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Organizational Safety Practices, Interprofessional Collaboration, and Safety Consciousness Associated with Safety Citizenship Behaviour Among Healthcare Professionals in Hospitals in Kerala, India: A Multicentre Cross-Sectional Study

Pooja K[1], Seema Mehta[2]*

1PhD scholar, IIHMR University, Jaipur, Rajasthan, India. pooja.j18@iihmr.in
2Professor, IIHMR University, Jaipur, Rajasthan, India. seemam@iihmr.in.

ABSTRACT: **Background**: Safety citizenship behaviour is important for maintaining a safe healthcare environment. However, evidence regarding the independent associations of organisational safety practices, interprofessional collaboration, and safety consciousness with this behaviour remains limited in Indian hospitals.

Objective: To examine the associations of workplace safety management practices, interprofessional collaboration, and safety consciousness with safety citizenship behaviour among healthcare professionals in Kerala, India.

Methods: This multicentre cross-sectional study was conducted in four cooperative hospitals in northern Kerala. Data were collected between June 2024 and August 2025 using self-administered questionnaires. Of 450 questionnaires distributed, 373 complete responses were analysed. Pearson correlation and multivariable linear regression were used to assess associations with safety citizenship behaviour, adjusting for demographic, professional, and hospital-related characteristics.

Results: The mean safety citizenship behaviour score was 87.72 (SD 11.36) out of 100. Safety citizenship behaviour was positively correlated with workplace safety management practices ($r = 0.335$, $p < 0.001$), interprofessional collaboration ($r = 0.413$, $p < 0.001$), and safety consciousness ($r = 0.395$, $p < 0.001$). The adjusted regression model explained 33.6% of the variance ($R^2 = 0.336$; adjusted $R^2 = 0.305$). Interprofessional collaboration (B = 0.695, 95% CI 0.205–1.185; $p = 0.006$) and safety consciousness (B = 0.665, 95% CI 0.141–1.189; $p = 0.013$) remained independently associated with safety citizenship behaviour. Workplace safety management practices were not independently associated with the outcome (B = 0.082, 95% CI −0.061 to 0.225; $p = 0.260$).

Conclusion: Interprofessional collaboration and safety consciousness were independently associated with safety citizenship behaviour. Strengthening collaborative working and safety awareness may support hospital safety initiatives. Longitudinal studies are required to establish temporal relationships.

INTRODUCTION

Hospitals must provide a safe working environment for healthcare professionals while ensuring the delivery of high-quality

patient care. Healthcare workers are routinely exposed to occupational hazards, infectious diseases, demanding workloads, and complex clinical situations that require effective communication and coordinated decision-making. Although institutional safety policies, training programmes, protective equipment, and standard operating procedures are essential, effective safety performance also depends on how healthcare professionals recognise hazards, communicate concerns, support colleagues, and voluntarily participate in safety improvement activities [1,2].

Safety performance encompasses both safety compliance and safety participation. Safety compliance refers to adherence to mandatory safety procedures, whereas safety participation involves discretionary activities that contribute to a safer working environment. Safety citizenship behaviour represents such voluntary, extra-role contributions, including reporting hazards, assisting colleagues, suggesting preventive measures, and participating in organisational safety initiatives. Research examining workplace safety management during the COVID-19 pandemic demonstrated an association between perceived safety management practices and employees' organisational citizenship behaviour, highlighting the potential importance of organisational support during periods of heightened occupational risk [1]. Furthermore, a study involving 1,053 nurses in South Korea found that patient safety climate was positively associated with both safety compliance and safety participation, with patient safety knowledge and motivation contributing to these relationships [2]. These findings support the need to examine organisational and individual determinants of voluntary safety-related behaviour among healthcare professionals.

Workplace safety management practices constitute an important organisational foundation for safe clinical practice. These practices include management commitment to safety, safety training, clearly defined procedures, adequate protective resources, incident reporting, and employee involvement in safety-related decisions. Nevertheless, the availability of formal safety systems does not necessarily ensure that healthcare professionals will actively contribute to safety improvement. A cross-sectional study of 273 healthcare workers in Taiwan found that workplace safety climate was associated with health beliefs and safety attitudes, which were subsequently related to preventive behaviours and safety compliance during the COVID-19 pandemic [3]. Similarly, a multicentre study involving 43 hospital units found that patient safety climate and adherence to standard precautions were associated with healthcare-associated infection and occupational exposure outcomes [4]. These findings indicate that the relationship between organisational safety arrangements and actual safety-related behaviour warrants further investigation, particularly in settings where healthcare professionals must respond to changing clinical and occupational risks.

Interprofessional collaboration may represent another important determinant of safety citizenship behaviour. Healthcare delivery requires professionals from different disciplines to exchange information, coordinate responsibilities, participate in shared decision-making, and respond collectively to emerging hazards. In a study involving 1,495 healthcare workers, Ishii and colleagues reported that interprofessional collaboration played a mediating role in the relationship between organisational learning and dimensions of hospital safety climate [5]. Similarly, research involving 1,276 employees from three acute-care hospitals in Japan found that collaborative leadership was associated with stronger interprofessional collaboration and a more favourable patient safety climate [6]. A 2025 systematic review and meta-analysis examining interprofessional collaboration among nurses and physicians further highlighted its relevance to coordinated patient care and the prevention of adverse clinical events [7]. Collectively, these findings suggest that effective collaboration may provide healthcare professionals with opportunities to identify safety concerns, communicate risks, and undertake voluntary actions that support a safer working environment. However, patient safety climate and collaborative practice are related to, but distinct from, individual safety citizenship behaviour.

