Investigating Patient Safety Culture of Nurses at Cheng Ching General Hospital: A Correspondent Analysis

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A B S T R A C T

Introduction:
This study focuses on nurses' perspectives to explore the relationships among safety characteristics, aiming to understand how age, gender, and workplace factors should be incorporated to enhance patient safety. Data were collected from Cheng Ching General Hospital in Taiwan, with 446 valid respondents. Participants were classified into three age groups and six departments to form two mixed variables: gender-age and workplace-age.

Materials and Methods:
The Safety Attitudes Questionnaire (SAQ), supplemented with three additional safety characteristics, was utilized. Correspondence Analysis was then applied to generate two-dimensional diagrams illustrating the relationships between the mixed variables and nine safety characteristics.

Results:
Female respondents demonstrated a less positive attitude toward team-to-team safety characteristics. Additionally, the older age group exhibited a higher level of positive attitude regarding managerial support-related characteristics and stress recognition compared to their younger counterparts. Finally, no age group within the emergency department showed a positive association with teamwork across departments.

Conclusions:
Key recommendations include: 1) Encouraging greater involvement of younger staff in developing safety policies; 2) Monitoring and managing the workload of older staff; and 3) Establishing structured monitoring procedures for patient transfers between the emergency department and other units.

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Introduction

Developing a patient safety culture is essential in healthcare organizations, as it enhances healthcare quality and leads to improved patient outcomes (1,2). Despite extensive research on the impact of employees' attitudes on patient safety culture (3- 7), there remains a critical gap in understanding how demographic and workplace factors influence nurses' perceptions of safety. Nurses represent the largest component of hospital staff and serve as primary caregivers (8), making their perspectives vital to the development of effective safety policies. The American Nurses Association has emphasized that improving workplace conditions for nurses requires understanding their perceptions and addressing how they are treated by management, physicians, support staff, and other clinical professionals (9). Additionally, ongoing education and training have been identified as key factors in enabling nurses to contribute effectively to safety initiatives (10).

The necessity of this study arises from the need to better understand how age, gender, and workplace environment shape nurses 'attitudes toward patient safety. Previous studies have suggested that these factors may significantly influence safety perceptions (11, 12), yet few have examined them simultaneously or in the context of Taiwanese healthcare settings. Addressing this gap is crucial for designing targeted interventions that improve safety culture and patient outcomes.

The central research question of this study is: How do age, gender, and workplace environment influence nurses' perceptions of patient safety culture? By answering this question, the study seeks to uncover patterns and associations that can inform hospital management. Accordingly, the aim of this study is to explore the relationships among safety characteristics from nurses' perspectives, using Correspondence Analysis to examine how age, gender, and workplace factors interact to shape attitudes toward patient safety. This approach allows for a nuanced understanding of the structural relationships among categorical variables, offering insights that can guide policy development and organizational improvements.

The structure of this paper is as follows: Section 2 presents a literature review on patient safety culture and Correspondence Analysis, Section 3 details the materials and methods used, Section 4 discusses the results, and Section 5 explores policy implications before concluding in Section 6.

Literature Review

Establishing a robust patient safety culture within healthcare organizations is increasingly recognized as a key factor in improving healthcare service quality. Regular assessment of patient safety culture enables hospital administrators to track progress and reinforce the prioritization of patient safety (5, 13, 14, 15). Research indicates that hospitals with a well-developed safety culture experience lower rate of adverse events, fewer medication errors, reduced patient falls, and lower overall mortality (6, 13, 16, 17, 18, 19).

Demographic characteristics are considered as important predictors of behavioral performance and an individual's capability of carrying out certain actions (20). Research has shown that the perceptions of a patient safety culture among nurses vary significantly based on age and gender (21, 22, 23, 24, 25). Shie et al. (22) indicate that male nurses are often more proactive in fostering safety practices, despite the field being predominantly female. Nyberg et al. (11), focusing on operating room nurses, indicated that longer work experience and older age were associated with more favorable attitudes toward patient safety. The study highlighted the need for improvements in communication and workload management to further enhance safety perceptions among all age groups. Workplace setting also plays a role in shaping safety culture perceptions, with nurses in intensive care units (ICUs) typically reporting higher awareness and adherence to safety protocols compared to those in general units (21, 25, 26). Hadad et al. (12) found that those working in intensive care units and emergency departments reported lower perceptions of safety culture. In ICUs, the development of strong multidisciplinary teams is essential to improving patient safety. If nurses consider

themselves to be an important part of their organizations, then they are willing to apply more efforts to developing a safe environment in ICUs (21).

The Safety Attitudes Questionnaire (SAQ), which is the instrument of the study, is one of the most widely used tools for evaluating patient safety culture in healthcare settings (4, 21, 27, 28, 29). Asi et al. (30) conducted a study to validate the SAQ and the Hospital Survey on Patient Safety Culture (HSOPSC 2.0) in both Estonian and Russian languages. The research involved healthcare employees from three hospitals, utilizing online and paper surveys. The findings affirmed the SAQ's reliability in assessing safety attitudes across diverse linguistic contexts. Alqahtani and Evley (31) utilized the SAQ to measure safety culture among staff in adult Intensive Care Units. The study highlighted the tool's applicability in Middle Eastern healthcare settings and underscored the importance of regular safety culture assessments to achieve a positive safety environment. Tocco Tussardi et al. (32) explored the use of the SAQ as a self-assessment tool to measure employees' perceptions and attitudes toward patient safety climate. The research emphasized the importance of understanding staff perceptions to foster a culture of safety within healthcare organizations. Pevec et al. (33) focused on translating and validating the SAQ for use in operating rooms. The study aimed to measure attitudes toward the safety climate in surgical settings, demonstrating the SAQ's versatility across different clinical environments. Malinowska-Lipień et al. (34) conducted a cultural adaptation of the SAQ—Short Form in Poland. The study validated the instrument's reliability and applicability in the Polish healthcare context, facilitating targeted assessments of safety attitudes. These studies collectively underscore the SAQ's global applicability and reliability in measuring patient safety culture across diverse healthcare settings. The instrument's adaptability to various cultural and linguistic contexts makes it an invaluable tool for healthcare organizations aiming to assess and improve their safety climates.

