (ILO, 2025).

There are three other aspects of the governance context relevant to this study. First, the rate of trade union presence is low – according to a DIFE review of 653 inspected garment factories, about 6% had registered unions and about 2% of the factories covered by the DIFE, which are BGMEA and BKMEA members, had trade unions. (Islam, 2014) this is a limit on independent outlets for workers to raise hazards. Secondly, a portion of export production is outsourced to subcontractors and indirectly sourced from factories that are less visible to buyers and may not participate in factory safety programmes for buyers (Labowitz & Baumann-Pauly, 2014). Thirdly, buyer purchasing practices such as short lead times, late order changes and pressure to lower prices limit the time and resources that suppliers can invest in OHS (Anner, 2020).

Workplace Safety Conditions and Injuries in Garment Factories

Structural vulnerability was found to be related to column capacity, structural system and materials (Das et al., 2018), as well as to the presence of locked exits, lack of alarm systems, lack of drills, and a U-shaped relationship of fire risk with factory size (Wadud et al., 2014) in the factories which were surprised during inspection. MSK injuries, respiratory and needle injuries are associated with long hours and poor conditions in garment industry (Kabir et al., 2019). Larger and medium-sized factories have better management of OHS and welfare as compared to small factories, and needle injuries are often not reported (Haque et al., 2024). The national survey findings indicate that hazardous working environment and absence of protective equipment are related to injury at work, when working over 48 hours a week (Tariqujjaman et al., 2025). Given the fact that the majority of the workforce in the country is women, OHS is also concerned with welfare facilities like separate toilet, child care room and protection from harassment. Bangladesh has ratified ILO Convention No. 190 (ILO, 2025) which underscores the importance of welfare facilities for women. All of this has led to the conclusion that garment factory safety cannot rely solely on the integrity of the buildings but on multiple interrelated domains.

Management Commitment and Worker Voice

Management commitment and safety climate predict safe behaviour and fewer injuries consistently (Zohar, 1980; Clarke, 2006; Christian et al., 2009) and interactive training is more effective that passive training (Burke et al., 2006). If workers' influence is weak in decisions and if there is no fear of retaliation for raising concerns, then worker involvement via elected representatives and committees will generate better results (Walters & Nichols, 2007). The rate of complaints per 1,000 workers in

Bangladesh is less than 2, suggesting low empowerment, as achieved by the safety committees supported by Accord (Alamgir & Sayeed, 2023). Additionally, due to the production demand of short lead times and low prices, time and money are often further constrained to focus on safety (Anner, 2020).

Research Gap

There are four gaps that relate to the objectives: Limited evidence of management systems, welfare and voice in addition to building safety (Objective 1); few comparisons between programme, building types and sizes, with most injury studies based on worker or national data (Objective 2); little evidence at the factory level to establish a link between injuries and compliance (Objective 3); and scarce independent verification of reported compliance (Objective 4), with few studies triangulating management reports against independent sources or examining how subcontracting, enforcement capacity and worker representation condition these relationships.

CONCEPTUAL FRAMEWORK

Based on these theories and the structure of ISO 45001, the study defines OHS in a factory as a factory system where outside factors affect the OHS management system, the OHS management system is realised through the compliance domain, and the compliance domain affects the safety outcome. The compliance domain is moderated by the characteristics of the factory, and the verification of the floor condition verifies reported compliance (Figure 1). External drivers comprise regulation (the Labour Act and Rules, DIFE inspection and the ratified ILO conventions) and market governance (buyer audits and safety programmes). There is a written Policy, a designated Safety Officer, a Safety Committee (with worker representatives), Risk Assessment and an OHS Budget as part of the management system. Implementation is documented in six areas: Fire safety, Structural/Electrical/Boiler safety, PPE/Machine safety, Training, Health and Welfare and Worker voice. The outcomes are injury and lost time injury rates. Table 1 illustrates the relationships between the constructs and what is measured on the surveys.