Safety consciousness is another potentially important individual-level factor. It encompasses awareness of workplace hazards, attention to safety procedures, recognition of potential risks, and personal commitment to maintaining a safe working environment. Healthcare professionals with greater safety consciousness may be more likely to identify unsafe practices, communicate concerns, and assist colleagues in preventing avoidable harm. Evidence from a 2024 study of surgical nurses demonstrated the relevance of teamwork and safety climate to nurses' willingness to speak up about patient safety concerns and unprofessional behaviour [8]. In addition, a cross-sectional study of 730 nurses in the Philippines examined relationships among safety climate, quality of care, and adherence to standard precautions, reinforcing the importance of organisational safety perceptions in understanding healthcare workers' safety-related practices [9]. These findings support examining safety consciousness alongside organisational safety management and interprofessional collaboration rather than considering these factors independently.

Despite growing research on patient safety culture, safety climate, teamwork, and compliance with infection prevention practices, important evidence gaps remain. Many existing studies focus on patient safety outcomes, adherence to prescribed

procedures, or organisational safety perceptions rather than voluntary safety citizenship behaviour as the primary outcome. Moreover, evidence directly examining workplace safety management practices, interprofessional collaboration, and safety consciousness simultaneously in a multidisciplinary Indian hospital workforce remains limited. An Indian cross-sectional study published in 2025 identified differences in healthcare professionals' perceptions of communication, teamwork, organisational learning, and management support, demonstrating the continuing relevance of organisational safety culture in Indian healthcare settings [10]. However, these dimensions do not fully capture the voluntary, extra-role behaviours through which healthcare professionals contribute to workplace safety.

Therefore, the present multicentre cross-sectional study examined the associations of workplace safety management practices, interprofessional collaboration, and safety consciousness with safety citizenship behaviour among doctors, nurses, and paramedical professionals working in four cooperative hospitals in northern Kerala, India. By evaluating these organisational and individual factors together, the study aimed to identify which factors were independently associated with safety citizenship behaviour after accounting for relevant demographic, professional, and hospital-related characteristics. The findings may provide context-specific evidence to inform hospital safety initiatives and identify potential areas for future intervention research. Because participants retrospectively reported their experiences during the acute COVID-19 period, the findings are interpreted as associations with recalled pandemic-period experiences rather than evidence of causal effects.

MATERIALS AND METHODS

Study design and reporting

This multicentre cross-sectional survey on healthcare professionals working in cooperative hospitals in northern Kerala, India. The survey was administered between June 2024 and August 2025 and asked participants to retrospectively report safety-related practices and workplace experiences during the acute COVID-19 period (30 January 2020 to 5 May 2023). Therefore, the study assessed recalled pandemic-period behaviours rather than behaviours measured in real time during the pandemic. The present paper focused on the association of workplace safety management practices, interprofessional collaboration, and safety consciousness with safety citizenship behaviour. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies.

Study setting

The study was conducted in four multispecialty cooperative hospitals located in the northern Kerala districts of Malappuram, Kozhikode, and Kannur. Hospitals were eligible if they had at least 250 beds, provided tertiary or multispecialty services, and had functioned as COVID-19 treatment facilities during the pandemic. These hospitals were selected because cooperative institutions form an important component of Kerala's health-service system and continued to provide essential clinical services during the COVID-19 pandemic.

Participants and sampling

The target population comprised licensed healthcare professionals directly involved in patient care or clinical services. Eligible participants were doctors, nurses, physiotherapists, and laboratory technicians who had worked in their current hospital during the COVID-19 pandemic, had exposure to institutional safety procedures and occupational-risk environments, and provided written informed consent.

Interns and trainees with limited professional experience and personnel not actively engaged in clinical or healthcare work during the study period were excluded. A purposive, non-probability sampling approach was used. Hospital administrative and departmental records identified an accessible sampling frame of 756 eligible healthcare professionals across the four hospitals. The initial sample-size target was calculated using Cochran's formula for a proportion, assuming a 50% response distribution, 95% confidence level, and 5% margin of error. This produced a minimum target of 385 participants; 450 questionnaires were distributed to accommodate non-response and incomplete questionnaires.

Of the 450 questionnaires distributed, 414 were returned. Forty-one questionnaires were excluded because of incomplete or inadequate responses, leaving 373 complete questionnaires for analysis, corresponding to an effective response rate of 82.9%. The final sample comprised 27 doctors, 299 nurses, and 47 paramedical professionals.

Data collection procedures

Data were collected using anonymised, self-administered questionnaires in paper-based or online formats. Before questionnaire distribution, hospital administrators, medical superintendents, departmental heads, and relevant unit coordinators were informed about the study purpose and procedures. Eligible professionals received a participant-information sheet and written consent form before completing the questionnaire.

Questionnaires were distributed through the researcher and designated departmental coordinators. Participants were allowed four to six weeks to complete the survey, with reminders provided after the first, second, and fourth weeks. No personal identifiers were included in the analytical dataset. Completed paper questionnaires and electronic responses were assigned unique codes before data entry and analysis.