Correspondence Analysis (CA) is a statistical method that enables the visualization of relationships among categorical data. It has been widely applied across various disciplines to uncover structural patterns, including studies on patient safety culture. By converting categorical data into graphical representations, CA allows researchers to identify associations between independent and dependent variables (35, 36, 37). CA facilitates the visualization of relationships among variables based on cross-tabulated data, where each variable is positioned according to its joint occurrence with others along vertical and horizontal axes (36, 38, 39, 40). It is typically conducted using a two-dimensional table that presents marginal (aggregate) and joint frequencies (40). CA can analyze different types of data, including interval, nominal, and ordinal, allowing categorical variables to be placed on a perceptual map. The closer dependent variables are to a specific independent variable on the map, the greater their similarities (39, 41, 42).

CA offers several advantages to researchers. First, it enables cross-tabulations of multiple categorical variables—such as companies, brands, products, performance measures, or perceptions—to be visually displayed in a perceptual map (36). Unlike many multivariate methods that require interval data, CA allows for the analysis of interval, ordinal, and nominal data by cross-tabulating categorical variables (35, 42). Second, CA not only reveals associations among variables but also illustrates how they are interrelated. Variables with similar frequencies appear as closely clustered points, while those with dissimilar frequencies are plotted further apart (43). This makes CA particularly useful for investigating structural relationships among categorical variables (42).

Third, CA can be applied to both quantitative data—such as attitudinal and satisfaction measures—and qualitative data that assess associations between tangible and intangible objects (35, 36, 44, 45). Research across various disciplines has demonstrated the effectiveness of CA in providing visual representations of data relationships and identifying key differences within datasets. Consequently, CA has been

utilized to explore a broad range of topics, including business strategies (36, 46), high-causality fires (42), disease patterns (47), health information dissemination (43), land development trends (48, 49), and education (41). However, despite its versatility, CA has not yet been extensively applied in research on patient safety culture.

Materials and Methods

The instrument of this study is the Chinese version of the SAQ (4, 50, 51). The original SAQ has six core characteristics. Teamwork climate refers to the quality of the relationships and cooperation among staff members. Safety climate describes the perceptions of a strong and proactive group's commitment to safety. Job satisfaction represents the staff's positive reaction to their work-related experiences.

Stress recognition is related to how performance is influenced by stressors. The perceptions of management refer to the approval of hospital administration and its actions. Finally, the dimension of working conditions is based on the perceived quality of the work environment and logistical support, in terms of elements such as staffing and equipment (21, 28, 52, 53). The Taiwan Joint Commission on Hospital Accreditation further expanded the SAQ by incorporating three additional dimensions: hospital management support for patient safety, teamwork across hospital units, and hospital handoffs and transitions (4, 50, 51, 54), resulting in a total of nine dimensions and 41 items as depicted in Table. 1. The participants rated each question based on a five-point Likert scale - never, rarely, sometimes, usually, and always.

Table 1. Forty-one items in the questionnaire to assess nine characteristics

1. Teamwork Climate
(1) Nurse input is well received in this clinical area
(2) In this clinical area, it is difficult to speak up if I perceive a problem with patient care
(3) Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient).
(4) I have the support I need from other personnel to care for patients
(5) It is easy for personnel here to ask questions when there is something that they do not understand
(6) The physicians and nurses here work together as a well-coordinated team
2. Safety Climate
(7) I would feel safe being treated here as a patient
(8) Medical errors are handled appropriately in this clinical area
(9) I know the proper channels to direct questions regarding patient safety in this clinical area
(10) I receive appropriate feedback about my performance
(11) In this clinical area, it is difficult to discuss errors
(12) I am encouraged by my colleagues to report any patient safety concerns I may have
(13) The culture in this clinical area makes it easy to learn from the errors of others
3. Job satisfaction
(14) I like my job
(15) Working here is like being part of a large family
(16) This is a good place to work
(17) I am proud to work in this clinical area
(18) Morale in this clinical area is high
4. Stress recognition
(19) When my workload becomes excessive, my performance is impaired

(20) I am less effective at work when fatigued
(21) I am more likely to make errors in tense or hostile situations (e.g. emergency resuscitation, seizure)
(22) Fatigue impairs my performance during emergency situations
5. Perception of management
(23) Management supports my daily efforts
(24) Management does not knowingly compromise patient safety
(25) I am provided with adequate, timely information about events that might affect my work
(26) The levels of staffing in this clinical area are sufficient to handle the number of patients 6. Working conditions
(27) Problem personnel are dealt with constructively
(28) This hospital does a good job of training new personnel
(29) All the necessary information for diagnostic and therapeutic decisions is routinely available to me
(30) Trainees in my discipline are adequately supervised
7. Hospital management support for patient safety
(31) Management is doing a good job
(38) The actions of hospital management show that patient safety is a top priority
(39) Problems rarely occur in the exchange of information across hospital units
8. Teamwork across hospital units
(32) Hospital units do not coordinate well with each other
(34) There is not enough cooperation among hospital units that need to work together
(36) It is often unpleasant to work with staff from other hospital units
(40) Hospital units does not work well together to provide the best care for patients
9. Hospital handoffs and transitions
(33) Things do not "fall between the cracks" when transferring patients from one unit to another
(35) Important patient care information is rarely lost during shift changes
(37) Problems do not occur much in the exchange of information across hospital units
(41) Shift changes are not problematic for patients in this hospital

The responses were collected from 446 nurses at Cheng Ching General Hospital in Taiwan. Table 2 presents the demographic information of the respondents. The sample included both male and female nurses, categorized into three age groups (under 30, 31-40, and 41-60 years old) and six workplace units - intensive care unit (ICU), operating room (OR), emergency department (ED), anesthesia room (AR), patient room (PR), and radiology room (RR). Ethical approval for the study was obtained from the Institutional Review Board of Cheng Ching General Hospital (IRB No: HP130026). SPSS 17.0 was used to perform Correspondence Analysis, assessing the relationships between the mixed variables (gender-age and workplace-age) and safety attitudes.

