

BMJ Open Perception of safety climate among nursing staff in operating rooms in Slovenia: a cross-sectional analytical study

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ABSTRACT

Objectives (1) To determine the perceived level of safety climate among nursing staff in operating rooms (ORs) in Slovenia; (2) to investigate correlations and differences between professional position, length of service, healthcare level and perceived safety climate and (3) to identify independent predictors of overall and domain-specific safety climate perceptions.

Design A cross-sectional non-experimental quantitative analytical study.

Setting Surgical departments in 14 hospitals across Slovenia between June 2024 and November 2024.

Participants A total of 169 OR and anaesthesia nurses employed in surgical departments with a minimum of 1 year of work experience.

Measures Self-reported perceived safety climate in the OR using the Slovenian version of the Safety Attitudes Questionnaire–OR (SAQ-OR).

Results Positive attitudes towards safety varied substantially across the SAQ-OR domains. The lowest proportion of positive responses was found in Perceptions of Management (7.7%; mean=45.89, 95% CI (42.92 to 48.87)), while the highest was recorded in Job Satisfaction (57.4%; mean=75.24, 95% CI (72.86 to 77.62)). OR nurses reported a more positive overall safety climate than anaesthesia nurses (mean difference=0.21, 95% CI (0.07 to 0.35)). Regression analyses identified the following independent predictors: professional nursing role for the global SAQ-OR score ($\beta=-0.21$, $p=0.007$) and institutional tenure for Stress Recognition ($\beta=-0.23$, $p=0.004$). The Perceptions of Management domain was predicted by professional role ($\beta=-0.17$, $p=0.033$) and institutional tenure as a positive driver ($\beta=0.16$, $p=0.041$).

Conclusions The safety climate among nursing staff working in Slovenian ORs was perceived as moderately positive, with notable variation across SAQ-OR domains and professional groups. Professional role and institutional tenure were identified as independent predictors of safety climate perceptions.

BACKGROUND

Patient safety is of paramount importance in contemporary healthcare systems, particularly in high-stakes operating room (OR) environments. ORs are dynamic settings characterised by advanced technology, complex

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This nationwide cross-sectional study included operating room (OR) and anaesthesia nurses from secondary and tertiary hospitals across Slovenia, supporting the representativeness of the nursing sample.
- ⇒ The use of the validated Slovenian version of the Safety Attitudes Questionnaire–OR enhances methodological rigour and allows international comparability.
- ⇒ The cross-sectional design captures safety climate perceptions at a single point in time and does not permit causal inference.
- ⇒ Data were collected using self-reported questionnaires, which may be subject to response bias, social desirability bias and individual interpretation of items.
- ⇒ The study focused exclusively on nursing staff and did not include other key OR professionals, limiting the assessment of interprofessional safety climate.

procedures, multidisciplinary teams and a heightened risk of adverse events.¹ Developing a robust safety culture is, therefore, imperative for ensuring the delivery of high-quality care and minimising patient harm.

The broader concept of safety culture encompasses the fundamental values, norms and behaviours that influence the prioritisation and implementation of safety measures within an organisation. In contrast, safety climate refers to more surface-level, measurable perceptions and attitudes towards safety practices held by staff.² This distinction becomes particularly relevant when examining the context of nursing staff working in ORs, as it helps distinguish between the foundational organisational ethos and the front-line perceptions that shape daily practices.

OR nurses and anaesthesia nurses play a central role in maintaining patient safety throughout the perioperative process.¹ Previous studies indicate that safety climate

perceptions may be influenced by professional role, age, work experience and organisational context; however, findings remain inconsistent across healthcare systems and settings.^{3,4} However, empirical evidence from Central and Eastern European countries remains scarce, and little is known about how these specific professional and institutional determinants interact to shape safety climate perceptions among OR nursing personnel within the Slovenian healthcare system.