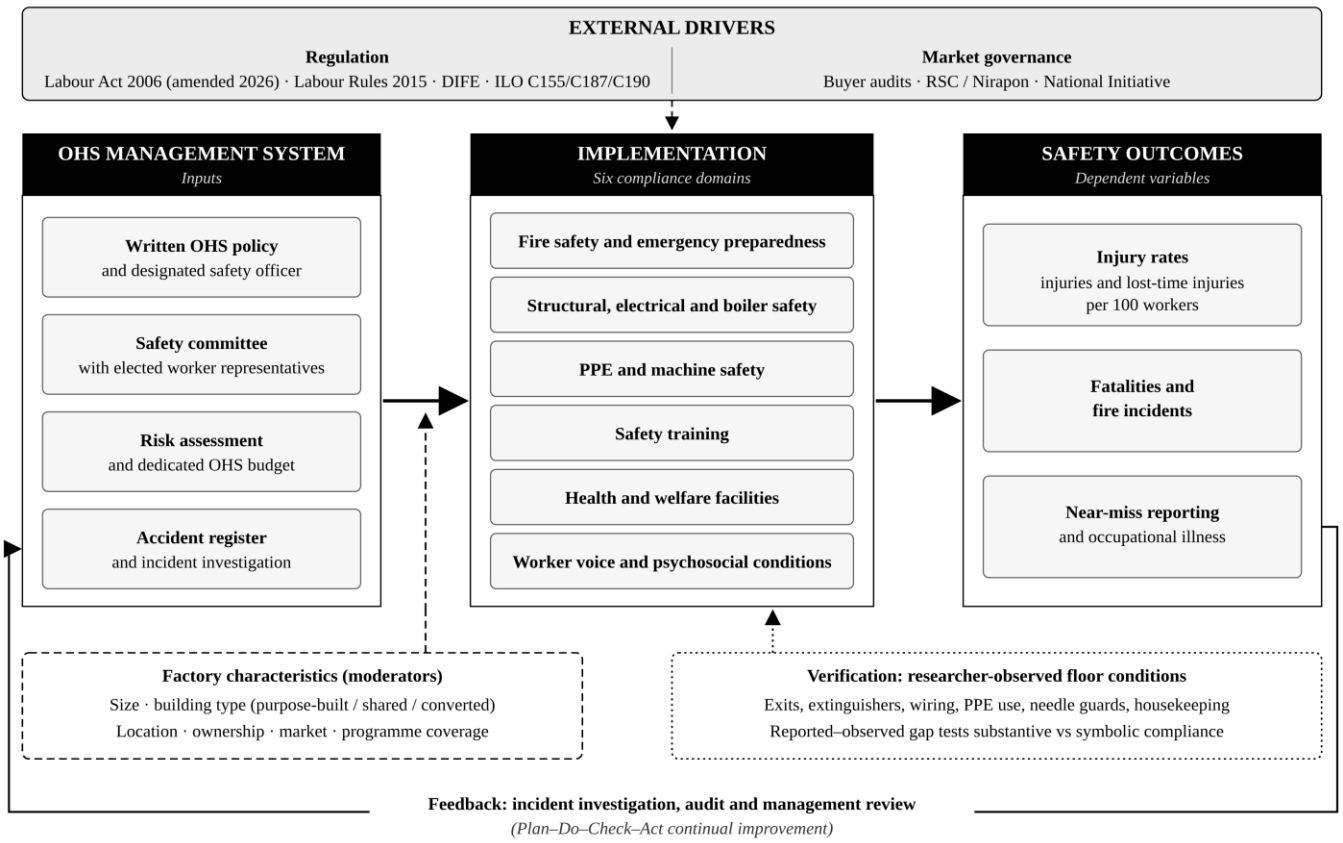

Figure 1. Conceptual framework of OHS management in RMG factories

Table 1. Operationalisation of framework constructs

Construct	Indicators	Survey items (Appendix A)
OHS management system	Policy, safety officer, committee, worker representatives, risk assessment, budget	Q13–Q19
Fire safety	Licence, alarm, sprinklers, protected stairs, evacuation plan, recent drill	Q22–Q27
Structural, electrical, boiler	Structural assessment, electrical inspection and records, boiler certificate	Q30, Q32–Q34
PPE and machine safety	Free PPE, needle guards, belt guards, PPE monitoring	Q35, Q37–Q39
Training	Induction, fire training, first-aiders	Q40, Q42, Q43
Health and welfare	First aid, medical room, water, toilets, canteen, childcare, ventilation, check-ups	Q44–Q51
Worker voice	Grievance, anti-harassment and participation committees, right to refuse	Q61–Q64
Outcomes	Injuries and lost-time injuries per 100 workers	Q52–Q60, Q7
Moderators / drivers	Programme, building, size, ownership, inspection	Q1–Q11, Q66–Q69
Observed conditions	12 floor observations	Q74–Q85

Hypothesis Development

Programme coverage. Institutional theory predicts that the binding inspection imposed as part of buyer-led programmes will lead to increased compliance in the areas of fire, structural and electrical hazards (Reinecke & Donaghey, 2025).

H1: The rate of fire safety index and structural–electrical safety index are higher for factories under a buyer-led programme (RSC or Nirapon) than for other factories.

Building type. The structural limitations and split responsibility for exits and fire systems are faced by converted buildings and multi-tenant buildings (Das et al., 2018).

H2: Compliance is higher for factories built in purpose-built, single-occupant buildings.

Factory size. There are more resources available in larger factories, and they can better manage OHS (Haque et al., 2024).

H3: The overall level of compliance is higher with larger factories.

Compliance and injuries. The principles of systems theory and evidence that support the effectiveness of OHSMS suggest that having a stronger defence decreases injuries (Robson et al., 2007; Christian et al., 2009).

H4: Compliance is associated with fewer injuries and fewer days missed from work for injuries.

Reported vs observed compliance. According to the institutional theory, compliance can be greater than documented (Locke, 2013).

H5: Management reported compliance rate is higher than the compliance rate observed by the researcher.

Subcontracting status was explored as a comparison without a directional hypothesis, since the practice of subcontracting can reduce the buyer's and regulatory oversight (Labowitz & Baumann-Pauly, 2014), but is also can carry over the systems of a compliant parent factory

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METHODOLOGY

Design, Sampling and Data Sources

This study applied a cross-sectional design with the factory as the unit of analysis and is reported following the STROBE guidance for observational studies (von Elm et al., 2007). **Sampling approach.** Because there is no complete public sampling frame and factory access required management consent, a purposive, non-probability sample was recruited through BGMEA and BKMEA member lists (32.1%), professional contacts (32.1%), referrals from other factories (26.4%) and other means (9.4%), predominantly in The major hubs of RMG are in Gazipur, Savar–Ashulia and Narayanganj, which recorded 6,855, 6,377 and 5,608 cases respectively. The factory units that were selected were the export oriented or local RMG manufacturing factory who agreed with the management to participate in the study. The sample was deliberately spread across the four compliance frameworks (RSC, Nirapon, National Initiative and none/not known), three building types and three bands of workforce size (<1,000; 1,000 to 2,499; ≥2,500 workers) but it is not statistically representative of the sector and no quotas were applied.