Table 2. Demographic Information of the Nurses

	Frequency	Percentage
Gender		
Male	9	2.0

Female	437	98.0
Age		
Under 20 years	7	1.6
21 to 30 years	208	46.6
31 to 40 years	191	42.8
41 to 50 years	39	8.7
51 to 60 years	1	0.3
Education		
High school	4	0.9
College/University	431	96.6
Master's Degree	1	2.5
Working Experience		
Under 6 months	37	8.3
6 to 11 months	15	3.3
1 to 2 years	93	20.9
3 to 4 years	76	17.0
5 to 10 years	117	26.2
11 to 20 years	101	22.6
21 years and above	7	1.7
Chief		
Yes	35	7.8
No	411	92.2
Employ Kind		
Full Time	418	93.7
Contract	28	6.3

Based on the survey data, CA was employed to examine the relationships between demographic variables and safety attitude characteristics. Unlike traditional factor analysis, CA does not assume interval-level data, making it ideal for analyzing demographic variables. Since CA is a multivariate technique that transforms categorical data into a low-dimensional space, it allows researchers to visualize the associations between respondent groups and survey items. The process of CA begins with the construction of a contingency table that cross-tabulates the frequencies of categorical responses, such as demographic groups and their attitudes toward specific safety dimensions. CA then transforms this table into a matrix of relative frequencies and applies chi-square distance metrics to assess the dissimilarities between row and column profiles. Through singular value decomposition (SVD), the method extracts eigenvalues and singular vectors, which are used to project both rows and columns onto a low-dimensional space—typically two dimensions—for graphical interpretation. This dimensionality reduction enables researchers to identify latent structures and associations within the data, where proximity between points on the perceptual map indicates similarity in response patterns.

Results

The analysis was performed in three steps. First, CA was run for each SAQ characteristic factor as the response variable, against the mixed variables (gender-age and workplace-age), to identify the significantly associated ones. Then the value of the chi-square test shows which characteristic has enough evidence to infer that the total inertia value (i.e. the total variance explained) is different from zero. The outcome is presented in Table 3. Among the nine safety attitude characteristics assessed, three (Hospital Management Support for Patient Safety [HMSP], Teamwork across Hospital Units [THU], and Hospital Handoffs and Transitions [HHT]) were significantly associated with the gender-age variable. For the workplace-age variable, four characteristics (Safety Climate [SC], Stress Recognition [SR], HMSP, and THU) demonstrated significant associations.

Table 3. Correspondence analysis for the nine characteristics in SAQ

	Correspondence analysis for SAQ Chi Square Test	
Characteristics	**Gender-Age**	**Workplace-Age**
1. Teamwork Climate (TC)	0.433	0.857
2. Safety Climate (SC)	0.068	**0.007**
3. Job Satisfaction (JS)	0.580	0.402
4. Stress Recognition (SR)	0.109	**0.034**
5. Perception of Management (PM)	0.310	0.408
6. Working Conditions (WC)	0.500	0.742
7. Hospital Management Support for Patient Safety (HMSP)	**0.000**	**0.000**
8. Teamwork across Hospital Units (THU)	**0.000**	**0.001**
9. Hospital Handoffs and Transitions (HHT)	**0.000**	0.081

Lastly, we run CA only for the significant characteristics for each mixed variable to generate the two-dimensional maps that indicate how each characteristic is associated with the different gender-age groups and the workplace-age groups. Figure 1 presents the maps of gender-age groups for those three characteristics. The gender-age mixed variable is defined based on the following notations - M: male, F: female, 01: younger (under 30 years old), 02: middle-aged (31-40 years old), and 03: older (41-60 years old). For example, 'M01' means the mixed group with male staff of age under 30 years old. Then we interpret the maps based on how the mixed groups (M01, M02, M03, F01, F02, F03) and the response labels of the characteristic (never, rarely, sometimes, usually, and always) are located. The key principles for interpreting these maps in this study are twofold. First, if the angle connecting a variable and a response label to the origin is small, it indicates they are positively associated (i.e. if 90 degrees, no association; if greater than 90 degrees, negative association).

Second, the further they are from the origin, where the x- and y-axes are both at 0, the stronger their association is.

Figure 1a summarizes the results for HMSP. Only M01 (males under 30 years old) is showing clear and strong association with

"always", which means they are showing the most positive attitude towards the patient safety support from the hospital management, whereas M02 is associated with "never". Also, all female groups show less positive association with low strength, except for F03. Figure 1b presents a two-dimensional summary of THU, which reveals that M01 again exhibited the most positive attitude (closer to 'always') for teamwork with other hospital units, and again female respondents besides F03 show less positive attitude. From Figure 1c, we can also see a resembling outcome where M01 strongly associated with "always" and the female groups not much showing association with positive attitude for handoffs and transition process.
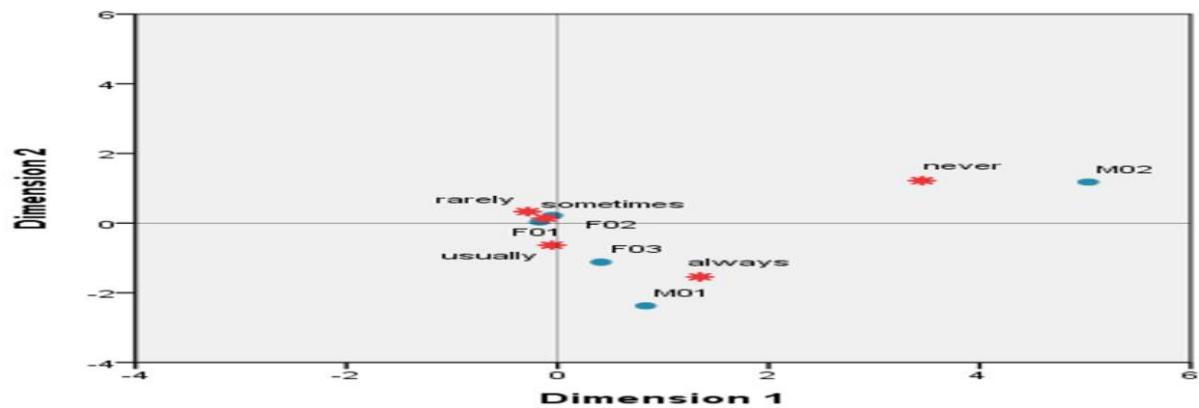