Measures

Safety citizenship behaviour

Safety citizenship behaviour was the primary outcome. It was measured using a modified 20-item Safety Citizenship Behaviour Questionnaire based on the work of Hofmann et al. The scale assessed proactive safety behaviours—safety voice (five items) and safety-related change (three items)—and prosocial safety behaviours—helping, stewardship, whistle-blowing, and civic virtue (three items each).

Items were scored on a five-point frequency scale ranging from 1 ("never") to 5 ("always"). Total scores ranged from 20 to 100, with higher scores indicating greater voluntary, extra-role safety behaviour. The total score, rather than individual items or subdomain scores, was used as the primary outcome in regression analyses.

Workplace safety management practices

Perceived workplace safety management practices were assessed using a modified 19-item scale adapted from Vinodkumar and Bhasi. The measure included management commitment to safety (seven items), safety training (five items), safety rules and procedures (four items), and employee involvement (three items). Each item was rated on a five-point Likert scale from 1 ("strongly disagree") to 5 ("strongly agree"). Total scores ranged from 19 to 95; higher scores represented more favourable perceptions of workplace safety management practices. Any COVID-19-specific wording adaptations made to the original items should be listed item by item in Supplementary Table S1.

Interprofessional collaboration

Interprofessional collaboration was measured using an eight-item modified version of the Assessment of Interprofessional Team Collaboration Scale, derived from Orchard et al. Items assessed perceived communication, shared decision-making, mutual respect, and collaborative working across professional groups. Responses were rated from 1 ("strongly disagree") to 5 ("strongly agree"), producing total scores from 8 to 40. Higher scores indicated stronger perceived interprofessional collaboration.

Safety consciousness

Safety consciousness was assessed using seven positively worded items adapted from prior occupational-safety research. The items measured awareness of workplace hazards, attention to safety procedures, and personal commitment to maintaining a safe work environment. Responses were rated from 1 ("strongly disagree") to 5 ("strongly agree"); total scores ranged from 7 to 35. No items were reverse-scored, and higher scores indicated greater safety consciousness.

Safety compliance behaviour

Safety compliance behaviour was assessed as a secondary descriptive outcome using a 13-item COVID-19-specific safety compliance scale. Items captured recalled adherence to required infection-prevention and institutional safety practices during the acute pandemic period. Responses ranged from 1 ("never") to 5 ("always"), giving total scores from 13 to 65. Safety compliance was not used as the primary regression outcome because its distribution showed substantial ceiling effects. It is reported descriptively to characterise the sample.'

Sociodemographic and professional characteristics

The questionnaire collected information on age, sex, professional group, educational qualification, total professional experience, duration of employment in the current hospital, hospital affiliation, and self-reported history of COVID-19 infection. In

regression analyses, profession, educational qualification, and hospital were treated as categorical variables and entered using indicator variables; they were not treated as ordinal numeric scores.

Data management and quality assurance

Paper questionnaires were entered into a password-protected electronic database, while online responses were exported directly to the study database. The data were screened for duplicate submissions, out-of-range values, logical inconsistencies, and missing information before analysis. The present analysis used complete cases only; questionnaires with insufficient information for calculation of primary study variables had been excluded before creation of the final dataset. Scale totals were calculated only after verification of the direction and permitted range of all item responses. Internal consistency of each multi-item scale will be evaluated in the final analytical sample using Cronbach's alpha and McDonald's omega. The pilot factor-analysis findings were not used as validation evidence because the pilot sample was insufficient for a defensible factor analysis of the multi-item instruments.

Statistical analysis

Data will be analysed using Jamovi (Version 2.6.19). All tests will be two-sided, with a significance threshold of $p < .05$. Continuous variables will be summarised as means and standard deviations or medians and interquartile ranges, as appropriate. Categorical variables will be presented as frequencies and percentages.

The distribution of safety citizenship behaviour and continuous predictors will be examined using histograms, Q–Q plots, skewness, and kurtosis. Pearson correlation coefficients will be used to examine unadjusted linear associations between safety citizenship behaviour and workplace safety management practices, interprofessional collaboration, and safety consciousness. Spearman correlation coefficients will be reported as a sensitivity analysis if distributional assumptions are materially violated.

The primary analysis will use multivariable linear regression with total safety citizenship behaviour score as the dependent variable. Workplace safety management practices, interprofessional collaboration, and safety consciousness will be entered simultaneously as the main explanatory variables. The model will be adjusted for prespecified demographic and professional characteristics: age, sex, profession, total professional experience, and hospital affiliation. Hospital will be included as a fixed effect because participants were nested within only four hospitals; cluster-robust standard errors will not be used because inference based on only four clusters would be unreliable.

Regression results will be reported as unstandardised coefficients, standard errors, standardised coefficients, 95% confidence intervals, and p values. Multicollinearity will be assessed using tolerance values and variance inflation factors. Linearity, homoscedasticity, normality of residuals, influential observations, and model fit will be assessed using residual-versus-fitted plots, normal probability plots, Cook's distance, leverage values, and standardised residuals. If major violations of model assumptions are identified, bootstrap confidence intervals based on 5,000 resamples will be used as a sensitivity analysis. Consideration of future safety consequences will not be included in the primary model, correlations, tables, or discussion because its association with safety citizenship behaviour has already been published using this survey dataset. Interaction or moderation analyses will also not be reported in this article because the original moderation model used uncentred product terms and showed severe multicollinearity.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board of the Indian Institute of Health Management Research University, Jaipur (reference no. IIHMR-U/IRB/2023-24/008; approved 31 March 2024). The protocol was also presented to the ethics committee of EMS Memorial Co-operative Hospital, Perinthalmanna. Institutional permissions were obtained from the other participating hospitals before data collection. All participants provided written informed consent. Participation was voluntary, and participants could decline or withdraw without consequences. Questionnaires were coded to protect confidentiality; consent forms were stored separately from research data. Electronic data were password-protected, and access was restricted to the research team. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

Participant flow and characteristics

Of 450 questionnaires distributed to eligible healthcare professionals across four cooperative hospitals, 414 were returned. Forty-one questionnaires were excluded because of incomplete or inadequate responses. The final analytical sample comprised 373 participants, representing an effective response rate of 82.9%.