I have targeted to collected 150 factory data or information near 90 factories management didn't the information for their privacy. Data were gathered from February 2025 to March 2026. The participating factories employed 107,890 workers, 61.1% of them women.

Instrument and Observation

The structured questionnaire consisted of 12 sections (Appendix A) that were used to collect data: factory profile; OHS management system; fire safety; structural, electrical & boiler safety; PPE & machine safety; training; health & welfare; accidents & injuries in the past year; worker voice; regulation & inspection; challenges; and researcher observation. The items were adapted from the Labour Act and Rules, ILO-OSH 2001, ISO 45001 and from the post-Rana-Laxmi inspection programmes (Government of Bangladesh, 2006, 2015; ILO, 2001; ISO, 2018). The manager responsible for compliance or safety (usually the compliance manager, the HR manager or the safety officer) was invited to provide documentation, including a fire licence, drill records and an accident register, for important items on the questionnaire. Where there were no accident registers, injury figures were sourced from the injury data sheets of the injured. During floor walk-throughs, a 12-point checklist was completed in 30 of the factories (56.6%) and on-site interviews (without walk-through) and remotely (15, 8 respectively) were conducted. Analyses of observed conditions were restricted to the 30 walk-through factories, because observation items could not be recorded in the 23 factories surveyed on site without a walk-through (15) or remotely (8).

Data sources and triangulation. Four sources were used: (1) the management questionnaire, completed by the manager responsible for compliance or safety; (2) documentary evidence inspected by the researcher in the 30 walk-through factories to check key items (fire licence, drill records, structural and electrical assessment reports, boiler certificate and training records); (3) the factory accident register, or, where this was not available, individual injury records, for injury outcomes; and (4) the researcher's floor observation checklist in the 30 walk-through factories. Triangulation in this case was between the management reports, documents and independent observation. This is a limitation because neither independent worker surveys nor confidential worker interviews nor external injury registers (e.g. DIFE accident notification or records from employment injury scheme) were collected, with the understanding that agreement between sources represents verification of the researcher's observation rather than that of the workers themselves.

Indicators, Scoring and Outcome Measures

The answers were scored as 1 for "Yes", 0 for "Not implemented", "Not applicable" (e.g. the boiler in a factory without a boiler) were omitted to be conservative. The percentages for each domain index are the proportion of items that were responded to with a "Yes". The Reported OHS Compliance Index is average of the seven OHS domains listed in Table 1, and the reported implementation index (H5) is the average of the five OHS domains that have an observable counterpart: fire; structural, electrical and boiler; PPE and machine; training; health and welfare. The index did not include worker voice and

the management system as these cannot be directly observed on the floor. Injury rates and lost-time injury rates were reported as the number of injuries per 100 workers per year. Table 2 presents the indicators for each domain and their operational definitions and the source used to verify. Fire safety was assessed as the presence of a valid fire licence, automatic detection and alarm, sprinklers, protected stairways, an evacuation plan and an evacuation drill in the last six months; building safety was assessed by having a structural assessment, electrical inspection with records and having a valid boiler certificate; machine guarding and PPE was assessed as having needle guards, belt and pulley guards, PPE supplied free of charge, and supervisory monitoring of PPE use, all within the health and welfare domain; adequate ventilation was assessed as having adequate ventilation in production areas, a check during walk-throughs; and OSH committees were assessed as having a safety committee and having worker representatives during a walk-through. All recorded work-related injuries were included in injury outcomes, lost-time injuries were those recorded by the factory and resulting in an absence from work, fire and near misses were recorded separately, as were fatalities.

Table 2. Indicators, operational definitions and data sources

Domain	Indicators (scored 1 = Yes, 0 = No/not implemented)	Data source and verification
OHS management system and OSH committee	Written OHS policy; designated safety officer; safety committee; worker representatives on the committee; recent written risk assessment; dedicated OHS budget	Management questionnaire (Q13–Q19)
Fire safety	Valid fire licence; automatic detection and alarm; sprinklers; protected stairways; evacuation plan; evacuation drill in previous 6 months	Questionnaire (Q22–Q27); fire licence and drill records inspected; floor observation (n = 30)
Building (structural, electrical, boiler) safety	Structural assessment; electrical inspection and records; boiler certificate (not applicable where no boiler)	Questionnaire (Q30, Q32–Q34); assessment reports/certificates where provided; floor observation (n = 30)
Machine guarding and PPE	Needle guards; belt/pulley guards; PPE provided free; supervisors monitor PPE use	Questionnaire (Q35, Q37–Q39); floor observation of guards and PPE use (n = 30)
Training	Induction training; fire-safety training; trained first-aiders	Questionnaire (Q40, Q42, Q43); training records where provided
Health, welfare and ventilation	First-aid boxes; medical room; safe drinking water; separate toilets; canteen; childcare room; adequate ventilation; regular health check-ups	Questionnaire (Q44–Q51); floor observation (n = 30)
Worker voice	Grievance mechanism; anti-harassment committee; participation committee; right to refuse unsafe work	Questionnaire (Q61–Q64)
Injury outcomes	All recorded injuries and lost-time injuries per 100 workers per year; fatalities; fire incidents; near misses (previous 12 months)	Accident register; individual injury records where no register (Q52–Q60, Q7)
Factory characteristics (moderators/confounders)	Compliance framework; building type; workforce size; ownership; location; DIFE inspection history; subcontracting status and trade union presence	Questionnaire (Q1–Q11, Q66–Q69)