Figure 1a. A two-dimensional summary of Hospital management support for patient safety (HMSP)
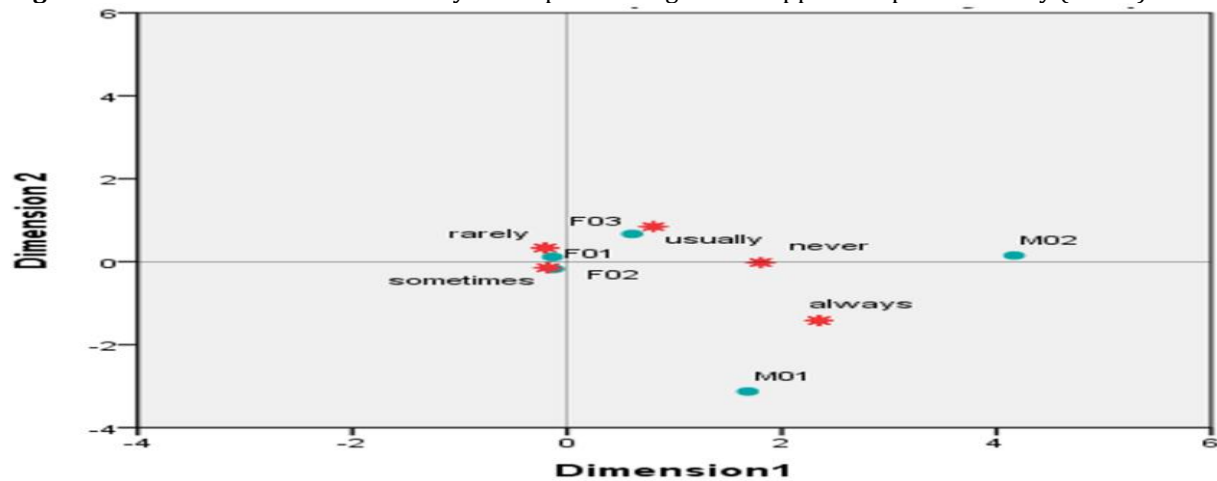

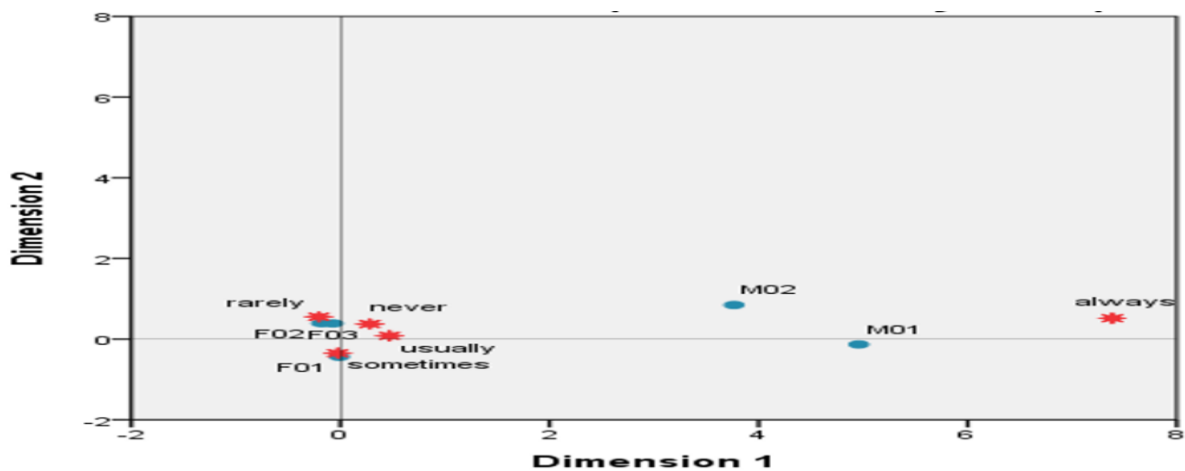**Figure 1b.** A two-dimensional summary of Teamwork across hospital units (THU)

Figure 1c. A two-dimensional summary of Hospital handoffs and transitions (HHT)

Figure 1. A two-dimensional summary of the significant categories in relation to gender-age Note: 01: younger (under 30 years old), 02: middle-aged (31-40 years old), and 03: older (41-60 years old), M: male, F: female

Figure 2 presents the results of the correspondence analysis with the workplace-age variable. The following notations are used - 01: under 30 years old, 02: 31-40 years old, and 03: 41-60 years old, A: intensive care unit (ICU), B: operating room (OR), C: emergency department (ED), D: anesthesia room (AR), E: patient room (PR), and F: radiology room (RR).
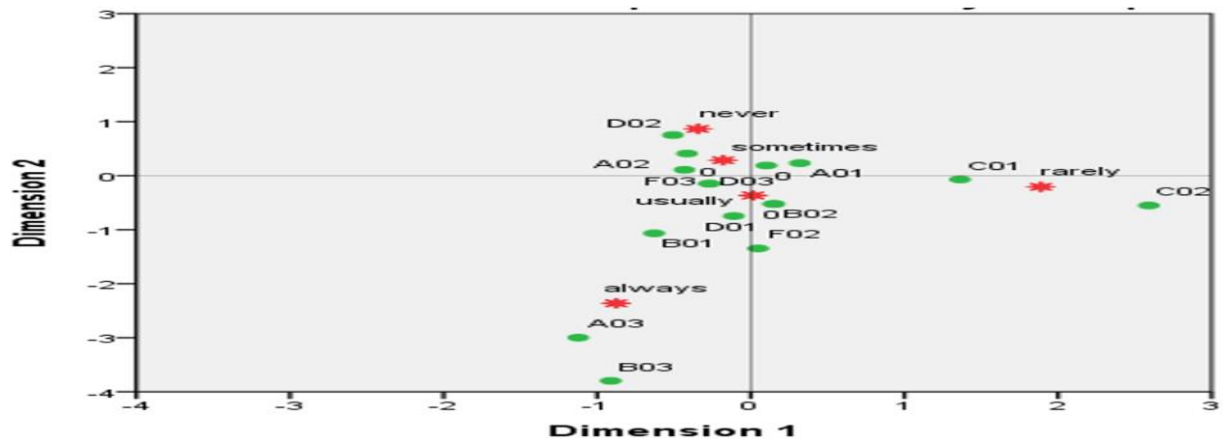
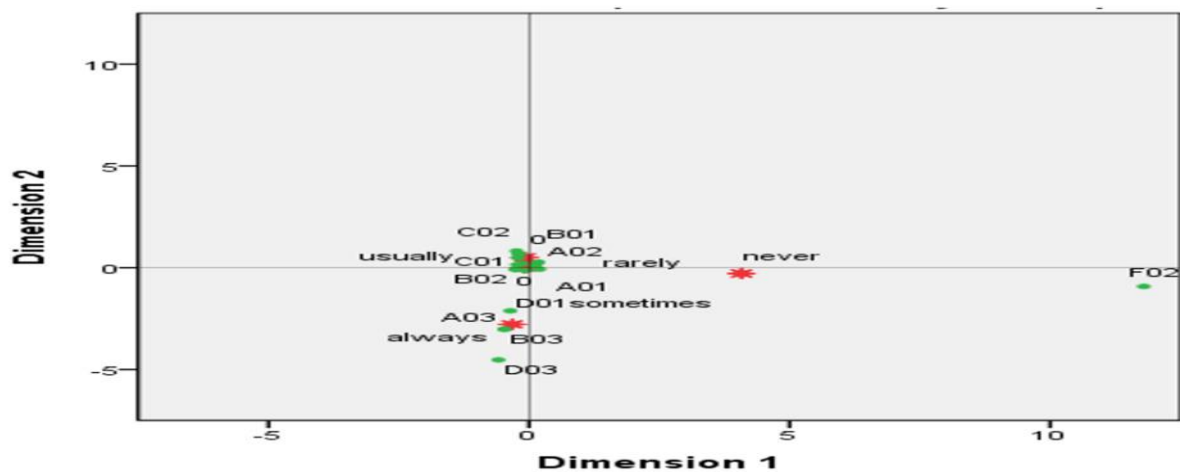**Figure 2a.** A two-dimensional summary of Safety climate (SC)