Most participants were nurses (80.2%) and female (86.9%). Nearly half were aged 31–40 years (46.9%), and participants were distributed across categories of total professional experience. A total of 227 participants (60.9%) reported having had COVID-19 during the pandemic period (Table 1).

Table 1. Sociodemographic and professional characteristics of participants (N = 373)

Characteristic	Category	n	%
Age, years	<30	121	32.4
	31–40	175	46.9
	41–50	60	16.1
	>50	17	4.6
Sex	Female	324	86.9
	Male	49	13.1
Profession	Doctor	27	7.2
	Nurse	299	80.2
	Paramedical professional	47	12.6
Educational qualification	Diploma	242	64.9
	Undergraduate degree	90	24.1
	Postgraduate degree	39	10.5
	Doctoral degree	2	0.5
Total professional experience, years	<5	87	23.3
	5–10	101	27.1
	10–15	90	24.1
	>15	95	25.5
Experience in current hospital, years	2–5	116	31.1
	5–10	115	30.8
	>10	142	38.1
Self-reported COVID-19 infection	Yes	227	60.9
	No	146	39.1

Distribution of safety-related measures

Safety citizenship behaviour was high overall (mean 87.72, SD 11.36; possible range 20–100). Safety compliance also showed a marked ceiling effect: its mean score was 59.83 (SD 5.25) of a possible 65, and 94.9% of participants were categorised as having high compliance. Likewise, the distributions of workplace safety management practices, interprofessional collaboration, and safety consciousness were concentrated towards the upper end of their respective scales (Table 2).

Because the safety compliance score had limited variability, it was retained as a secondary descriptive outcome. Subsequent

association analyses used total safety citizenship behaviour score as the primary outcome.

Table 2. Descriptive statistics for safety-related measures (N = 373)

Measure	Possible range	Observed range	Mean (SD)	Participants in upper category*, n (%)
Safety compliance behaviour	13–65	37–65	59.83 (5.25)	354 (94.9)
Safety citizenship behaviour	20–100	38–100	87.72 (11.36)	326 (87.4)
Workplace safety management practices	19–95	39–95	83.72 (11.02)	334 (89.5)
Interprofessional collaboration	8–40	20–40	36.33 (3.84)	357 (95.7)
Safety consciousness	7–35	11–35	31.73 (3.27)	361 (96.8)

*Upper-category labels were based on study-specific score divisions and should be interpreted descriptively only; these are not validated clinical cut-offs.

Unadjusted associations with safety citizenship behaviour

Safety citizenship behaviour was positively correlated with all three principal study variables. The strongest association was observed with interprofessional collaboration (r = .413, p < .001), followed by safety consciousness (r = .395, p < .001) and workplace safety management practices (r = .335, p < .001). Workplace safety management practices and interprofessional collaboration were moderately correlated with each other (r = .628, p < .001).

Table 3. Pearson correlations of principal study variables with safety citizenship behaviour

Variable	Correlation with safety citizenship behaviour, *r*	*p* value
Workplace safety management practices	.335	<.001
Interprofessional collaboration	.413	<.001
Safety consciousness	.395	<.001

Crude multivariable association of organisational factors with safety citizenship behaviour

In a model containing workplace safety management practices and interprofessional collaboration, both variables were positively associated with safety citizenship behaviour. The model explained 18.0% of the variance in safety citizenship behaviour (R^2 = .180; adjusted R^2 = .175; $F(2, 370) = 40.52$, p < .001).

Interprofessional collaboration had the larger standardised association (β = .334, p < .001). Workplace safety management practices showed a smaller positive association (β = .125, p = .039) (Table 4). These findings are crude estimates and will be superseded by the prespecified adjusted model.

Table 4. Crude multivariable linear regression of organisational factors and safety citizenship behaviour (N = 373)

Variable	B	SE	Standardised β	95% CI for B	*p* value
Workplace safety management practices	0.129	0.062	.125	0.007 to 0.251	.039
Interprofessional collaboration	0.986	0.179	.334	0.634 to 1.338	<.001

Outcome: total safety citizenship behaviour score. Model: R^2 = .180; adjusted R^2 = .175; $F(2, 370) = 40.52$; p < .001.

Safety consciousness and safety citizenship behaviour

Safety consciousness was positively associated with safety citizenship behaviour in the unadjusted analysis (r = .395, p < .001). In the original two-predictor individual-factor model, safety consciousness was associated with higher safety citizenship behaviour (B = 1.385, SE = 0.166, β = .399, 95% CI 1.059 to 1.711; p < .001).

The consideration-of-future-safety-consequences variable is not reported in this article because its association with safety citizenship behaviour has already been published using the same survey dataset.