As expected, the reliability for the OHS management system was 0.73 (Kuder–Richardson 20) and the reliability for the observation checklist was 0.91, while the reliabilities for the other domains were in the range 0.12–0.51. Content validity was met by using items from statutory and international standards; convergent validity was determined by comparing observed conditions with the items, and criterion validity was determined by comparing these items with the frequency of injuries (Section 4). Common-method bias was reduced, though not eliminated, by using the observation and accident registers as independent sources. The low KR-20 scores for some domains are due to the low number of items within each domain and are

therefore not reflective scales, but checklists of required provisions (formative indices

Data Analysis

Analyses used Python 3.13 (SciPy 1.18, pandas 3.0). Eight of nine indices were not normally distributed ($p < .01$) and so a Spearman correlation was used, as well as a Kruskal–Wallis and Mann–Whitney test (H1–H3) and Wilcoxon signed-rank test with effect size r (H5); exact McNemar tests were used for matched items (H2–H3). The negative binomial regression was used for H4 where the count of injuries was over-dispersed with a mean of 12.7 and a variance of 271.6 (incidence rate ratios (IRR) are reported). The differences across compliance framework (four groups, and buyer-led versus other), building type, and workforce size band were analysed for the total index and each domain. Model 1 was unadjusted; Model 2 was adjusted for compliance framework (buyer-led versus other) and building type (shared or converted versus purpose-built) and log workforce were specified prior to the analyses as potential confounders as each is potentially related to compliance and to injury risk, and in the 30 walk-through factories the reported index of the floor condition was also replaced by the observed condition in that model. The number of covariates per model was small to reduce over-fitting with 53 factories. Binary injury outcomes were not modelled as only three factories had no injuries. The sample gave 80% power to detect $\rho \geq .38$ at $\alpha = .05$. Half credit for "Partially" answers was given during a sensitivity analysis. For statistical significance, p was set at $< .05$ and for marginal results, with the number of comparisons, p was interpreted with caution and in the range of .01 – .05.

Ethics

Only consensual participation in the study was requested; informed consent was obtained from the management; the names of the factories were not included.

RESULTS

Factory Profile

The majority of factories were situated in Gazipur (52.8%), owned by Bangladeshis (77.4%), housed specifically built factories (60.4%) and mainly exported (88.7%) (Table 3). The median workforce was 1,530 (IQR 970–2,100). Compliance managers (32.1%), HR managers (26.4%) and safety officers (24.5%) were the largest groups of respondents. Thirty factories (56.6%) completed floor walk-throughs, 15 factories conducted floor survey, and 8 factories did a remote survey.

Table 3. Characteristics of the surveyed factories (N = 53)

Characteristic	n	%
Location		
Gazipur	28	52.8
Savar / Ashulia	12	22.6
Narayanganj	9	17.0
Other (Chattogram, Dhaka, Mymensingh)	4	7.5
Safety programme		
RSC	17	32.1
Nirapon	14	26.4
National Initiative	18	34.0
None / not known	4	7.5
Building type		
Purpose-built	32	60.4
Shared	15	28.3
Converted	6	11.3
Ownership		
Bangladeshi	41	77.4
Joint venture / foreign	12	22.6

Workforce		
< 1,000 workers	14	26.4
1,000–2,499 workers	27	50.9
≥ 2,500 workers	12	22.6

OHS Compliance (Objective 1)

The average score of the Reported OHS Compliance Index was 75.3% (SD = 15.5). The highest rates of compliance were for training (84.9%) and structural, electrical and boiler safety (82.5%) with the lowest being for the OHS management system (60.9%) (Table 4; Figure 2). Nearly all companies had formal structures in place, such as a safety committee (94.3%) and structural assessment (94.3%), while only a quarter (24.5%) had a written budget for OHS, one-third (37.7%) had recently held a written risk assessment and just over half (54.7%) had a right to refuse unsafe work. Fire safety measures such as automatic detection and alarm systems (49.1%), sprinklers (58.5%) and protected staircases (60.4%) were much less common than fire licences and one in four factories had not conducted an evacuation drill in the previous six months. Regular health check-ups (56.6%) and adequate ventilation (66.0%) were the weakest of the welfare items, while only 54.7% of factories had supervisors monitoring PPE use.