In Slovenia, inpatient surgical care is provided at both secondary and tertiary healthcare levels. Secondary-level healthcare includes general and specialised hospitals offering specialist diagnostic and treatment services, while tertiary-level healthcare is delivered mainly by university medical centres, which provide highly specialised clinical services as well as educational and research activities.⁵ These differences may influence safety climate perceptions among OR personnel.^{2,3}

The Safety Attitudes Questionnaire (SAQ) is one of the most widely used instruments for assessing safety climate in healthcare.⁶ It is based on Vincent's framework for analysing clinical risk⁷ and Donabedian's structure-process-outcome model of healthcare quality.⁸ The OR-specific version (Safety Attitudes Questionnaire-OR (SAQ-OR)) retains the original domains while incorporating contextual adaptations relevant to perioperative practice.⁹ The Slovenian version of the SAQ-OR has demonstrated good psychometric properties among OR professionals.²

Given the limited evidence from Slovenia, this study aims to assess the safety climate among OR nursing personnel and identify professional and institutional factors associated with safety climate perceptions. Its findings may inform future interventions and organisational strategies to improve patient safety and staff well-being.

The objectives of the study are as follows:

1. To determine the perceived level of safety climate among nursing staff in ORs in Slovenia.
2. To examine correlations and differences between professional position, length of service, healthcare level and perceived safety climate.
3. To identify the independent predictors of overall and domain-specific safety climate perceptions among nursing staff in ORs in Slovenia.

Systematic investigation of these organisational dynamics within the perioperative environment was guided by the following research hypotheses:

H1: there is a significant difference in perceptions of the overall safety climate between the two primary professional nursing roles within the surgical team (OR nurses and anaesthesia nurses).

H2: length of service at the current institution negatively predicts Stress Recognition among nursing staff.

H3: length of service at the current institution positively predicts Perceptions of Management among nursing staff.

METHODS

Setting and participants

A cross-sectional, non-experimental, quantitative analytical study was conducted using an online questionnaire between June 2024 and November 2024. Using criterion purposive sampling,¹⁰ recruitment was restricted to OR and anaesthesia nurses employed in surgical departments. A minimum of 1 year of tenure was required to ensure sufficient socialisation and exposure to the institution's safety culture.

In June 2024, emails containing the survey link, study objectives and a request for distribution were sent to nurse managers of surgical departments in all 14 public hospitals providing acute surgical care in Slovenia (constituting a national census of the target setting: 9 general hospitals, 2 university medical centres and 3 specialised hospitals), as well as to the Section of OR Nurses and the Section of Nurses in Anaesthesiology, Intensive Care and Transfusion Medicine (both operating under the Nurses and Midwives Association of Slovenia), specifically targeting nursing personnel whose practice is situated within OR and anaesthesia environments. Email addresses were obtained from hospital and professional association websites. To safeguard anonymity within Slovenia's small and closely interconnected healthcare system, participating hospitals are not named; survey links were distributed via surgical department nurse managers and professional association coordinators. As the link was distributed indirectly through these channels rather than a centralised roster, the exact number of recipients could not be tracked, preventing the calculation of traditional response rates.

The study was reported in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines.¹¹

Instrument

Data were collected using the SAQ-OR instrument. Originally developed by Sexton *et al*,⁶ the tool was adapted by Göras *et al*⁹ to evaluate surgical environments. For this study, we used the linguistically and psychometrically validated Slovenian version of the SAQ-OR,² translated from the established English protocol with appropriate permissions obtained from the authors. The SAQ-OR comprises 28 items across 6 safety climate domains: Teamwork Climate, Safety Climate, Job Satisfaction, Stress Recognition, Perceptions of Management and Working Conditions. Items are scored on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

Following standard protocols, domain and global composite scores were calculated as item means and transformed to a 0–100 scale.^{3,4,12–14} Scores ≥ 75 indicate positive safety attitudes.^{3,14} For item-level descriptive analysis, ratings of 4 or 5 (≥ 75 on the transformed scale) were classified as reflecting positive attitudes towards a given safety domain among OR staff.^{14,15} The final section of the questionnaire addressed sociodemographic and institutional attributes (gender, age, education, role, healthcare level

and tenure); specific hospital identifiers were omitted to protect anonymity.

Data analysis

Prior to data analysis, the dataset was examined for missing or inconsistent values. Surveys with incomplete responses to core SAQ-OR items were excluded, whereas cases missing only sociodemographic data (eg, age or tenure) were retained. The data analysis was conducted using IBM SPSS Statistics V.29.0 and Microsoft Excel for Microsoft 365 MSO (V.2508). Descriptive statistics included frequencies, percentages, means, SD, medians, IQRs, minimum, maximum, skewness and kurtosis.