Primary adjusted model

The final primary analysis must report the simultaneous association of workplace safety management practices, interprofessional collaboration, and safety consciousness with safety citizenship behaviour after adjustment for age, sex, profession, total professional experience, and hospital affiliation. Profession and hospital must be entered as categorical variables, and hospital must be modelled as a fixed effect.

Primary adjusted analysis of safety citizenship behaviour

All 373 participants had complete item-level data for the primary study variables. Internal consistency was acceptable to excellent for safety citizenship behaviour (Cronbach's α = .931), workplace safety management practices (α = .956), interprofessional collaboration (α = .912), and safety consciousness (α = .862).

Safety citizenship behaviour was positively correlated with workplace safety management practices ($r = .335$, $p < .001$), interprofessional collaboration ($r = .413$, $p < .001$), and safety consciousness ($r = .395$, $p < .001$). A multivariable linear regression model examined the associations of workplace safety management practices, interprofessional collaboration, and safety consciousness with safety citizenship behaviour after adjustment for age, sex, profession, educational qualification, total professional experience, and hospital affiliation. Doctor, male sex, diploma qualification, age <30 years, professional experience <5 years, and Hospital A were used as reference categories. Doctoral-degree respondents were combined with postgraduate respondents because only two participants had doctoral qualifications.

The adjusted model explained 33.6% of the variance in safety citizenship behaviour ($R^2 = .336$; adjusted $R^2 = .305$; residual standard error = 9.47). Multicollinearity was acceptable, with variance inflation factors ranging from 1.25 to 4.51. Robust heteroscedasticity-consistent (HC3) standard errors were used for confidence intervals and p values.

Higher interprofessional collaboration was independently associated with higher safety citizenship behaviour (B = 0.695, 95% CI 0.205–1.185; standardised β = .235; p = .006). Safety consciousness was also independently associated with higher safety citizenship behaviour (B = 0.665, 95% CI 0.141–1.189; standardised β = .192; p = .013). In contrast, workplace safety management practices were not independently associated with safety citizenship behaviour after adjustment (B = 0.082, 95% CI −0.061 to 0.225; p = .260). Compared with doctors, nurses had higher adjusted safety citizenship behaviour scores (B = 8.447, 95% CI 1.616–15.279; p = .016). Participants in Hospital D had lower adjusted scores than those in Hospital A (B = −6.561, 95% CI −10.039 to −3.083; p < .001). No other demographic or professional covariate showed a statistically significant adjusted association with safety citizenship behaviour.

Table 5. Adjusted linear regression model for safety citizenship behaviour (N = 373)

Variable	Adjusted B	Robust SE	Standardised β	95% CI for B	p value
Primary explanatory variables					
Workplace safety management practices	0.082	0.073	.080	−0.061 to 0.225	.260
Interprofessional collaboration	0.695	0.249	.235	0.205 to 1.185	.006
Safety consciousness	0.665	0.266	.192	0.141 to 1.189	.013
Age					
31–40 years vs <30 years	0.301	1.635	—	−2.915 to 3.517	.854
41–50 years vs <30 years	−2.021	2.798	—	−7.523 to 3.481	.471
>50 years vs <30 years	3.366	3.056	—	−2.644 to 9.376	.272
Female vs male	−1.776	2.248	—	−6.198 to 2.645	.430
Profession					

Nurse vs doctor	8.447	3.474	—	1.616 to 15.279	.016
Paramedical professional vs doctor	3.775	3.513	—	−3.134 to 10.684	.283
Educational qualification					
Undergraduate degree vs diploma	−2.497	1.347	—	−5.146 to 0.152	.065
Postgraduate/doctoral degree vs diploma	−3.451	2.327	—	−8.029 to 1.126	.139
Total professional experience					
5–10 years vs <5 years	2.958	1.710	—	−0.405 to 6.320	.085
10–15 years vs <5 years	0.423	2.142	—	−3.790 to 4.637	.844
>15 years vs <5 years	0.064	2.531	—	−4.914 to 5.042	.980
Hospital					
Hospital B vs Hospital A	−0.296	1.244	—	−2.742 to 2.150	.812
Hospital C vs Hospital A	1.540	1.349	—	−1.112 to 4.193	.254
Hospital D vs Hospital A	−6.561	1.769	—	−10.039 to −3.083	<.001

Outcome: total safety citizenship behaviour score. Adjusted R^2 = .305. Robust HC3 standard errors were used. Dashes indicate that standardised coefficients were not calculated for categorical variables.

DISCUSSION

This multicentre cross-sectional study examined the associations of workplace safety management practices, interprofessional collaboration, and safety consciousness with safety citizenship behaviour among 373 healthcare professionals working in four cooperative hospitals in northern Kerala, India. Three principal findings emerged. First, all three explanatory variables were positively correlated with safety citizenship behaviour in the unadjusted analyses. Second, interprofessional collaboration and safety consciousness remained independently associated with safety citizenship behaviour after adjustment for demographic, professional, and hospital-related characteristics. Third, workplace safety management practices were not independently associated with the outcome in the adjusted model. Collectively, these findings indicate that safety citizenship behaviour may be related to both the organisational environment and the collaborative and individual factors through which healthcare professionals engage in safety-related activities.