Table 4. OHS compliance indices

Domain	**n**	**Mean (%)**	**SD**	**Median**
OHS management system	53	60.9	26.5	57.1
Fire safety	53	70.1	23.4	66.7
Structural, electrical and boiler	53	82.5	22.1	100.0
PPE and machine safety	53	71.2	24.7	75.0
Safety training	53	84.9	23.2	100.0
Health and welfare	53	81.1	16.4	87.5
Worker voice	53	76.4	25.7	75.0
Reported OHS Compliance Index	53	75.3	15.5	75.7
Observed floor conditions	30	56.7	35.9	58.3

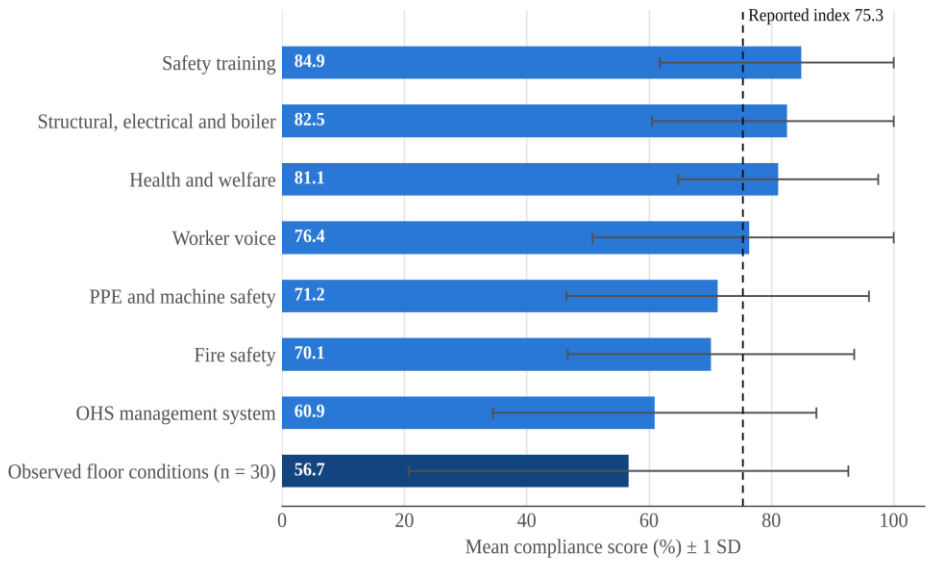

Figure 2. Mean compliance by domain (±1 SD)

Reported versus Observed Compliance (H5)

Reported implementation was 78.3% on average across the 30 walk-through factories, but observed implementation was 56.7% (Wilcoxon $Z = -4.10$, $p < .001$, $r = 0.75$; Figure 4). First-aid boxes were reported in 93.3% and observed in 56.7% of factories, (McNemar $p = .003$) as were drinking water (reported in

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93.3% and observed in 56.7%, McNemar p < .001). Variations in terms of PPE use and needle guards were in the same direction, but failed to reach significance. H5 was supported.

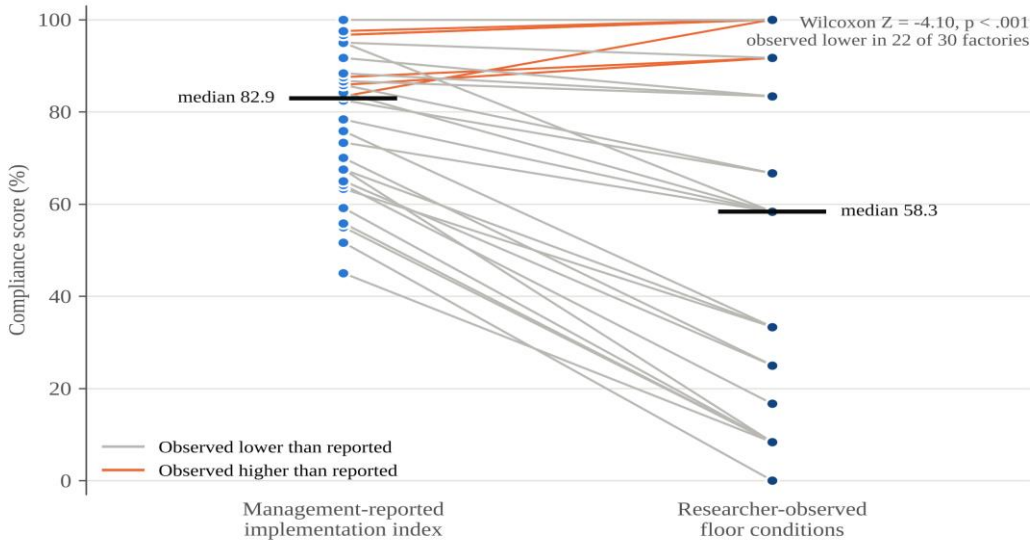

Figure 4. Reported and observed compliance in each walk-through factory (n = 30)

Relationships among Domains

The 21 out of 28 correlations between domains were significant (Figure 3). Convergent validity of the reported indices was supported by the high correlations between observed conditions and the reported OHS management system (ρ = .83) and fire safety (ρ = .79).

