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Educational Level and Length of Work Experience as Predictors of Adverse-Event Reporting and Patient-Safety Perception Among Nurses in Croatian General and County Hospitals: A National Cross-Sectional Study

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Abstract

Background/Objectives: Two sociodemographic characteristics of the nursing workforce — formal level of education and length of professional experience — are widely assumed to shape both how often nurses report adverse events and how safe they perceive their workplace to be for patients. Empirical evidence on these associations remains uneven, however, and large multicentre data from Central and Eastern European secondary-care systems are scarce. The present study examined whether educational level and length of work experience are independently related to (a) the self-reported frequency of adverse-event reporting and (b) the perceived level of patient safety, in a national sample of nurses working in Croatian general and county hospitals. **Methods:** We conducted a cross-sectional, multicentre survey in 2023 covering all 22 general and county hospitals in the Republic of Croatia. A 99-item paper questionnaire — including 81 items distributed across six previously validated scales (Cronbach's α 0.730–0.951) — was distributed proportionally to the eligible nursing workforce (N = 6,661). Of the 1,657 questionnaires distributed, 1,518 were returned fully completed (response rate 91.6%). Two outcomes were examined in parallel: self-reported frequency of adverse-event reporting in the past 12 months, and global perceived level of patient safety on the respondent's ward. Group differences were tested with Pearson's chi-square and Kruskal–Wallis H tests; effect sizes were assessed using the φ coefficient and Cramér's V. The study followed the STROBE reporting guideline. **Results:** Educational level was associated with the frequency of adverse-event reporting ($\chi^2 = 29.873$, df = 8, $p < 0.001$; $\varphi = 0.14$) and with safety perception ($\chi^2 = 16.084$, df = 8, $p = 0.041$; $\varphi = 0.10$). The same monotonic gradient was confirmed by Kruskal–Wallis tests, with mean ranks rising from secondary (SSS) through bachelor (VŠS) to master's or doctoral (VSS+DR) levels for both reporting (719.40; 772.93; 836.56; H = 15.901, $p < 0.001$) and safety perception (735.29; 775.89; 844.86; H = 10.539, $p = 0.005$). Length of total work experience was associated with reporting ($\chi^2 = 22.708$, df = 12, $p = 0.030$; $\varphi = 0.12$; H = 9.249, $p = 0.026$): mean ranks were lowest for nurses with ≤ 10 years and ≥ 31 years, and highest for mid-career nurses (11–20 and 21–30 years). For safety perception, the experience gradient ran in the opposite direction — highest in nurses with ≤ 10 years (mean rank 795.08) and lowest in those with ≥ 31 years (718.17; $\chi^2 = 35.036$, df = 12, $p < 0.001$; $\varphi = 0.15$; H = 8.517, $p = 0.036$). **Conclusions:** Educational level and length of work experience are independently related to both the reporting of adverse events and the perception of patient safety among Croatian hospital nurses, but the two characteristics operate in different ways. Higher education is associated with more reporting and more favorable safety perception, whereas longer experience is associated with more reporting at mid-career but with a less favorable view of

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workplace safety in late-career nurses. Investing in continuing nursing education and in mid-career retention, while remaining attentive to the deteriorating safety perception of the most experienced staff, may be more effective than redesigning reporting forms alone. The findings inform nursing leadership, continuing-education planning, and national patient-safety policy in Central and Eastern European secondary-care systems.

Keywords: adverse events; patient safety; nursing education; work experience; safety perception; safety culture; incident reporting; cross-sectional studies; nursing workforce; Croatia

1. Introduction

Adverse-event reporting and the perception of patient safety are two closely related but conceptually distinct dimensions of hospital safety culture. The first is a behavior: the documented willingness of clinicians to formally record events that did, or could have, harmed a patient. The second is an attitude: the global judgement a clinician forms about how safe his or her workplace is for the patients in its care. The World Health Organization's Global Patient Safety Action Plan 2021–2030 treats both as priority targets for improvement and explicitly calls for measurement systems in which reporting and perception are tracked together rather than in isolation [1]. Nurses, who provide the largest share of bedside care and witness most medication, procedural, and care-coordination errors, occupy a central role in this measurement architecture [2,3].