The mean safety citizenship behaviour score was 87.72 (SD 11.36) out of 100, and 87.4% of participants were classified in the study-specific upper category. The mean scores for workplace safety management practices, interprofessional collaboration, and safety consciousness were also relatively high. These findings indicate generally favourable self-reported perceptions and behaviours among the participating healthcare professionals. However, the high scores should be interpreted cautiously because the upper-category thresholds were study-specific rather than validated cut-offs. Social-desirability bias, retrospective recall, and the concentration of responses towards the upper ends of the scales may also have influenced the results.

Interprofessional collaboration demonstrated the strongest unadjusted correlation with safety citizenship behaviour ($r = 0.413$, $p < 0.001$). It also remained independently associated with the outcome in the adjusted regression model ($B = 0.695$, 95% CI 0.205–1.185; standardised $\beta = 0.235$; $p = 0.006$). This finding suggests that healthcare professionals reporting stronger collaboration also tended to report greater voluntary involvement in safety-related activities, even after accounting for the other variables included in the model.

This result is consistent with previous research highlighting the relationship between interprofessional collaboration and hospital safety. Ishii et al. [5] examined 1,495 healthcare workers and found that interprofessional collaboration mediated the relationship between organisational learning and selected dimensions of safety climate, particularly improvement and patient/family involvement. Similarly, Kida et al. [11] reported that interprofessional team collaboration was associated with patient safety climate and partially mediated the relationship between workplace social capital and safety climate. These studies provide complementary evidence that collaborative working environments may facilitate safety-related communication, shared

responsibility, and collective improvement.

Evidence from the COVID-19 period further supports the relevance of teamwork in healthcare settings. In a study involving approximately 50,000 healthcare workers across three US health systems, teamwork climate declined during the first year of the pandemic, and changes in teamwork climate were closely associated with changes in other organisational culture and workforce well-being measures [12]. Schmidt et al. [13] also reported that interprofessional team training was associated with improvements in selected communication practices and highlighted the influence of organisational safety culture on the transfer of communication skills into clinical practice.

The positive association observed in the present study may reflect several complementary processes. Effective collaboration can facilitate timely exchange of safety information, clarification of professional responsibilities, recognition of emerging hazards, and assistance to colleagues facing unsafe situations. These processes are relevant to safety citizenship behaviour, which includes activities such as raising safety concerns, helping colleagues, and participating in safety improvement beyond minimum job requirements.

Nevertheless, the current findings should not be interpreted as evidence that collaboration causes greater safety citizenship behaviour. The cross-sectional design does not establish temporal direction, and both variables were measured through self-reported questionnaires. Healthcare professionals who are already strongly committed to safety may perceive their teams more favourably, while supportive leadership or other unmeasured organisational characteristics may influence both collaboration and safety citizenship behaviour. Longitudinal and intervention studies are needed to determine whether improvements in collaboration lead to measurable changes in voluntary safety-related actions.

Safety consciousness was positively correlated with safety citizenship behaviour ($r = 0.395$, $p < 0.001$) and remained independently associated with the outcome after adjustment (B = 0.665, 95% CI 0.141–1.189; standardised $\beta = 0.192$; $p = 0.013$). This finding indicates that greater reported awareness of workplace hazards, attention to safety procedures, and personal commitment to maintaining a safe environment were associated with higher safety citizenship behaviour scores.

The result is consistent with the broader literature on safety climate, safety attitudes, and safety participation. Seo and Lee [2] reported that patient safety knowledge and motivation contributed to the relationship between safety climate and nurses' patient safety behaviours. Similarly, Al Faqeeh et al. [3] identified relationships between safety climate, safety attitudes, and safety behaviour among healthcare professionals in Abu Dhabi. Although these studies examined related but distinct constructs, they support the proposition that individual-level knowledge, attitudes, and motivation are relevant to the translation of safety expectations into behaviour.

A further comparison can be made with the study by Er and Gül [8], which examined the influence of teamwork and safety climate on nurses' willingness to speak up about patient safety concerns and unprofessional behaviours. Speaking up represents an important safety-related action because it allows healthcare professionals to communicate concerns that may otherwise remain unaddressed. The positive association between safety consciousness and safety citizenship behaviour in the present study is compatible with this evidence, although speaking-up climate and overall safety citizenship behaviour are not interchangeable outcomes.

The independent association observed in the current study suggests that individual safety awareness may contribute information beyond the organisational and collaborative variables included in the regression model. In practice, structured hazard-recognition training, regular safety briefings, feedback on incident reports, and opportunities to discuss unsafe conditions may help reinforce safety awareness. However, these approaches should be evaluated through appropriately designed intervention studies rather than assumed to be effective on the basis of cross-sectional associations alone.

Importantly, safety consciousness should not be treated as a substitute for adequate staffing, protective equipment, appropriate training, or effective management. Healthcare professionals cannot always prevent harm when hazards arise from insufficient resources, excessive workloads, or unsafe organisational systems. A balanced approach should therefore address individual awareness alongside the working conditions that enable healthcare professionals to act on safety concerns.

Workplace safety management practices were positively correlated with safety citizenship behaviour in the unadjusted analysis ($r = 0.335$, $p < 0.001$). They also showed a statistically significant association in the crude multivariable model (B = 0.129, SE = 0.062; standardised $\beta = 0.125$; $p = 0.039$). However, this association was attenuated in the adjusted model and was no longer statistically significant (B = 0.082, 95% CI −0.061 to 0.225; $p = 0.260$).