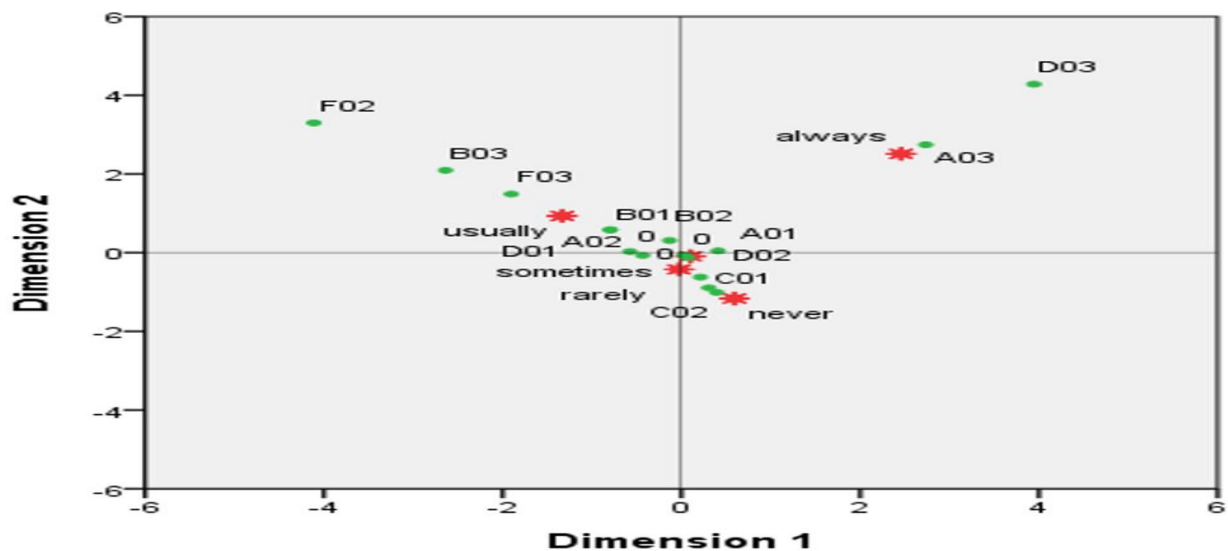**Figure 2b.** A two-dimensional summary of Stress recognition (SR)

Figure 2c. A two-dimensional summary of Hospital management support for patient safety (HMSP)
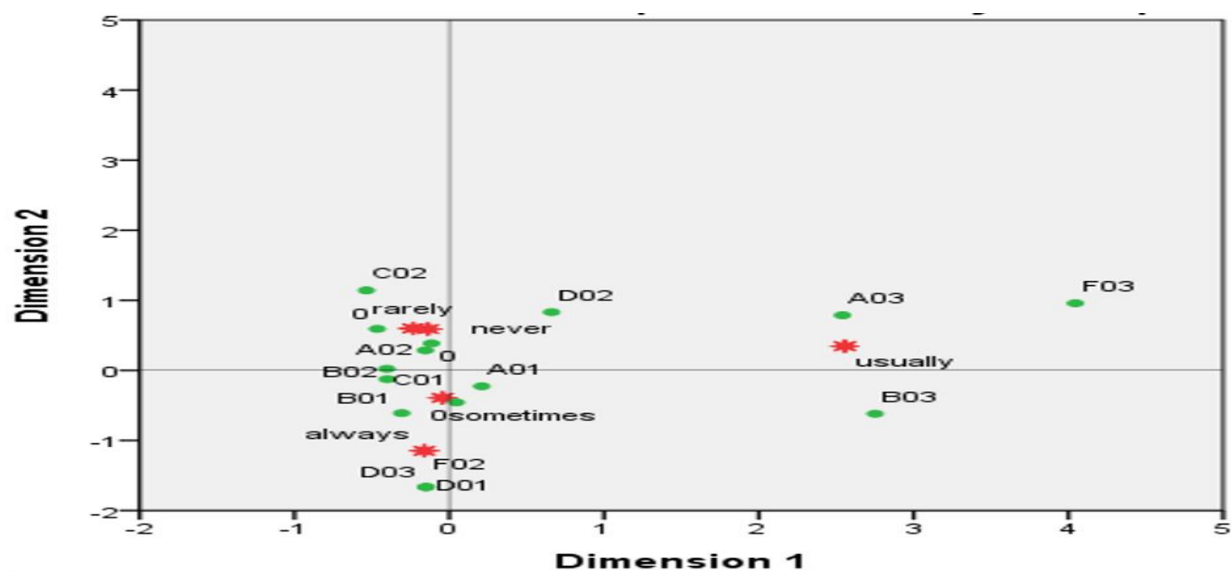

Figure 2d. A two-dimensional summary of Teamwork across hospital units (THU)

Figure 2. A two-dimensional summary of the significant categories in relation to workplace-age

Note: 01: under 30 years old, 02: 31-40 years old, and 03: 41-60 years old, A: intensive care unit (ICU), B: operating room (OR), C: emergency department (ED), D: anesthesia room (AR), E: patient room (PR), and F: radiology room (RR).