Normality of the data distribution was assessed using Z-scores for skewness (Z_{skew}) and kurtosis (Z_{kurt}), calculated by dividing the values by their respective SEs. Based on our sample size ($n=169$), absolute Z-scores >3.29 were used as the criterion for distributions deviating from normality.¹⁶

Associations between variables were assessed using Pearson's correlation coefficients. To obtain 95% CIs, a bootstrap procedure with 1000 resamples was applied. To determine whether the mean scores of the SAQ-OR domains differed from the neutral reference point of 3, one-sample t-tests were conducted. Comparisons between independent groups were performed using the independent samples t-test and Mann-Whitney U test. Simultaneous multiple linear regression analysis was conducted to identify independent predictors of the global SAQ-OR score, Stress Recognition and Perceptions of Management. Predictors included professional role (0=OR nurse and 1=anaesthesia nurse), healthcare level (0=secondary and 1=tertiary) and institutional tenure (years of service at the current institution). Model assumptions were verified using collinearity diagnostics (tolerance and variance inflation factor (VIF)) and the Durbin-Watson statistic. A significance level of $\alpha=0.05$ was applied to all statistical tests. Effect sizes were interpreted according to Cohen's guidelines,¹⁷ where values of approximately 0.20, 0.50 and 0.80 correspond to small, medium and large effects, respectively.

RESULTS

Participants

Table 1 presents participants' demographic and professional characteristics. The study included 145 women (85.8%) and 24 men (14.2%), for a total of 169 participants. For the age variable ($n=167$), the mean was 40.4 years, ranging from 23 to 62 years. Regarding tenure, the mean length of service at the current healthcare institution ($n=161$) was 16.7 years ($SD=10.5$), ranging from 1 to 41 years, while the mean length of service in the current position ($n=156$) was 14.4 years ($SD=9.5$), ranging from 1 to 40 years. Most participants (113, 66.9%) held a bachelor's degree (first cycle of the Bologna Process) and were employed at the tertiary healthcare level (100, 59.2%).

Table 1 Participants' demographic and professional characteristics

Variable	Value	N (%)
Gender	Men	24 (14.2)
	Women	145 (85.8)
Level of education	Vocational training	6 (3.6)
	Higher vocational programme	15 (8.9)
	Bachelor's degree (first cycle of the Bologna Process)	113 (66.9)
	Master's degree (second cycle of the Bologna Process)	33 (19.5)
Professional position	Master of Science	2 (1.2)
	OR nurse	112 (66.3)
Healthcare level	Anaesthesia nurse	57 (33.7)
	Secondary	69 (40.8)
	Tertiary	100 (59.2)

N (%), number of participants and percentage in each category; OR, operating room.

The most common professional position was OR nurse (112, 66.3%).

Perceived level of safety climate and positive attitudes towards safety

Supplementary materials table 1 presents the descriptive statistics for the items in the SAQ-OR, and table 2 summarises the domain-level and global SAQ-OR scores on a 100-point scale. The percentage of respondents reporting positive attitudes towards safety ranged from 7.7% for the Perceptions of Management domain, with a mean of 45.89 (95% CI (42.92 to 48.87)), to 57.4% for the Job Satisfaction domain, with a mean of 75.24 (95% CI (72.86 to 77.62)). Job Satisfaction was, therefore, the most positively evaluated domain in terms of safety climate, in contrast to Perceptions of Management, which received the lowest scores.

When examining positive responses at the item level (supplementary material table 1), the proportions were generally higher than the domain-level positive scores. In the Job Satisfaction domain, perceived as having the strongest safety climate, the item with the highest mean (4.45, $SD=0.63$) and percentage of positive responses (94.1%) was '*I like my job*'. In the Perceptions of Management domain, perceived as having the weakest safety climate, the item with the lowest mean (2.60, $SD=0.98$) and percentage of positive responses (14.8%) was '*Hospital management supports my daily efforts*'.