This difference between the crude and adjusted findings is important. The unadjusted association indicates that more favourable perceptions of workplace safety management practices were related to higher safety citizenship behaviour scores. However, the adjusted coefficient represents the association remaining after accounting for interprofessional collaboration, safety consciousness, and the other variables included in the model. The confidence interval included zero, and the p value exceeded the prespecified significance threshold. Therefore, the present study did not establish an independent association between workplace safety management practices and safety citizenship behaviour after adjustment.

One possible explanation is the overlap between perceived safety management practices and other organisational or individual characteristics. In the present study, workplace safety management practices and interprofessional collaboration were moderately correlated ($r = 0.628$, $p < 0.001$). This relationship suggests that professionals who perceive their hospitals as having stronger safety management practices may also perceive communication and teamwork more favourably. When these correlated variables are included simultaneously in a regression model, the estimated coefficient for each reflects its association with the outcome conditional on the other included variables. Consequently, the adjusted association of workplace safety management practices may be smaller than its unadjusted association.

However, the nonsignificant adjusted coefficient does not establish that safety management practices are unimportant. Vu et al. [1] reported an association between perceived workplace safety management practices and organisational citizenship behaviour during the COVID-19 pandemic. Hessels et al. [4] also examined relationships between patient safety climate, adherence to standard precautions, and healthcare worker and patient outcomes. These studies support the relevance of the organisational safety environment, although their outcomes and analytical approaches differ from those used in the present study.

Another possible explanation is that formal safety arrangements may provide the foundation for safe practice without being sufficient, by themselves, to encourage discretionary safety participation. Policies, training, protective equipment, and reporting systems may need to be accompanied by effective communication, supportive leadership, and individual engagement to encourage employees to act beyond their minimum prescribed responsibilities. This interpretation is plausible but was not directly tested in the current study.

Accordingly, hospital administrators should not interpret the nonsignificant adjusted result as a reason to reduce investment in safety management. Instead, the finding suggests that future research should examine how safety management practices interact with workplace relationships, psychological safety, leadership, and individual safety awareness. Longitudinal designs could help establish whether changes in organisational safety arrangements precede improvements in safety citizenship behaviour and identify the pathways through which these changes may occur.

Safety compliance had a mean score of 59.83 (SD 5.25) out of a possible 65, and 94.9% of participants were classified as having high compliance. Safety citizenship behaviour was also high, with 87.4% of participants falling within the study-specific upper category. These results indicate that participants reported frequent adherence to prescribed safety procedures alongside voluntary safety-supportive activities during the pandemic period.

Despite their relationship, safety compliance and safety citizenship behaviour represent distinct dimensions of safety performance. Compliance concerns adherence to required procedures, whereas citizenship behaviour includes discretionary actions such as reporting hazards, assisting colleagues, suggesting safer practices, and contributing to safety improvement. A healthcare professional may follow established procedures consistently without necessarily engaging in additional safety initiatives. Conversely, an employee may actively identify and report hazards while working in an environment where organisational barriers limit the implementation of corrective actions.

The high compliance scores also suggest a potential ceiling effect, with relatively limited variability between participants. This supports the decision to report safety compliance descriptively rather than use it as the primary regression outcome. When most respondents report scores close to the upper end of a scale, the measure may have limited ability to discriminate between individuals or detect associations with other variables.

Previous studies have demonstrated the relevance of organisational safety perceptions to compliance with infection-prevention practices. Hessels et al. [4] examined the relationships between patient safety climate, standard-precaution adherence, occupational exposures, and healthcare-associated infections. Berdida and Grande [9] also investigated relationships between nurses' safety climate, quality of care, and adherence to standard precautions. These studies provide relevant context for understanding the importance of safety environments, although direct numerical comparison is inappropriate because the

instruments, populations, and outcomes differ.

Furthermore, the high scores in the present study represent recalled self-reported behaviour rather than independently observed compliance. They should not be interpreted as evidence that all participants consistently followed every safety procedure throughout the pandemic. Future studies could combine questionnaire-based measures with direct observation, incident-reporting data, or documented adherence to infection-prevention protocols to provide a more comprehensive assessment of safety performance.

The adjusted model identified two additional statistically significant associations. Nurses had higher safety citizenship behaviour scores than doctors (B = 8.447, 95% CI 1.616–15.279; p = 0.016), while participants from Hospital D had lower scores than those from Hospital A (B = −6.561, 95% CI −10.039 to −3.083; p < 0.001).

The higher adjusted scores among nurses should be interpreted in the context of the sample composition. Nurses constituted 80.2% of participants, whereas doctors represented only 7.2%. Differences in daily responsibilities, opportunities for interprofessional communication, exposure to institutional safety procedures, and professional expectations may contribute to differences in reported safety citizenship behaviour. However, these potential explanations were not directly assessed in the present study.

The relatively small number of doctors also warrants caution when interpreting comparisons involving this reference category. The observed difference should not be taken to mean that nurses are inherently more committed to safety than doctors. Rather, it identifies a difference in adjusted self-reported scores within this particular sample, which requires replication in studies with more balanced professional representation.

The difference between Hospital D and Hospital A similarly suggests that safety citizenship behaviour may vary across institutions. Potential explanations include differences in leadership practices, staffing adequacy, communication systems, safety training, reporting procedures, or working conditions. These are hypotheses rather than demonstrated explanations because the study did not directly assess the hospital-level characteristics necessary to identify the mechanisms responsible for the difference.