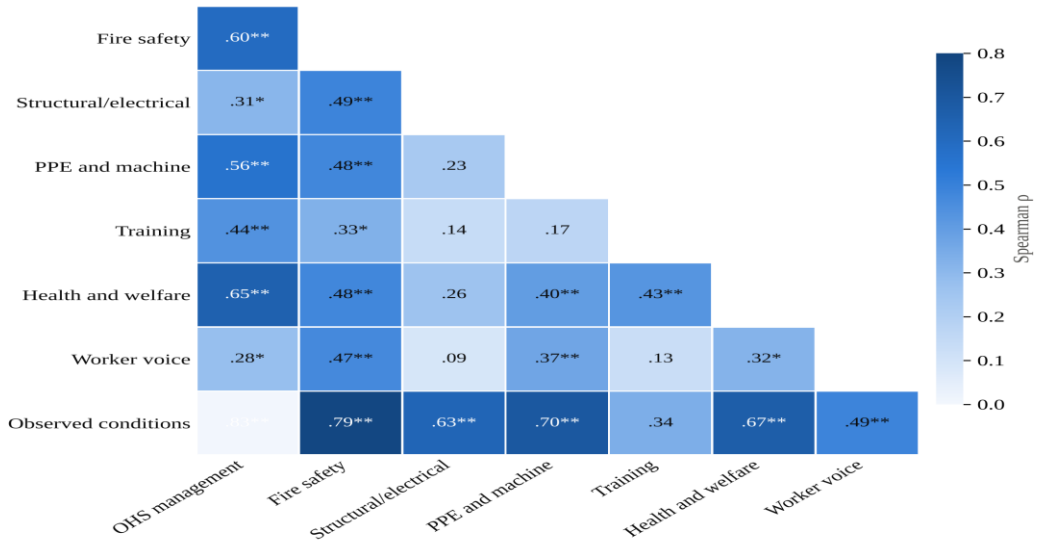

Figure 3. Spearman correlations among domains (* p < .05, ** p < .01)

Compliance Framework, Building Type, Factory Size and Subcontracting (H1–H3)

There was no significant difference between compliance across the four programme groups for the overall index (H = 4.87, p = .181), fire safety (p = .289) or structural safety (p = .250) (Table 5). H1 was not supported as buyer-led factories had lower scores than other factories (U = 230, p = .046) with National Initiative factories having the highest scores (81.3%). There was no association between building type (H = 2.56, p = .278) and workforce size (ρ = .05, p = .748) and compliance.H2 and H3 were not supported. The mean compliance scores were lowest for converted buildings (66.6%) and highest for mid-sized factories (1,000 to 2,499 workers) when compared to smaller (69.7%) and larger (71.0%) factories, with the

difference being close to the 5% level (p = .050).

Table 5. Mean compliance (%) by safety programme

Programme	n	Overall	Fire	Structural
RSC	17	68.6	61.8	74.5
Nirapon	14	74.4	70.2	79.8
National Initiative	18	81.3	77.8	89.8
None / not known	4	80.2	70.8	93.8

Compliance and Injuries (H4)

Over a 12-month period, there were 673 injuries and 143 lost-time injuries, and 2 fatalities, in factories, with a median injury rate of 0.51 per 100 workers. The most frequently occurring injuries were needle puncture (34.0%), slips and falls (22.6%) and cuts (13.2%) and workers were always paid for an injury in 64.2% of factories. The median lost-time injury rate was 0.10 per 100 workers, 24 (45.3%) factories recorded one or more fire incidents and the median factory recorded 11 near miss incidents. There was a strong negative association between compliance and injury rates ($\rho = -.70$, $p < .001$; Figure 5). Each 10-point increase in compliance was associated with a 26% lower injury rate (Table 6). It was also found that the association continued after adjustment for compliance framework, building type and size of workforce (Model 2: IRR = 0.71, 95% CI 0.65–0.78) and also in researcher-observed conditions for walk-through factories (Model 3: IRR = 0.87, 95% CI 0.83–0.91). The results are similar to H4 and reinforce the criterion validity of the index, but reflect the relationship between the factories at a single point in time and do not imply that more injuries occurred when the factories were less compliant.

Table 6. Negative binomial regression of injury counts (offset: log workers)

Predictor	IRR	95% CI	p
Model 1 (n = 53)			
Compliance index (per 10 points)	0.74	0.68–0.80	< .001
Model 2, adjusted (n = 53)			
Compliance index (per 10 points)	0.71	0.65–0.78	< .001
Buyer-led programme	0.76	0.58–1.01	.057
Shared or converted building	1.03	0.80–1.34	.805
Workforce (log)	1.12	0.94–1.34	.206
Model 3, walk-through (n = 30)			
Observed conditions (per 10 points)	0.87	0.83–0.91	< .001

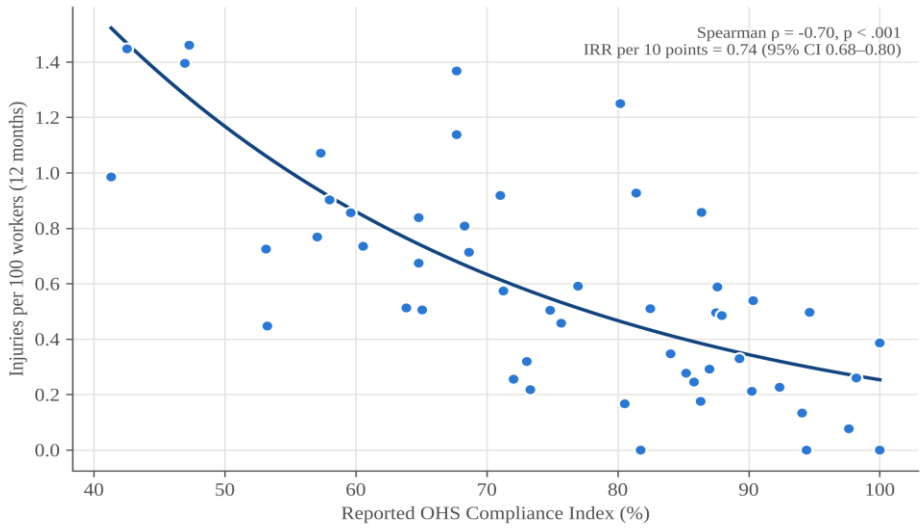

Figure 5. Compliance and injury rate (line = fitted model)