Supplementary material table 2 presents the descriptive statistics for the SAQ-OR domain composite scores and the results of one-sample t-tests comparing the SAQ-OR domain composite score means with the neutral reference value of 3. The Job Satisfaction domain had the highest mean score ($M=4.01$, $SD=0.63$), while Perceptions of Management had the lowest ($M=2.84$, $SD=0.78$). The results show that the mean score was statistically

Table 2 Domain-level and global SAQ-OR scores with 95% CIs and percentage of respondents reporting positive attitudes (≥ 75) on the 100-point scale (n=169)

Domain	N (%)	M	95% CI
Teamwork Climate	67 (39.6)	67.22	64.75 to 69.68
Safety Climate	50 (29.6)	64.23	61.70 to 66.75
Job Satisfaction	97 (57.4)	75.24	72.86 to 77.62
Stress Recognition	69 (40.8)	64.72	61.18 to 68.26
Perceptions of Management	13 (7.7)	45.89	42.92 to 48.87
Working Conditions	29 (17.2)	57.95	55.46 to 60.44
Global score	22 (13.0)	63.28	61.58 to 64.98

M, mean score on the 100-point scale; N (%), number and percentage of respondents who had positive attitudes towards safety (≥ 75 on the 0–100 scale); SAQ-OR, Safety Attitudes Questionnaire–Operating Room.

significantly higher than the test value of 3 in the following domains: Teamwork Climate, Safety Climate, Job Satisfaction, Stress Recognition and Working Conditions. The mean score was statistically significantly lower than the test value in the Perceptions of Management domain. Calculated effect sizes (Cohen's d) were large for the Teamwork Climate, Safety Climate and Job Satisfaction domains; medium for the Stress Recognition and Working Conditions domains and small for the Perceptions of Management domain.

Associations between SAQ-OR domains

Table 3 presents Pearson's correlation coefficients among SAQ-OR domains with 95% CIs. Statistically significant correlations were detected between most SAQ-OR domains, with absolute coefficient values ranging from $r=0.20$ to $r=0.69$ and $p<0.05$ or $p<0.01$. Notably, Teamwork Climate demonstrated a statistically significant positive correlation with Safety Climate and a statistically significant negative correlation with Stress Recognition.

Associations with the perceived level of safety climate

Table 4 presents Pearson's correlation coefficients examining the associations between SAQ-OR domain composite scores and length of service, both at the current institution and in the current position. Length of service at the current institution showed a statistically significant negative correlation with Stress Recognition, and a statistically significant positive correlation with Perceptions of Management.

Differences in the perceived level of safety climate

Independent-samples t-test results showed that the global perceived level of safety climate mean score for the OR nurse group ($M=3.60$, $SD=0.44$) was statistically significantly different from that of the anaesthesia nurse

Table 3 Pearson's correlation coefficients among SAQ-OR domains with 95% CIs (n=154)

Domain	1	2	3	4	5	6
1. Teamwork Climate	–					
2. Safety Climate	0.69** (0.60 to 0.76)	–				
3. Job Satisfaction	0.58** (0.46 to 0.68)	0.52** (0.4 to 0.63)	–			
4. Stress Recognition	–0.25** (–0.41 to –0.08)	–0.20* (–0.36 to –0.06)	–0.20* (–0.34 to –0.04)	–		
5. Perceptions of Management	0.46** (0.33 to 0.59)	0.51** (0.38 to 0.63)	0.31** (0.17 to 0.45)	–0.08 (–0.26 to 0.09)	–	
6. Working Conditions	0.50** (0.38 to 0.61)	0.64** (0.54 to 0.72)	0.49** (0.37 to 0.60)	–0.11 (–0.27 to 0.05)	0.55** (0.42 to 0.66)	–

The values represent Pearson's correlation coefficients with 95% CIs obtained via bootstrap resampling (1000 samples, bias-corrected and accelerated method). * $p<0.05$; ** $p<0.01$.
SAQ-OR, Safety Attitudes Questionnaire–Operating Room.

Table 4 Correlations between the SAQ-OR domain composite scores and length of service (n=154)

Domain	Length of service at the current institution			Length of service in the current position		
	r	p	95% bootstrap CI for r	r	p	95% bootstrap CI for r
Teamwork Climate	0.10	0.202	−0.06 to 0.27	0.03	0.677	−0.14 to 0.21
Safety Climate	0.10	0.232	−0.07 to 0.28	−0.02	0.801	−0.19 to 0.17
Job Satisfaction	0.09	0.243	−0.07 to 0.25	0.03	0.736	−0.14 to 0.20
Stress Recognition	−0.19	0.015*	−0.33 to −0.04	−0.12	0.137	−0.26 to 0.02
Perceptions of Management	0.20	0.011*	0.04 to 0.34	0.10	0.241	−0.03 to 0.22
Working Conditions	0.15	0.071	−0.02 to 0.30	0.03	0.744	−0.16

*p<0.05.
p, p-value; r, Pearson's correlation coefficient; SAQ-OR, Safety Attitudes Questionnaire–Operating Room.

group (M=3.39, SD=0.44), as indicated by the test results ($t(167)=2.98$, $p=0.003$, mean difference=0.21, 95% CI (0.07 to 0.35)), Cohen's $d=0.48$, 95% CI (0.16 to 0.81), indicating a medium and statistically significant effect. Consequently, hypothesis H1—proposing a significant difference in overall safety climate perceptions between OR and anaesthesia nurses—was fully supported.