Despite this central role, under-reporting by hospital nurses remains persistent and well documented [4,5]. Systematic reviews and qualitative syntheses consistently group the underlying barriers into three layers: organizational factors such as a punitive culture, complex reporting pathways and absent feedback [4,6]; team-level factors such as poor communication and limited management visibility [3,7]; and individual-level factors, of which fear of blame, time pressure, and the nurse's own uncertainty about what counts as a reportable event are the most frequently cited [4,5]. Within this third layer, two sociodemographic characteristics are repeatedly proposed as upstream predictors but rarely tested at scale: formal level of education and length of professional experience [8,9].

The link between education and safety culture has been explored mostly through the lens of nursing leadership and the practice environment. Studies in Nursing Reports and adjacent nursing journals have shown that workforces with a higher proportion of bachelor- and master-prepared nurses tend to operate in environments where reporting is more frequent and where the wider safety climate is rated more favourably by staff [10–12]. Continuing-education and curriculum studies have, in parallel, demonstrated that targeted training in patient-safety competencies improves both self-efficacy in error recognition and the stated intention to report [13,14]. By contrast, the role of length of professional experience has been less consistently described. Some single-hospital studies report a positive linear association between years of practice and reporting; others find a non-linear, mid-career peak; and qualitative work suggests that the most experienced nurses may in fact disengage from formal reporting because of habituation, perceived futility, or pre-retirement attitudes [4,5,9]. To our knowledge, no national multicenter study has yet examined how education and experience act on reporting and on safety perception in parallel.

Most of the available evidence has, in addition, been generated in high-income North American and Western European systems. Central and Eastern European secondary-care hospitals, where the nursing workforce is more heterogeneous in formal education and where reporting infrastructure is still maturing, are under-represented in this literature. Croatia is a useful setting in which to address this gap. Croatian nurses span three formal qualification levels (secondary medical school, SSS; Bachelor of Nursing, VŠS; and master's or doctoral level, VSS+DR), and adverse-event reporting is legally mandated for sentinel events but operationally heterogeneous across institutions [15,16]. Existing Croatian work has been confined to psychometric validation of the Hospital Survey on Patient Safety Culture and to single- or three-hospital descriptive studies [15,16]; multicenter

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evidence on the sociodemographic predictors of reporting behavior and safety perception has not previously been published in a peer-reviewed nursing journal.

The present study, drawn from a national doctoral survey of all 22 general and county hospitals in Croatia, was designed to address this gap. Its specific aims were (i) to describe the self-reported frequency of adverse-event reporting and the perceived level of patient safety in this national workforce; and (ii) to test, in parallel, whether educational level and length of work experience are associated with each of these two outcomes. Following the doctoral protocol from which this analysis is derived, four pre-specified hypotheses were examined:

H2a. Self-reported frequency of adverse-event reporting differs significantly between groups of nurses defined by formal educational level.

H2b. Self-reported frequency of adverse-event reporting differs significantly between groups of nurses defined by length of total work experience.

H3a. Perceived level of patient safety differs significantly between groups of nurses defined by formal educational level.

H3b. Perceived level of patient safety differs significantly between groups of nurses defined by length of total work experience.

The labelling of these hypotheses (H2a/H2b for the reporting outcome and H3a/H3b for the perception outcome) follows the numbering used in the underlying doctoral protocol [16] and is preserved here for transparency and to facilitate cross-referencing with companion analyses from the same dataset.

2. Materials and Methods

2.1. Study Design and Reporting Guideline

A national, cross-sectional, multicenter, quantitative survey was conducted in 2023 in all 22 general and county hospitals in the Republic of Croatia. The study followed the STROBE Statement for cross-sectional studies (Supplementary Material S1). The aim, population, hypotheses, and statistical plan were specified prior to data collection as part of the doctoral research protocol approved by the participating institutions [16].