From Figure 2a, A03 (ICU, 41-60 years old) and B03 (OR, 41-60 years old) are identified as the group with the most positive attitudes (strongly associated with 'always' or 'usually') for Safety Climate of the organization, although C01 (ED, under 30 years old), and C02 (ED, 31-40 years old) and D02 (AR, 31-40 years old) are associated with more negative attitudes. Figure 2b

shows that A03 (ICU, 41-60 years old), B03 (OR, 41-60 years old), and D03 (AR, 41-60 years old) are strongly associated with 'always', whereas F02 (RR, 31-40 years old) indicates a strong association with 'never' for recognizing stress during their work. Regarding support from hospital management (HMSP), Figure 2c demonstrates that many old age groups (A03, B03, D03, F03, F02) imply very positive attitude since they show strong association with 'always' or 'usually'. The groups from ED (C01 and C02) are associated with negative attitude. Figure 2d suggests a similar pattern of attitude exists for teamwork with other units where A03, B03, D03, F03, D01, and F02 are highly associated with either 'always' or 'usually'

and C02 being associated with 'rarely' and 'never'.

Discussion And Limitations

In relation to gender, the outcomes illustrate there may be differences between male and female nurse respondents in Hospital Management support for patient safety (HMSP), Teamwork across hospital units (THU) and Hospital handoffs and transitions (HHT) – more positive attitude from male nurses in people-to-people/group setting safety characteristics. This finding may be related to Yan et al. (55) which suggests that the phenomenon of organizational silence among male nurses is widespread due to systemic environmental pressures of being minority in the organization. It can lead male nurses to more positive answers to indicate they are not having any issues and doing fine. If this is the case, healthcare administrators should refine management practices by strengthening communication frameworks and cultivating a culture of openness and transparency. Strengthening the professional identity of male nurses requires a multifaceted approach. This includes establishing clear pathways for career progression, investing in the development of clinical expertise and academic credentials, and launching public initiatives that raise awareness and foster greater societal recognition of their contributions to healthcare (55).

Regarding age, the older age group (41-60) in highly structured and enclosed departments, such as ICU and OR, show a significant level of positive attitude in the Safety climate. Most respondents in this age group hold managerial positions, which allows them to be directly involved in hospital policies and better understand their implementation. Similarly, for Hospital management support for patient safety, the oldest respondents (aged 41-60) working in ICU, surgery, and anesthesiology report receiving greater support from hospital management regarding patient safety than their younger counterparts. This is consistent with the results from Nyberg et al. (11), suggesting that hospital managers should improve communication with younger staff when announcing or

implementing new policies to enhance their effectiveness and efficiency in fostering a strong safety culture. In addition, the management needs to promote more involvement of younger staff in establishing safety-related policies. For Stress recognition, respondents aged 41-60 reported higher levels of stress recognition than other age groups. This outcome can be related to Hatch et al. (56). Despite their extensive experience, older nurses in these divisions require greater attention to reduce stress levels, as their physical limitations may make them more vulnerable to occupational strain. The allocation of workload for older staff should be carefully monitored and adjusted, calling for interventions for workload management that targets older staff for burnout prevention and health maintenance.

In terms of workplace, no age group in the Emergency Department (ED) are associated with positive attitude for the all four safety characteristics of workplace-age variable and only illustrate association with negative responses ('rarely' and 'never'), which is alarming and consistent with Milton et al. (57). After receiving emergency treatment, patients must be transferred from the ED to other units such as wards, the ICU, or operating rooms. Inefficiencies or disruptions in these transfers can significantly compromise overall patient safety. Therefore, improving the coordination and communication between the ED and other hospital units should be a priority to enhance patient outcomes and ensure a smoother transition process. To help the ED staff and the other departments in the receiving end coordinate better, hospital management needs to provide more opportunities to identify the issues and to build constructive monitoring processes. Milton et al. (57) state that ED-specific communication and professional and clinical experience are critical factors for the safety culture in ED. Since this study is focused on the viewpoint of nurses, there are several limitations that should be considered when interpreting our findings. First, the global nursing workforce is predominantly female, with approximately 90% of nurses worldwide being women (58). This gender imbalance may have influenced the

generalizability of our results, particularly in regions where male nurses constitute an even smaller proportion of the workforce. For instance, in the east asian countries, the percentage of male nurses is notably lower than in other regions, with Taiwan reporting a male nurse workforce of only 3.6% (59). Given the similar limitation of demographic distribution in this study, our findings may not fully capture the perspectives and experiences of male nurses, and therefore they are not included in our recommendations. Second, our study primarily focused on analyzing safety characteristics through the lens of age, gender, and workplace (department).

While this approach provides valuable insights into key factors influencing nursing safety, we did not account for potential differences in perception among chief nurses. As individuals in leadership roles, chief nurses may have unique viewpoints regarding workplace safety that differ from those of frontline nursing staff. Future research could benefit from incorporating this perspective to gain a more comprehensive understanding of safety characteristics in nursing environments. Despite these limitations, this study answers the necessity of investigating how age, gender, and workplace environment simultaneously affect the patient safety of nurses. Another critical strength of this study is the use of CA, which gives a powerful advantage for analyzing categorical variables, particularly demographic data, by transforming complex contingency tables into interpretable visual maps. Unlike traditional methods that may struggle with high-dimensional categorical data, CA reveals underlying patterns and associations between categories in a more accessible manner with visualization. This graphical representation enables researchers to detect relationships, clusters, and trends that might otherwise remain hidden. We believe our study contributes to the ongoing discourse on workplace safety in nursing and offers a foundation for further studies that can advance research in patient safety of healthcare organizations.

Conclusions

A strong patient safety culture is essential for healthcare organizations striving to continuously improve the quality of medical services. This study provides a comprehensive investigation of patient safety culture among nurses at Cheng Ching General Hospital, emphasizing the influence of demographic factors. By employing Correspondence Analysis, the research offers a visually intuitive and statistically robust framework for interpreting complex categorical data. The findings reveal critical associations between age, gender, and departmental placement with key safety dimensions, such as hospital management support, teamwork across units, and stress recognition. Notably, younger nurses exhibited lower perceptions of safety climate and managerial support, while older nurses—particularly those in structured departments like ICU and OR—demonstrated stronger positive attitudes but also higher stress recognition, underscoring the need for age-sensitive policy and workload management. The study also highlights systemic challenges within the Emergency Department, where no age group showed positive associations with safety characteristics, pointing to urgent needs for improved interdepartmental coordination and communication.