The Mann-Whitney U test indicated a statistically significant difference between the OR nurse group (median (Me)=3.80, IQR=0.55) and the anaesthesia nurse group (Me=3.60, IQR=0.90) in the Teamwork Climate domain (Mann-Whitney U statistic (U)=2502.5, $p=0.021$). The Hodges-Lehmann estimate of the median difference was 0.20, 95% CI (0.00 to 0.40), indicating lower values in the anaesthesia nurse group.

Supplementary material table 3 presents independent-samples t-test results for the perceived level of safety climate by professional position in the following domains: Safety Climate, Job Satisfaction, Stress Recognition, Perceptions of Management and Working Conditions. OR nurses reported statistically significantly higher mean scores than anaesthesia nurses in two domains: Safety Climate (M=3.67, SD=0.64 vs M=3.37, SD=0.67), indicating a medium effect size; and Perceptions of Management (M=2.93, SD=0.74 vs M=2.65, SD=0.83), indicating a small effect size.

Supplementary material table 4 presents independent-samples t-test results for the perceived level of safety climate by healthcare level in the following domains: Safety Climate, Job Satisfaction, Stress Recognition, Perceptions of Management and Working Conditions. In the Job Satisfaction domain, the secondary healthcare level group reported a statistically significant higher mean score than the tertiary level group (M=4.14, SD=0.64 vs M=3.92, SD=0.60), indicating a small effect size.

Multivariate predictors of safety climate perceptions

To evaluate the independent influence of professional characteristics and institutional context on safety climate perceptions, simultaneous multiple linear regression was conducted across three separate models (supplementary material table 5). Model assumptions were met, showing

independent residuals (Durbin-Watson: 1.66–1.80) and no multicollinearity (tolerance>0.99, VIF<1.01).

The global regression model predicting the global SAQ-OR score was statistically significant, with professional position identified as the sole significant independent predictor. When tenure and healthcare level were held constant, anaesthesia nurses scored significantly lower than OR nurses.

The model predicting Stress Recognition was also statistically significant, with institutional tenure identified as the sole significant predictor. Each additional year of service was associated with a 0.516-point decrease in Stress Recognition domain scores, fully supporting hypothesis H2.

Finally, the model predicting Perceptions of Management was statistically significant, revealing dual effects: anaesthesia nurses held significantly lower opinions of administration than OR nurses, while institutional tenure emerged as a significant positive driver, with each year of service corresponding to a 0.298-point increase in management scores, providing full support for hypothesis H3.

DISCUSSION

The present study examined safety climate perceptions among nursing staff working in Slovenian ORs. Overall, safety climate was rated moderately positively, although substantial differences were observed across SAQ-OR domains and professional groups. The Job Satisfaction domain received the highest ratings, whereas the Perceptions of Management domain received the lowest. Professional position and institutional tenure were the main independent predictors of overall and domain-specific safety climate perceptions.

The Job Satisfaction domain received the most favourable ratings, with over half of respondents reporting positive attitudes. Conversely, the Perceptions of Management domain received the least favourable ratings, with only a small proportion of respondents expressing positive views. Other domains, including Teamwork Climate, Safety Climate, Working Conditions and Stress Recognition,

received moderate evaluations. These findings suggest that OR nursing staff experience a high degree of motivation and place significant value on their work. However, they also perceive deficiencies in the organisational and managerial support for patient safety. This finding is consistent with international research, which consistently identifies Job Satisfaction as the most positively rated domain of the SAQ, while Perceptions of Management are repeatedly the lowest-rated domain.^{3 4 6 18} As demonstrated by Tarling *et al*¹⁹ and Ferreira *et al*,¹ similar findings have been documented in other European contexts. In these cases, intrinsic professional motivation is high, yet organisational leadership is perceived as distant from the realities of frontline work. The lowest scores were recorded in Perceptions of Management, particularly regarding daily support from hospital management, which highlights the persistent gap between frontline staff and leadership. As noted by Nyberg *et al*,³ similar findings have been reported in Sweden, where OR nursing staff expressed considerable dissatisfaction with managerial engagement, despite relatively high levels of satisfaction with their own professional roles.