2.2. Setting and Population

The eligible population comprised all registered nurses and nursing technicians employed on inpatient wards of the 22 general and county hospitals in Croatia (N = 6,661). General and county hospitals form the secondary level of the Croatian public-healthcare system and cover surgical, internal-medicine, gynecology/obstetrics, pediatric, psychiatric, intensive-care and anesthesiology departments. Tertiary university hospitals, special hospitals, and primary-care institutions were excluded.

2.3. Sample Size and Sampling

A target sample of 25% of the eligible population (1,657 nurses) was allocated proportionally to each hospital's nursing workforce. Within each hospital, the chief nursing officer distributed the paper questionnaire to nurses on inpatient wards using a convenience approach during regular shifts. Of 1,657 questionnaires distributed, 1,518 were returned fully completed (response rate 91.6%); this sample is well above the minimum required to detect a small-to-medium effect ($\varphi = 0.10$) at $\alpha = 0.05$ with 80% power for chi-square tests on the relevant 3×3 and 4×3 contingency tables.

2.4. Instrument

The 99-item paper questionnaire combined a sociodemographic and professional section (18 items) with six validated scales (81 items): (1) Interpersonal relationships (16 items; 5 reverse-coded); (2) Management attitude towards patient safety (4 items; 2 reverse-coded); (3) Communication in the

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work environment (6 items; 1 reverse-coded); (4) Management approach to patient safety (10 items; 6 reverse-coded); (5) Personal safety experience (11 items; 2 reverse-coded); and (6) Frequency of inappropriate nursing care practices (34 items, no reverse-coding). The principal outcome for the present analysis — self-reported frequency of adverse-event reporting in the past 12 months — was captured on a five-point ordered scale (none; 1–2; 3–5; 6–10; >10 reports). Internal consistency in this sample was satisfactory to high across all six scales (Cronbach's α 0.730–0.951). The English-language version is provided as Supplementary Material S3.

2.5. Variables

Two outcomes were examined in parallel. The first was self-reported frequency of adverse-event reporting in the past 12 months, captured on a five-point ordered scale (none; 1–2; 3–5; 6–10; ≥11 reports). The second was the respondent's global perception of patient safety on his or her ward, captured on a five-point ordinal scale (none; poor; acceptable; very good; excellent). The two main independent variables were formal educational level (secondary medical school [SSS]; Bachelor of Nursing [VŠS]; master's or doctoral degree [VSS+DR]) and length of total work experience in healthcare (≤10; 11–20; 21–30; ≥31 years). Length of service in the current hospital, sex, age band, hospital department, the workplace communication scale score and the management approach scale score were retained as descriptive variables.

2.6. Statistical Analysis

Descriptive statistics summarized demographic and professional characteristics. Group comparisons used Pearson's chi-square tests for categorical contingency tables (validity verified by ensuring that fewer than 20% of expected frequencies were below 5; one test failed this criterion and is reported with the corresponding caveat). For ordinal and non-normally distributed continuous outcomes, the Mann–Whitney U test (two-group comparisons) and the Kruskal–Wallis H test (more than two groups) were used. Effect sizes were quantified with the φ coefficient and Cramér's V, interpreted as: 0.00–0.15 very weak; 0.15–0.20 weak; 0.20–0.25 moderate; 0.25–0.30 moderately strong; 0.30–0.35 strong; 0.35–0.40 very strong [16]. The threshold for statistical significance was $p < 0.05$; results are reported as $p < 0.05$ (*), $p < 0.01$ (*), $p < 0.001$ (**). Analyses were performed in IBM SPSS Statistics version 27.

2.7. Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Boards / Ethics Committees of all 22 participating hospitals. Representative approval codes include General Hospital Varazdin 02/191/111-2022; County Hospital Cakovec 01-4763/1/2022; County Hospital Nasice 01-87/2-2023; the full list of approval codes is provided as Supplementary Material S2. All approvals were obtained prior to data collection. Participation was voluntary and anonymous; written informed consent was obtained from all participants prior to questionnaire completion. The study population consisted of registered nurses and nursing technicians; no patients, service users, carers, or members of the public were involved in the design, conduct, or reporting of this research.