Based on the findings, the following managerial insights can help hospital administrators strengthen their safety culture. Concerning age, two key aspects should be considered: policymaking and workload allocation. The younger age group demonstrated lower perception levels in Safety Climate and Hospital Management Support for Patient Safety, highlighting the need for their increased involvement in developing safety-related policies. While older nurses may have more experience and familiarity with safety policies, their higher levels of stress recognition (as seen in Stress recognition) suggest that their workload should be carefully monitored and adjusted to mitigate physical strain. In terms of departmental coordination, improving collaboration between Emergency Department (ED) staff and receiving units in Hospital Handoffs and Transitions is critical. Providing more opportunities to identify challenges and establish structured monitoring processes will streamline

patient transfers, ultimately enhancing overall patient safety culture across the organization. In addition, the limitations of our study are provided so that they can lead healthcare researchers to meaningful future studies. We believe that our work can contribute to draw meaningful insights on how age, gender, and workplace should be incorporated for building actionable recommendations for hospital administrators, including fostering inclusive policy development, tailoring support systems to demographic needs, and enhancing transition protocols between units.

References

1. Vincent C, Taylor-Adams S, Stanhope N. Framework for analyzing risk and safety in clinical medicine. BMJ. 1998;316(7138):1154–7.

2. Institute of Medicine (US) Committee on Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington (DC): National Academies Press (US); 2001. PMID: 25057539.

3. Williamson AM, Feyer A, Cairns D, Biancotti D. The development of a measure of safety climate: The role of safety perceptions and attitudes. Saf Sci. 1997;25(1–3):15–27.

4. Lee W, Wung H, Liao H, Lo C, Chang F, Wang P, et al. Hospital safety culture in Taiwan: a nationwide survey using Chinese version safety attitude questionnaire. BMC Health Serv Res. 2010;10:234.

5. Tabrizchi N, Sedaghat M. The First Study of Patient Safety Culture in Iranian Primary Health Centers. Acta Med Iran. 2012;50(7):505–10.

6. Nie Y, Mao X, Cui H, He S, Li J, Zhang M. Hospital survey on patient safety culture in China. BMC Health Serv Res. 2013;13:228.

7. Kuriakose R, Aggarwal A, Sohi RK, Goel R, Rashmi NC, Gambhir RS. Patient safety in primary and outpatient health care. J Fam Med Prim Care. 2020;9(1):7.

8. American Association of Colleges of Nursing. Nursing Fact Sheet. Available from: http://www.aacn.nche.edu/media-relations/fact-sheets/nursing-fact-sheet (accessed 10 May 2022).

9. Buerhaus P, Donelan K, Ulrich B, Norman L, Dittus R. State of the Registered Nurse Workforce in the United States. Nurs Econ. 2006;24(1):6–12.

10. Friesen M, Farquhar M, Hughes R. The Nurse's Role in Promoting a Culture of Patient Safety. Am Nurses Assoc. 2005.

11. Nyberg A, Olofsson B, Fagerdahl A, Haney M, Otten V. Longer work experience and age

12. Hadad ES, Abd Elrhmaan SM, Ahmad FA, Ali HD. Perceptions of Staff Nurses about Patient Safety Culture at Minia General Hospital. Minia Sci Nurs J. 2021;10(1):68–77.

13. Ahmed N, Adam S, Al-Moniem I. Patient safety: Assessing nurses' perception and developing an improvement plan. Life Sci J. 2011;8(2):53–64.

14. Cliff B. The Evolution of Patient-Centered Care. J Healthc Manag. 2012;57(2):86–8.

15. Albalawi A, Kidd L, Cowey E. Factors contributing to the patient safety culture in Saudi Arabia: a systematic review. BMJ Open. 2020;10(10):e037875.

16. Zuniga F, Schwappach D, De Geest S, Schwendimann R. Psychometric properties of the Swiss version of the nursing home survey on patient safety culture. Saf Sci. 2013;55:88–103.

17. Mardon R, Khanna K, Sorra J, Dyer N, Famolaro T. Exploring relationships between hospital patient safety culture and adverse events. J Patient Saf. 2010;6(4):226–32.

18. Rosen A, Zhao S, Rivard P, Lovel S, Montez-Rath M, Elixhauser A, Romano P. Tracking rates of patient safety indicators over time: Lessons from the veterans administration. Med Care. 2006;44(9):850–61.

19. Agnew C, Flin R, Mearns K. Patient safety climate and worker safety behaviours in acute hospitals in Scotland. J Safety Res. 2013;45:95–101.

20. Dunlap R, Van Liere K, Mertig A, Jones R. Measuring endorsement of the new ecological paradigm: a revised NEP scale. J Soc Issues. 2000;56(3):425–42.

21. Abdou H, Saber K. A baseline assessment of patient safety culture among nurses at Student University Hospital. World J Med Sci. 2011;6(1):17–26.

22. Shie H, Lee W, Hsiao H, Lin H, Yang L, Jung F. Patient safety attitudes among respiratory therapists in Taiwan. Respir Care. 2011;56(12):1924–9.

23. Kitch B. Patient safety culture: a review of survey instruments. Presented at: National Patient Safety Congress, Orlando; 2005.

24. Altinpinar I, Başar E. Investigation of the effect of vessel type on seafarers' safety culture. Int J Occup Saf Ergon. 2022;28(3):1618–23.

25. Gambashidze N, Hammer A, Wagner A, Rieger MA, Brösterhaus M, Van Vegten A, Manser T, WorkSafeMed Consortium. Influence of gender, profession, and managerial function on clinicians' perceptions of patient safety culture: a cross-national cross-sectional study. J Patient Saf. 2021;17(4):e280–7.

26. Singer S, Lin S, Falwell A. Relationship of safety climate and safety performance in hospitals. Health Serv Res. 2009;44:399–421.

27. Azimi L, Tabibi S, Maleki M, Nasiripour A, Mahmoodi M. Influence of training on patient safety culture: a nurse attitude improvement perspective. Int J Hosp Res. 2012;1(1):51–6.