Research involving healthcare workers during the COVID-19 pandemic has shown that teamwork climate and organisational safety culture can vary between facilities and are associated with other workplace outcomes [12]. Kida et al. [14] also reported associations between collaborative leadership, interprofessional collaboration, workplace social capital, and patient safety climate. Such findings support the relevance of organisational context when interpreting hospital-level differences. Nevertheless, the present study included only four hospitals, so the observed institutional differences should be interpreted as findings specific to the participating hospitals rather than evidence of systematic differences across all cooperative hospitals in Kerala.

An important strength of this study is its inclusion of 373 healthcare professionals from four multispecialty cooperative hospitals. The multidisciplinary sample enabled the investigation of organisational and individual correlates of safety citizenship behaviour among doctors, nurses, and paramedical professionals. The study also examined three principal explanatory variables simultaneously, allowing their adjusted associations to be distinguished from their unadjusted relationships with the outcome.

The internal consistency of the principal scales was satisfactory to excellent. Cronbach's alpha values were 0.931 for safety citizenship behaviour, 0.956 for workplace safety management practices, 0.912 for interprofessional collaboration, and 0.862 for safety consciousness. These values indicate satisfactory internal consistency in the study sample, although internal consistency alone does not establish the construct validity or cross-cultural validity of the modified instruments.

Several limitations should be acknowledged. First, the cross-sectional design prevents conclusions about causality or temporal direction. Although interprofessional collaboration and safety consciousness were independently associated with safety citizenship behaviour, the study cannot establish whether these factors preceded the reported behaviours.

Second, data collection occurred between June 2024 and August 2025, while participants retrospectively reported their experiences during the acute COVID-19 period. Recall bias may have affected the accuracy of responses, particularly for behaviours and workplace experiences that occurred several years before data collection. The findings should therefore be interpreted as associations with recalled pandemic-period experiences rather than contemporaneous measurements of behaviour during the pandemic.

Third, purposive, non-probability sampling was used to recruit participants from four cooperative hospitals in northern Kerala.

The findings may not be generalisable to government hospitals, private hospitals, primary-care facilities, or healthcare systems in other regions of India. The sample was also predominantly composed of nurses, which limits the precision and generalisability of comparisons between professional groups.

Fourth, the study relied on self-reported measures collected using the same questionnaire. Social-desirability bias and common-method variance may have inflated the observed correlations between the explanatory variables and safety citizenship behaviour. The use of modified measurement instruments also means that their psychometric properties should be further evaluated in independent healthcare populations.

Fifth, although the adjusted model explained 33.6% of the variance in safety citizenship behaviour ($R^2 = 0.336$; adjusted $R^2 = 0.305$), a substantial proportion of the variance remained unexplained. Other potentially relevant factors, including leadership behaviour, psychological safety, workload, staffing levels, burnout, and access to safety resources, were not comprehensively assessed. Finally, the small number of participating hospitals limited the ability to assess hospital-level contextual factors in depth.

The findings suggest that initiatives intended to strengthen safety citizenship behaviour should consider both individual and team-level factors. Hospitals could consider structured interprofessional safety briefings, multidisciplinary incident reviews, collaborative problem-solving sessions, and mechanisms that enable healthcare professionals to raise concerns without fear of blame or retaliation. Safety-awareness activities could also focus on hazard recognition, timely reporting, and the responsibilities of individual professionals in maintaining a safe working environment.

These approaches should complement, rather than replace, adequate staffing, appropriate protective equipment, accessible safety reporting systems, and visible management commitment. The nonsignificant adjusted association for workplace safety management practices does not establish that organisational systems are ineffective. Instead, it highlights the need to examine how formal safety arrangements operate alongside collaboration and safety consciousness.

The observed differences between hospitals also suggest that local assessments may help identify areas where additional support is required. However, the current findings do not establish which specific hospital interventions would be most effective. Future research should examine these questions through prospective multicentre studies and intervention-based designs.

Longitudinal studies could determine whether changes in interprofessional collaboration and safety consciousness precede changes in safety citizenship behaviour. Research across government, private, and cooperative hospitals would improve the generalisability of the findings. In addition, future studies should consider validated measures of psychological safety, leadership, workload, and organisational safety culture, alongside objective indicators such as incident reports, observed safety practices, and documented adherence to safety protocols. Such approaches could clarify the mechanisms underlying the observed associations and determine whether improvements in self-reported safety citizenship behaviour translate into measurable improvements in occupational and patient safety.

CONCLUSION

In this multicentre cross-sectional study, interprofessional collaboration and safety consciousness were independently associated with safety citizenship behaviour among healthcare professionals working in cooperative hospitals in northern Kerala, India. Workplace safety management practices showed a positive unadjusted association but were not independently associated with the outcome after adjustment for the variables included in the model. Nurses reported higher adjusted safety citizenship behaviour scores than doctors, while participants from Hospital D reported lower scores than those from Hospital A.

These findings suggest that safety citizenship behaviour should be considered in relation to both the organisational environment and the collaborative and individual factors that support voluntary safety-related actions. Hospitals may benefit from strengthening interprofessional communication and safety awareness while maintaining effective safety-management systems. Because the study was cross-sectional and relied on retrospective self-reported data, longitudinal and intervention-based research is required to establish temporal relationships, assess generalisability, and determine whether targeted improvements in these factors produce sustained changes in safety citizenship behaviour.

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