Intercorrelations between SAQ-OR domains suggest that the dimensions of safety climate are not independent. The findings of the present study demonstrate a positive correlation between higher ratings of Teamwork Climate and more positive perceptions of Safety Climate. Furthermore, our data revealed a negative correlation between higher evaluations of Working Conditions and higher levels of Job Satisfaction. This aligns with previous research demonstrating that teamwork, communication and psychological safety are closely interrelated and constitute the key determinants of safety attitudes and safety climate within perioperative teams.^{18 20 21} Studies have also shown that deficiencies in managerial support can exert cascading effects on various domains.^{18 20 22} The implication is that interventions to strengthen safety culture cannot address each domain in isolation; rather, improvements in management visibility, communication and feedback mechanisms are likely to generate positive effects across the broader safety climate.

Compared with their counterparts in the field of anaesthesia, OR nurses also reported a more positive attitude towards safety. A Turkish study revealed analogous disparities in job satisfaction and overall safety attitudes, with OR nurses demonstrating significantly higher scores than anaesthesia nurses.⁴ A potential explanation for this lies in the distinct professional roles and workflows characteristic of these two sectors. OR nurses are integrated within larger surgical teams, whereas anaesthesia nurses often work in smaller teams or dyads under close supervision and in situations characterised by higher cognitive and procedural demands. These differences in professional roles and working environments are likely to shape perceptions of teamwork, stress recognition and managerial support.²³ Similarly, a recent Danish study demonstrated that safety attitudes vary across professional groups working in ORs and identified the professional role

and organisational context in perioperative settings as important determinants of safety climate.²⁴ Our multiple linear regression models confirmed that professional role remained an independent predictor of overall safety climate and perceptions of management after adjustment for healthcare level and institutional tenure. Even when controlling for other institutional variables, the anaesthesia nurse role remained a significant independent predictor of lower scores on both the global SAQ-OR scale and the Perceptions of Management domain.

Furthermore, a positive correlation was identified between length of service and variations in perceptions of safety climate. In the present study, respondents with more professional experience reported a more positive evaluation of safety climate in specific domains, notably Working Conditions and Perceptions of Management. As indicated by Nyberg *et al*,³ similar associations have been documented in Sweden, where experienced staff reported higher levels of satisfaction with managerial practices and working conditions. This may be due to the fact that experienced staff have developed more effective coping strategies and realistic expectations regarding organisational limitations.^{14 20}

Healthcare level was not retained as an independent predictor in the multivariable models, suggesting that professional role and institutional tenure may have a greater influence on safety climate perceptions. Institutional tenure emerged as an important predictor of safety climate perceptions. Although longer tenure was associated with more favourable perceptions of management, it was also linked to lower Stress Recognition scores. This suggests that experienced staff may become increasingly aligned with organisational processes while simultaneously reporting lower awareness of the impact of stress on performance. Previous findings indicate similar associations between professional maturity and safety attitudes.^{3 25} However, the literature also shows that prolonged exposure to organisational challenges may negatively affect morale and engagement over time, highlighting the importance of providing support and professional development opportunities throughout all career stages.¹⁹

When considered as a whole, these findings emphasise several key points. First, while nursing staff in ORs across Slovenia demonstrate strong job satisfaction and motivation, organisational support—particularly from management—remains a weak point. Second, discrepancies between professional groups, levels of experience and hospital types underscore the necessity for customised strategies. For anaesthesia nurses, targeted interventions aimed at improving teamwork and communication could be particularly beneficial. For less experienced staff, implementing mentorship programmes and structured onboarding initiatives could improve perceptions of the safety climate and accelerate the development of coping strategies.^{26 27} At the organisational level, efforts to enhance the visibility and engagement of hospital leadership, such as leadership walk-rounds, structured feedback

and recognition initiatives, have the potential to improve perceptions of management and, through interdomain correlations, strengthen the overall safety climate.