28. Göras C, Wallentin F, Nilsson U, Ehrenberg A. Swedish translation and psychometric testing of the safety attitudes questionnaire. BMC Health Serv Res. 2013;13(1):104.

29. Aziminasab N, Amini S, Morovatdar N. Validation of the Persian Version of the Safety Attitudes Questionnaire. J Patient Saf Qual Improv. 2020;8(3):139–43.

30. Asi S, Calsbeek H, Kangasniemi MK, Vähi M, Põlluste K. Patient Safety Culture and Safety Attitudes in the Estonian Context: Simultaneous Bilingual Cultural Adaptation and Validation of Instruments. Int J Public Health. 2024;69:1607392.

31. Alqahtani AS, Evley R. Application of Safety Attitudes Questionnaire (SAQ) in adult intensive care units: a cross-sectional study. MedRxiv. 2020 Jul.

32. Tocco Tussardi I, Moretti F, Capasso M, Niero V, Visentin D, Dalla Barba L, Tardivo S. Improving the culture of safety among healthcare workers: Integration of different instruments to gain major insights and drive effective changes. Int J Health Plann Manag. 2022;37(1):429–51.

33. Pevec T, Albreht T, Turk E. Safety culture in the operating room: translation, validation of the safety attitudes questionnaire–operating room version. BMC Health Serv Res. 2023;23(1):491.

34. Malinowska-Lipień I, Brzyski P, Gabryś T, Gniadek A, Kózka M, Kawalec P, et al. Cultural adaptation of the safety attitudes questionnaire– short form (SAQ-SF) in Poland. PLoS One. 2021;16(2):e0246340.

35. Hair J, Black W, Babin B, Anderson R. Multivariate data analysis. 5th ed. Upper Saddle River, NJ: Prentice-Hall; 2010. Hatch DJ, Freude G, Martus P, Rose U, Müller G, Potter GG. Age, burnout and physical and psychological work ability among nurses. Occup Med. 2018;68(4):246–54.

36. Kudlats J, Money A Jr. Correspondence analysis: A promising technique to interpret qualitative data in family business research. J Fam Bus Strategy. 2014;5:30–40.

37. Hoffman D, Franke G. Correspondence analysis: Graphical representation of categorical data in marketing research. J Mark Res. 1986;23(3):213–27.

38. Agresti A. Categorical data analysis. Hoboken: John Wiley & Sons; 2002.

39. San Augustine A, Long W, Pantzallis J. Hospital Positioning: A Strategic Tool for the 1990s. J Health Care Mark. 1992;12(1):15–23.

40. Beh E. Correspondence analysis of aggregate data: The 2×2 table. J Stat Plan Inference. 2008;138:2941–52.

41. Ivy J. Higher education institution image: A correspondence analysis approach. Int J Educ Manag. 2001;15(6):276–82.

42. Lu S, Mei P, Wang J, Zhang H. Fatality and influence factors in high-casualty fires: A correspondence analysis. Saf Sci. 2012;50(4).

43. Kakai H, Maskarinec G, Shumay D, Tatsumura Y, Tasaki K. Ethnic differences in choices of health information by cancer patients using complementary and alternative medicine: An exploratory study with correspondence analysis. Soc Sci Med. 2003;56:851–62.

44. Whipple T. Mapping focus group data. Mark Res. 1994;6(1):16–21.

45. Atilgan E, Akinci S, Aksoy S. Mapping service quality in the tourism industry. Manag Serv Qual. 2003;13(5):412–22.

46. Lee M, Atkins K, Kim Y, Park S. Competitive analyses between regional malls and big-box retailers: A correspondence analysis for segmentation and positioning. J Shopping Cent Res. 2006;13(1):81–98.

47. Méjean C, Traissac P, Eymard-Duvernay S, Ati J, Delpeuch F, Maire B. Influence of socio-economic and lifestyle factors on overweight and nutrition-related diseases among Tunisian migrants versus non-migrant Tunisians and French. BMC Public Health. 2007;7:265.

48. Pineda-Vargas C, Prozesky V, Przybylowicz W, Mayer J. Correspondence analysis evaluation of linear nutrient distribution in root tips of the tropical forage Brachiaria brizantha. Nucl Instrum Methods Phys Res B. 2001;181:493–8.

49. Cakir H, Khorram S, Nelson S. Correspondence analysis for detecting land cover change. Remote Sens Environ. 2006;102:306–17.

50. Wagner C, Smits M, Sorra J, Huang C. Assessing patient safety culture in hospitals across countries. Int J Qual Health Care. 2013;25(3):213–21.

51. Lee L, Hsu C, Hong J. Explore the impact of hospital restructuring medical practitioners of patient safety culture attitudes. J Health Manag. 2012;10(2):189–99.

52. Sexton J, Helmreich R, Neilands T, Rowan K, Vella K, Boyden J, et al. The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research. BMC Health Serv Res. 2006;6(1):44.

53. Rigobello M, Carvalho R, Cassiani S, Galon T, Capucho H, Deus N. The climate of patient safety: perception of nursing professionals. Acta Paul Enferm. 2012;25(5):728–35.

54. Tang YT, Wu HH, Lee YC, Huang CH. Evaluating the psychometric properties of the Chinese

version of the Safety Attitudes Questionnaire among medical staff in Taiwan. J Health Organ Manag. 2022;37(1):84–95.

55. Yan M, Shi Z, Zhou A, Zeng S. Analysis and interpretation of organizational silence behavior of male nurses from the perspective of phenomenology. BMC Nurs. 2025;24(1):864.

56. Hatch DJ, Freude G, Martus P, Rose U, Müller G, Potter GG. Age, burnout and physical and psychological work ability among nurses. Occup Med. 2018;68(4):246–54.

57. Milton J, Erichsen Andersson A, Åberg ND, Gillespie BM, Oxelmark L. Healthcare professionals' perceptions of interprofessional teamwork in the emergency department: a critical incident study. Scand J Trauma Resusc Emerg Med. 2022;30(1):46.

58. World Health Organization. State of the World's Nursing 2020: Investing in education, jobs and leadership. Available from: https://www.who.int/publications/i/item/978 9240003279 (Accessed 16 Dec 2024).

59. Zeng D, Shimosaka M, Wu X, Anagnostou D, Asakura K, Kinoshita A. Why do male nurses choose to work in foreign countries? A qualitative study on Chinese male nurses working in Japan. Heliyon. 2024;10(1).