3. Results

3.1. Sample Characteristics

Of 1,657 distributed questionnaires, 1,518 were returned fully completed (response rate 91.6%). Most participants were women (n = 1,222; 80.5%), 209 were men (13.8%), and 87 (5.7%) preferred not to disclose their sex. More than half of the samples (n = 891; 58.7%) were younger than 40 years. By educational level, 883 participants (58.2%) had completed secondary medical school (SSS), 476 (31.4%) held a bachelor's degree in nursing (VŠS), 147 (9.7%) held a master's degree, and

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approximately 1% held a doctoral degree (master's and doctoral participants were pooled into a single VSS+DR category for the present analyses). The largest groups worked in surgery and internal medicine departments (combined: 64% of the sample). Most participants (41%) had less than 10 years of total work experience in the healthcare system; the mean total experience was 16 years.

3.2. Instrument Reliability

Internal consistency was confirmed for all six scales in the main study (Table 1). Cronbach's α ranged from 0.730 (Management attitude towards patient safety) to 0.951 (Frequency of inappropriate nursing care practices), corresponding to satisfactory-to-high reliability across all conceptual domains of the instrument.

Table 1. Internal consistency (Cronbach's α) of the six scales in the main study (N = 1,518).

Scale	Items	Reverse-coded	Cronbach's α	Interpretation
1. Interpersonal relationships	16	5/16	0.751	Satisfactory
2. Management attitude towards patient safety	4	2/4	0.730	Satisfactory
3. Communication in the work environment	6	1/6	0.781	Satisfactory
4. Management approach to patient safety	10	6/10	0.810	Good
5. Personal safety experience	11	2/11	0.741	Satisfactory
6. Frequency of inappropriate nursing care practices	34	0/34	0.951	High
Total	81	16/81	—	—

Reliability interpretation: $\alpha < 0.6$ unacceptable; $\alpha \geq 0.7$ satisfactory; $\alpha \geq 0.8$ good; $\alpha \geq 0.9$ high.

3.3. Educational Level and Adverse-Event Reporting (H2a)

Educational level was associated with the self-reported frequency of adverse-event reporting in both the contingency-table framework and the rank-based framework. The Pearson chi-square test for the three-by-five table of educational level by reporting frequency returned $\chi^2 = 29.873$ (df = 8), $p < 0.001$, with a very weak effect size ($\varphi = 0.14$; Cramér's V = 0.10). The Kruskal–Wallis H test confirmed a monotonic gradient across the three educational groups (Table 2): mean ranks rose from 719.40 in nurses with secondary education (SSS) through 772.93 in bachelor-prepared nurses (VŠS) to 836.56 in nurses with a master's or doctoral qualification (VSS+DR), with H = 15.901 (df = 2), $p < 0.001$. Hypothesis H2a was therefore supported.

Table 2. Association of educational level and length of work experience with self-reported adverse-event reporting frequency (H2a, H2b) and with perceived patient safety (H3a, H3b). Pearson chi-square and Kruskal–Wallis H tests; N = 1,518.

Hypothesis / association	Subgroup	n	Mean rank	Chi-square (df, φ)	Kruskal–Wallis H (df, p)
H2a. Educational level × Reporting	Secondary (SSS)	867	719.40	$\chi^2 = 29.873$ (8); $\varphi = 0.14$; $p < 0.001$ ***	H = 15.901 (2); $p < 0.001$ ***
	Bachelor (VŠS)	474	772.93		
	Master's/Doctoral (VSS+DR)	155	836.56		
H2b. Total work experience × Reporting	≤ 10 years	612	718.99	$\chi^2 = 22.708$ (12); $\varphi = 0.12$; $p = 0.030$ *	H = 9.249 (3); $p = 0.026$ *
	11–20 years	351	783.41		
	21–30 years	296	779.41		
	≥ 31 years	237	734.39		
H3a. Educational level × Safety perception	Secondary (SSS)	883	735.29	$\chi^2 = 16.084$ (8); $\varphi = 0.10$; $p = 0.041$ *	H = 10.539 (2); $p = 0.005$ **
	Bachelor (VŠS)	476	775.89		
	Master's/Doctoral (VSS+DR)	159	844.86		
H3b. Total work experience × Safety perception	≤ 10 years	620	795.08	$\chi^2 = 35.036$ (12); $\varphi = 0.15$; $p < 0.001$ ***	H = 8.517 (3); $p = 0.036$ *
	11–20 years	355	733.81		