Table 7. Summary of hypothesis tests

Hypothesis	Result	Decision
H1 Programme coverage	Buyer-led lower (p = .046)	Not supported
H2 Building type	p = .278	Not supported
H3 Factory size	p = .748	Not supported
H4 Compliance → fewer injuries	IRR 0.74, p < .001	Supported (association only)
H5 Reported > observed	p < .001	Supported

DISCUSSION

Reported versus Practised Safety

Nearly three-quarters of walk-through factories reported conditions that were better than observed in the daily life of the factory, most significantly for basic conditions that should be available on a daily basis, such as first aid boxes and drinking water. Documented structures like committees, structural assessment and fire licences were widespread, while resource based practices like risk assessment and OHS budgeting were low. It is consistent with institutional explanations for symbolic compliance (Locke, 2013; Alamgir & Banerjee, 2019) and the literature that OHS systems are only effective when they are implemented (Robson et al., 2007). According to Swiss cheese model, documented defence can be present in the model, but latent gaps can be found on the floor of the model (Reason, 1997). However, there was a strong correlation between reported and observed scores ($\rho = .83$): factories were not randomly chosen to report, and it was so that the better-scoring factories were better-scoring on the floor. For this reason, management reports are generally considered to be a reasonable ranking but not an absolute rating, and should not be taken as a standard by regulators or buyers without confirmation.

Compliance and Injuries

The strong inverse association between compliance and injury rates is consistent with the systems perspective. The strongest relationships were between the management system and fire safety, consistent with the literature on the associations between management commitment and safety climate (Zohar, 1980; Christian et al., 2009), and the associations were found for those aspects that were observed independently of each other. It also adds to the national evidence at worker level, that hazardous environments and absence of protective equipment are associated with injury (Tariqujjaman et al., 2025), to the factory level. The link with compliance is plausible since the most common injuries, which are needle punctures, slips and falls and cuts are the very ones that are aimed at in machine guarding, housekeeping and PPE supervision. Causal conclusions cannot be made from cross-sectional data, however. Other differences between the factories investing in safety may be unmeasured, including management quality, buyer relationships or workforce composition, or reverse causation (factories improving their compliance after sustaining injuries) and differential recording of injuries cannot be ruled out. However, there is little evidence that it was due to under-recording of accidents, as those factories without an accident register actually made reports of higher rates of accidents (0.72 compared to 0.50 per 100 workers).

Buyer-Led Programmes

However, buyer-led programme factories fared worse than the others, in contrast to H1. These programmes may focus on building and fire risks more than the broader OHS system (Kabeer et al., 2020); buyers suppliers might face the greatest purchasing pressure, which might constrain their investment in OHS, or they may report more honestly (Anner, 2020); and/or National Initiative factories might have been recruited through contacts, which may explain better performance. While the Accord has been successful in addressing specific hazards, it warns that coverage of these hazards does not imply a comprehensive approach to OHS management (Reinecke & Donaghey, 2025). With respect to management systems, welfare and worker voice which programme inspections do not cover, it also indicates that gains in building and fire safety have not automatically translated into improvement in these areas.

Why Gaps Persist: Enforcement, Worker Representation and Purchasing Practices

It is important to recognize that there is not a complete alignment between the reported and the observed compliance, which is paralleled by the weak resource-based practices, in the context of the enforcement environment. DIFE is a statutory regulator of all factories, including those not participating in the buyer led programmes, however, in 2022 only 311 of 575 sanctioned inspector positions were filled with 500,000 factories (Munni, 2022). This capacity makes it very rare for inspections to be carried out, and it is these that our factories scored well on: floor level things like the lack of first aid equipment, drinking water, lack of exit signs, emergency lighting are less likely to be detected. ILO Conventions No. 155 and 187 (ILO, 2025) force the state to establish a national OHS system, which will involve a stronger inspectorate to inspect these factories, not only in the presence of the inspector, but also by conducting unannounced inspections based on risk assessment, especially in smaller units, converted units and subcontracting factories that do not fall under buyer-led programmes.

Worker representation is a second explanation. Safety committees were widely established (94.3%) but the concept of refusal of unsafe work was recognised by only half of factories (54.7%). In areas where trade unions do little, committees will be more likely to be led by management and more likely to be used as a form of audit documentation rather than as a tool for workers to report hazards without fear of repercussions (Walters & Nichols, 2007; Alamgir & Sayeed, 2023). The union-involving design of the Accord, which embedded safety committees and complaint processes in independent unions, was at the heart of its remediation record (Donaghey & Reinecke, 2018; Reinecke & Donaghey, 2025). This explanation is interpretive as trade union presence was not analysed as a predictor in this study [AUTHORS: if not in Q61-69, modify this accordingly].

Third, the resources for safety are determined by buyer purchasing practices. The low budgets for OHS control, the falling prices and short lead times force suppliers to work overtime and fall back on subcontractors, resulting in less time being available for OHS budgets, risk assessment and supervision as the weakest points in our data. (Anner, 2020; Labowitz & Baumann-Pauly, 2014) Meanwhile, symbolic compliance (Locke, 2013) can be promoted through the use of buyer audits that require documentation. These connections are made as possible explanations, and were not directly measured when purchasing practices were conducted.