Limitations and generalisability

This study provides new insights from Slovenia, where research on patient safety climate in ORs has been limited. Using a validated instrument (SAQ-OR) enables direct comparison with international data, and the relatively large, diverse sample offers a useful overview of how professional roles, experience and institutional context shape safety attitudes. Several limitations must be considered. The cross-sectional design prevents causal interpretation and provides only a snapshot of safety climate perceptions at a single point in time. Although the SAQ-OR was originally developed to assess safety climate and evaluate changes following patient safety interventions, this study did not examine temporal changes or intervention effects. The findings, therefore, reflect current attitudes and perceptions but do not permit conclusions about trends over time or the effectiveness of organisational improvement initiatives. In addition, reliance on self-reported data introduces potential bias. The study focused only on nurses and excluded other key OR team members, such as surgeons and anaesthesiologists, whose perspectives are integral to a comprehensive assessment of safety climate. Consequently, the findings primarily reflect nurses' perceptions and should not be interpreted as representative of the safety climate across the entire multidisciplinary OR team. Moreover, small subgroup sizes reduced statistical power, limiting the ability to detect subtle differences. The study also did not investigate whether perceptions of safety climate are associated with actual patient outcomes, a link that would have strengthened its practical relevance. Future longitudinal studies should examine how safety climate evolves over time and whether targeted interventions produce measurable improvements in specific SAQ-OR domains.

By including 14 different hospitals, this study captured a broad institutional footprint across the Slovenian healthcare system, meaning the identified themes likely reflect systemic challenges in the country's perioperative frameworks. However, because the final sample was limited to 169 participants, the generalisability of the absolute score values to the entire national OR nursing workforce should be approached with caution. Furthermore, these findings are specific to the multidisciplinary environment of standard ORs and may not generalise to specialised private clinics or non-OR nursing units. Nationwide, these results serve as a valuable initial benchmark for future, larger-scale safety climate monitoring in Slovenian surgical settings.

Implications for practice and health system improvement

The findings highlight important system-level gaps relevant to perioperative patient safety. Low scores in Perceptions of Management indicate a disconnect between frontline nursing staff and leadership. Enhancing

leadership visibility, improving feedback mechanisms and recognising safety-oriented behaviours may help rebuild trust. Differences between professional groups underline the need for tailored interventions. Anaesthesia nurses, who reported lower teamwork and safety climate scores, may benefit from interprofessional simulation, structured briefings and strengthened communication practices. The association between longer service and more positive views of management suggests that novice nurses require additional organisational support, including structured onboarding, mentorship and peer support.

Nationwide implementation of the SAQ-OR offers a basis for routine monitoring of safety climate in Slovenian ORs. Regular assessments integrated into quality-improvement cycles can support benchmarking, trend observation and evaluation of interventions, contributing to continuous learning.

CONCLUSIONS

Nursing staff working in Slovenian ORs perceived the safety climate as moderately positive, with notable variation across SAQ-OR domains and between professional groups. Job Satisfaction emerged as the highest-rated domain, whereas Perceptions of Management received the lowest ratings. Professional role and institutional tenure were identified as independent predictors of overall and domain-specific safety climate perceptions, while healthcare level was not independently associated with safety climate after adjustment for individual characteristics. These findings contribute to understanding organisational and professional factors associated with safety climate among OR nursing staff in Slovenia.

Contributors IK, MKB and PP were involved in the conceptualisation, investigation, methodology, design and formal analysis of the study. IK and MKB curated the data and secured the necessary resources. IK managed project administration. MKB performed the validation of the findings. PP provided formal supervision, developed the visualisations and oversaw the study's execution. IK, MKB and PP drafted the original manuscript, critically revised the text for important intellectual content and approved the final version to be published. PP acts as the guarantor for this study, accepts full responsibility for the work and the conduct of the study, has access to the data and controls the decision to publish. As English is not the authors' native language, AI was used to check grammar, enhance clarity and improve overall readability.

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Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the ethics committee of the University of Primorska (Ethics Committee No 4264-19-6/23). The study was conducted in accordance with the Code of Ethics for Nursing Care of Slovenia and the guidelines of the Helsinki–Tokyo Declaration. Anonymity and voluntary participation were guaranteed, and participants were informed of their right to withdraw from the study at any point without consequences. All participants provided electronic informed consent prior to accessing the survey. The questionnaire was preceded by an information page requiring participants to actively select either 'I agree and wish to continue filling out the questionnaire' to proceed or 'I do not agree and wish to finish' to immediately terminate the session.

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Data availability statement Data are available upon reasonable request. The dataset analysed in this study is available from the corresponding author on reasonable request.

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