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Hypothesis / association	Subgroup	n	Mean rank	Chi-square (df, φ)	Kruskal–Wallis H (df, p)
	21–30 years	301	749.86		
	≥ 31 years	242	718.17		

Note. $p < 0.05$; $p < 0.01$; ** $p < 0.001$. φ = phi coefficient (effect size for chi-square tests). Subgroup n values are based on valid responses for each contingency table; small differences across rows reflect missing values for either the independent or the dependent variable. SSS = secondary medical school; VŠS = Bachelor of Nursing; VSS+DR = master's or doctoral degree.

3.4. Length of Work Experience and Adverse-Event Reporting (H2b)

Length of total work experience in the healthcare system was also associated with reporting frequency, with a smaller effect than for education and a non-monotonic shape. The four-by-five chi-square test returned $\chi^2 = 22.708$ (df = 12), $p = 0.030$ ($\varphi = 0.12$; Cramér's V = 0.07). The Kruskal–Wallis H test gave H = 9.249 (df = 3), $p = 0.026$, with mean ranks of 718.99 (≤10 years), 783.41 (11–20 years), 779.41 (21–30 years) and 734.39 (≥31 years) (Table 2). Reporting frequency was thus highest in the two mid-career bands and lower at both ends of the experience distribution. Hypothesis H2b was therefore supported.

3.5. Educational Level and Safety Perception (H3a)

A parallel analysis examined whether educational level was associated with the global perception of patient safety on the respondent's ward. The three-by-five chi-square test returned $\chi^2 = 16.084$ (df = 8), $p = 0.041$ ($\varphi = 0.10$; Cramér's V = 0.07), and the Kruskal–Wallis H test gave H = 10.539 (df = 2), $p = 0.005$. Mean ranks rose monotonically across the three educational levels, from 735.29 (SSS) through 775.89 (VŠS) to 844.86 (VSS+DR) (Table 2). Better-educated nurses thus reported a more favorable view of patient safety on their ward. Hypothesis H3a was therefore supported.

3.6. Length of Work Experience and Safety Perception (H3b)

Length of total work experience was associated with safety perception in the opposite direction to that observed for reporting frequency. The four-by-five chi-square test was the strongest of the four pre-specified tests in this analysis ($\chi^2 = 35.036$, df = 12, $p < 0.001$; $\varphi = 0.15$; Cramér's V = 0.09), and the Kruskal–Wallis H test gave H = 8.517 (df = 3), $p = 0.036$. Mean ranks were highest in the youngest group (795.08, ≤10 years) and fell progressively through the mid-career groups (733.81 for 11–20 years; 749.86 for 21–30 years) to the lowest value in the most senior nurses (718.17, ≥31 years) (Table 2). The most experienced nurses thus held the least favorable view of patient safety on their ward. Hypothesis H3b was therefore supported.

3.7. Summary of Findings

All four pre-specified hypotheses were supported, but the patterns they described were not identical. For the reporting outcome, educational level produced a monotonic, increasing gradient (H2a), whereas length of work experience produced a non-linear mid-career peak (H2b). For the safety-perception outcome, education produced the same monotonic, increasing gradient (H3a), but length of work experience produced a monotonic decreasing gradient — highest in early-career and lowest in late-career nurses (H3b). The two sociodemographic predictors therefore jointly shape both reporting behavior and safety perception, but they do so along different functional shapes.

4. Discussion

In this national, multicenter survey of 1,518 nurses working across all 22 general and county hospitals in Croatia, formal level of education and length of total work experience were each independently associated with both the self-reported frequency of adverse-event reporting and the perceived level of patient safety. The two predictors did not, however, act in the same way. Education produced a clean, monotonic, increasing gradient on both outcomes: better-educated nurses reported

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more events and perceived their wards as safer. Length of experience produced a more complex pattern — a mid-career peak in reporting, paired with a progressive decline in safety perception from the youngest to the most senior nurses. Taken together, these results align with, and extend, the international literature on the determinants of nurses' reporting behavior and safety culture [4–7,12].