The two key components of any management system (ISO, 2018) i.e. OHS budget and a recent risk assessment were less than 1/4 of factories. Only 55% of factories reported workers' right to refuse unsafe work, which is consistent with the limited exercise of this right in Accord factories (Alamgir & Sayeed, 2023); and this right has recently been explicitly granted statutory protection under the Labour (Amendment) Act 2026 (MiHCM, 2026).

Objective 3 found that higher compliance was associated with lower injury rates, but the cross-sectional design of this study does not allow for causal conclusions; and there were significantly worse observed floor conditions than reported compliance (Objective 4).

Management Systems, Worker Voice and Factory Characteristics

Less than 1/4 of factories had OHS budget and just over one-third (37.7%) had a recent risk assessment, which are the cornerstones of any management system (ISO, 2018). Only 55% of factories reported that workers had the right to refuse unsafe work, consistent with the limited exercise of this right in Accord factories (Alamgir & Sayeed, 2023); the right has only recently been given explicit statutory protection by the Labour (Amendment) Act 2026 (MiHCM, 2026). The median weekly hours were equal to the ceiling of the Labour Act, which is an average of 56 hours per week over a year and nine factories had a weekly hours ceiling of 60, which is a known injury risk (Tariqujjaman et al., 2025). The findings for fire safety corroborate previous research which identified missing alarm systems and drills as a key concern: 10 years after Wadud et al. (2014) found that missing alarm systems and drills were a concern for 10%, of the factories surveyed, only 50% had automatic detection and alarm devices installed and working exit signs and emergency lighting were observed in less than 50% of walk-through factories.

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Building type and size were not significant but the lowest scores were in the converted building and the highest in mid-sized factories, which is consistent with previous evidence (Das et al., 2018; Haque et al., 2024; Wadud et al., 2014). However, small factories might not have the resources and expertise (Hasle & Limborg, 2006) and very large factories might be more difficult to implement consistently across many floors and shifts.

Implications

The findings are consistent with both theories: the interrelation of the domains (as predicted by systems theory) and the correlation between overall compliance and injuries (as predicted by systems theory), and the gap between the reported and observed compliance and the weak programme effect (as predicted by institutional pressures). In terms of methodology, the study demonstrates that by using both the management report and independent observation, the difference between substantive compliance and symbolic compliance at factory level is possible. In practice, measures should be taken to strengthen the risk assessment, budgeting and supervision and ensure continued basic provision and to broaden the focus of the buyers and safety programmes from building and fire safety to purchasing pressure, with special focus on smaller factories and those in converted buildings, and to ensure that the measures do not rely solely on document checks, but also on unannounced checks on the floor.

CONCLUSION

In 53 RMG factories, the compliance was moderate, with the lowest level observed in the management system (Objective 1), and was not influenced by the type and size of the building, and/or the coverage of the programme by the buyers (Objective 2); higher compliance was associated with lower injury rates, although the cross-sectional design does not permit causal inference (Objective 3); and observed floor conditions were substantially poorer than reported compliance (Objective 4).

The study provides a multi-domain compliance index that is associated with injury outcomes and evidence at the factory level of the gap between what was reported and what was observed, highlighting the challenge is no longer building safety but ensuring verifiable safety management is embedded in the day-to-day.

Five recommendations follow. (2) Greater sanction for inspectors: DIFE needs to be resourced to fill authorised inspector positions and should carry out both document review and unannounced, risk-based, floor inspections (with a greater focus on smaller, converted-building, and subcontracting factories, outside buyer-led programmes); RSC and buyers should also incorporate unannounced, risk-based, floor checks. (2) Reporting of injuries should be transparent: every factory should have an accident register with a standard format covering needle injuries and near misses; annual injury and lost time rates should be reported to DIFE; DIFE should publish aggregated sector-level rates of injuries. (3) Worker participation: workers should be elected to safety committees to have meaningful authority and there should be freedom of association, and workers' rights to refuse and work in dangerous conditions should be made known to all workers. (4) Management systems and purchasing procedures: A separate OHS budget should be set up in each factory, and a written risk assessment should be conducted annually by the safety committee, and lead-time and price should be synchronized by purchasing agents with their expectations of safety. National policy – government has ratified ILO Conventions of 155 and 187 – need to develop national OHS policy & programme including all factories

LIMITATIONS AND FUTURE RESEARCH

There are some drawbacks to the study. Firstly, the sample was purposive and non-probabilistic, with a high percentage of better performing factories, so the results are not generalizable for the sector as a whole, especially for small and subcontracting factories. Second, the compliance data were self-reported by management, with some items checked against documents but no independent worker surveys or confidential worker interviews conducted, meaning that workers' views on voice, harassment and rights to refuse are not captured. Thirdly, floor observation was only conducted in 30 factories, based on a

management arranged visit, which may have caused conditions to be better on the visit day, thus underestimating the reported–observed gap. Fourth, it was not possible to cross-check data on injuries against separate injury registers, and because of the tendency for under-reporting of minor needle injuries (Haque et al., 2024), data on injury were based on the factory record. Fifth, some of the domain indices were found to have low internal consistency and other items were measured to varying extents, and are discussed interpretatively because of this. Finally, the cross-sectional design does not allow for causal inferences and the compliance-injury association might be due to residual confounding, reverse causation or differential recording. Future studies should involve probability sampling from DIFE or association databases, gather compliance reports, independent worker surveys, confidential interviews, and conduct floor observation and follow-up on independent injury register data in the same factories, and then follow these workers over time (longitudinal or panel design) to determine if there is a relationship between compliance improvements and injury reductions.

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