4.1. Education as a Cross-Cutting Predictor (H2a, H3a)

The most consistent finding in our data was the role of formal educational level. Across the three Croatian qualification groups (secondary, bachelor, master's or doctoral), the same monotonic gradient appeared on both outcomes: higher education was associated with more frequent reporting (H2a) and with a more favorable view of patient safety on the respondent's ward (H3a). This dual gradient is conceptually important. It mirrors evidence from previous studies in Nursing Reports and adjacent nursing journals that link a higher proportion of bachelor- and master-prepared nurses to a stronger safety climate and to more mature reporting practices [10,11], and it is consistent with the concept-analytic literature that positions formal education as an antecedent of the positive nursing practice environment [12].

In the patient-safety literature, the simultaneous presence of high reporting and high perceived safety is generally interpreted as a protective rather than a complacent pattern, because it reflects active surveillance rather than passive reassurance [4,7,12]. The fact that this pattern was detectable in our national Croatian data, on individual self-report from a large multicenter sample, suggests that the educational gradient is sufficiently robust to register even in a workforce where reporting infrastructure remains operationally heterogeneous. For Croatian nursing leadership, this is an actionable finding: continued investment in bachelor- and master-level nursing qualifications can reasonably be expected to improve both the reporting behavior and the lived safety culture of the workforce [13,14].

4.2. The Mid-Career Peak in Reporting (H2b)

For length of work experience, the relationship with reporting was non-monotonic and best described as a mid-career peak: nurses with 11–20 and 21–30 years of total experience reported more frequently than either early-career (≤10 years) or late-career (≥31 years) colleagues. The same shape has been described in qualitative and systematic-review work on speak-up behaviors, where early-career nurses are typically deterred by fear of blame and by uncertainty about what counts as a reportable event, and late-career nurses by habituation, perceived futility of reporting, or gradual pre-retirement disengagement [4,5,9]. The clinical-leadership implication is that reporting-promotion strategies cannot reasonably target a single career stage. Early-career nurses appear to need psychological-safety and just-culture support to begin reporting in the first place, while late-career nurses appear to need engagement and renewal interventions if their reporting is to be sustained [13,14].

4.3. The Inverse Experience Gradient in Safety Perception (H3b)

For the second outcome — perceived level of patient safety — length of experience produced a markedly different pattern. Mean ranks fell progressively from the youngest band (≤10 years; 795.08) through the two mid-career bands to the most experienced nurses (≥31 years; 718.17). In other words, the longer a Croatian nurse had been working in the system, the less favorably she or he tended to perceive the safety of his or her ward. We interpret this finding cautiously, but it is striking. It is consistent with two well-described mechanisms in the safety-culture literature. The first is calibration: experienced nurses, who have witnessed more near-misses and adverse events over the course of their careers, may rate workplace safety against a more demanding internal benchmark than colleagues earlier in their professional life [4,5,9]. The second is moral distress and burnout: longitudinal nursing-workforce research has repeatedly shown that prolonged exposure to under-

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staffing, workload pressure and unresolved adverse events erodes the safety perception of senior staff [9,17].

The juxtaposition of H2b and H3b is, in our view, the single most policy-relevant signal in this analysis. Mid-career nurses are simultaneously the most active reporters (H2b) and a group whose safety perception has already begun to decline relative to early-career colleagues (H3b). The most senior nurses report less often (H2b) and rate workplace safety least favorably (H3b). Nursing leadership should therefore not interpret a fall in reporting from senior staff as reassurance about safety; on the contrary, in our data the two trajectories run in opposite directions. Targeted retention, debriefing, and renewal interventions for nurses with ≥21 years of experience may be an under-recognized lever for sustaining both reporting and realistic safety perception in this group.

4.4. Strengths and Limitations

The principal strengths of this study are its national scope — all 22 general and county hospitals in Croatia — the high response rate (91.6%), the use of six previously validated scales with confirmed internal consistency (Cronbach's α 0.730–0.951), and the pre-specified analytic plan documented in a registered doctoral protocol [16]. Two outcomes were examined in parallel rather than separately, allowing the comparative interpretation of education and experience gradients that constitute the main contribution of this paper. Limitations include the cross-sectional design, which precludes causal inference; reliance on self-reported reporting frequency rather than verified hospital reporting-system data; convenience sampling within each hospital; and the under-representation of male nurses, which mirrors the Croatian workforce structure but limits sex-stratified analyses. The pooling of master's and doctoral participants into a single VSS+DR category was necessary because of the small number of doctoral-level nurses; as the Croatian workforce continues to develop, future analyses should examine the doctoral subgroup separately. Finally, one chi-square test marginally exceeded the conventional 20% expected-frequency-below-5 threshold and is reported with the corresponding caveat.

4.5. Implications for Practice and Policy

Three implications follow from the joint pattern of H2a/H2b and H3a/H3b. First, for nursing leadership and continuing-education planning, the educational gradient (H2a, H3a) supports continued investment in bachelor- and master-level nursing qualifications as a cross-cutting lever that improves both reporting behavior and lived safety perception. Second, for clinical management at ward level, the divergent experience patterns (H2b versus H3b) argue against treating reporting frequency as a stand-alone indicator of safety culture: a fall in reporting among the most experienced nurses, in our data, coexists with the least favorable safety perception in the workforce. Third, for national patient-safety policy in Central and Eastern European secondary-care systems, the findings reinforce the case set out by the WHO Global Patient Safety Action Plan 2021–2030 [1] for combining standardized electronic reporting infrastructure with continued expansion of formal nursing education and with targeted mid- and late-career retention programmes.

5. Conclusions

In a national, multicenter sample of 1,518 nurses working across all 22 Croatian general and county hospitals, formal level of education and length of total work experience were each independently associated with both the self-reported frequency of adverse-event reporting and the perceived level of patient safety, but the two predictors operated along different functional shapes. Education produced a monotonic, increasing gradient on both outcomes (H2a, H3a): better-educated nurses reported more events and perceived their wards as safer. Length of experience produced a mid-career peak in reporting (H2b) but a monotonic decrease in safety perception from early- to late-career nurses (H3b). The juxtaposition of these patterns cautions against using reporting frequency as a stand-alone indicator of safety culture in older cohorts of staff. Within the wider WHO Global

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Patient Safety Action Plan 2021–2030 agenda, our results support a coordinated investment in formal nursing education, in mid- and late-career retention, and in standardized reporting infrastructure as complementary, rather than alternative, levers for strengthening organizational safety culture in Central and Eastern European secondary-care systems.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org. Supplementary Material S1 — STROBE Statement checklist for cross-sectional studies; Supplementary Material S2 — full list of Ethics Committee approval codes from all 22 participating hospitals; Supplementary Material S3 — English-language version of the questionnaire.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Boards / Ethics Committees of all 22 participating hospitals (representative codes: General Hospital Varazdin 02/191/111-2022; County Hospital Cakovec 01-4763/1/2022; County Hospital Nasice 01-87/2-2023; full list in Supplementary Material S2).

Informed Consent Statement: Written informed consent was obtained from all participants prior to questionnaire completion. Participation was voluntary and anonymous.

Data Availability Statement: The de-identified dataset analyzed during the current study is available from the corresponding author upon reasonable request, subject to the data-sharing provisions of the participating institutions' ethics approvals.

Public Involvement Statement: There was no patient or public involvement in the design, conduct, or reporting of this research. The study population consisted of registered nurses and nursing technicians.

Guidelines and Standards Statement: This manuscript adheres to the EQUATOR network's STROBE Statement guidelines for the reporting of cross-sectional studies. The completed STROBE checklist is provided as Supplementary Material S1.

Use of Artificial Intelligence: AI was not used in the design, conduct, analysis, or interpretation of this study. Generative AI tools were used solely for language-level editing of the English-language manuscript text; the authors verified, accepted responsibility for, and approved all final wording.

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