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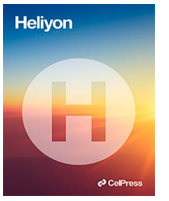

Determinants of nurses' readiness for disaster response: A cross-sectional study

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ABSTRACT

Reducing the impacts of disasters is imperative in these times when disasters continually threaten people's lives. Given that the readiness for disaster response of nurses are essential in mitigating damage, however, studies on the determinants of nurses' readiness for disaster response remain inconclusive and require further research, especially with various populations. This study therefore aimed to investigate factors associated with readiness for disaster response among Taiwanese hospital nurses. A cross-sectional study was conducted on 365 eligible and registered nurses at a medical centre in northern Taiwan. The Readiness for Disaster Responses Scale including four subscales: personal preparedness, self-protection, emergency response, and clinical management were used for assessment. Analyses were performed using multiple linear regression models. Our study results showed that the length of nursing work was positively associated with nurses' readiness for disaster responses ($\beta = 0.28$, $p < .001$). Nurses with a master's degree and working in intensive care units or emergency rooms had higher readiness for disaster responses ($\beta = 0.13$, $p = .032$; $\beta = 0.14$, $p = .024$) than those with a bachelor's degree and working in other units/specialties (i.e., outpatient department, operating rooms, etc.). Furthermore, nurses with previous disaster training were associated with greater readiness for disaster responses ($\beta = 0.24$, $p < .001$). This study findings indicate that the identified determinants of hospital nurses' readiness for disaster responses can be taken into consideration in the future recruiting of nurses for deployment to disaster response assistance and the designing of disaster training programmes specifically for nurses.

1. Introduction

A disaster is 'a serious disruption of the functioning of a community or society at any scale due to hazardous events interacting with

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conditions of exposure, vulnerability and capacity, leading to human, material, economic, and environmental losses and impacts' [1]. All communities globally are potentially threatened by disasters. For example, 432 disastrous events occurred in 2021 resulting in 10, 492 deaths and 101.8 million people affected, particularly in Asia, where was the most severely impacted, suffering 40% of all disaster events and accounting for 49% of the total number of deaths and 66% of the total number of people affected [2]. Therefore, individuals and governments are attempting to decrease the negative consequences of these disasters and develop strategies to mitigate the initial impacts, as well as prepare for post-disaster response and recovery needs.

Taiwan is prone to various types of disasters due to its geographical location and natural hazards. The most significant disasters that have affected Taiwan include earthquakes, typhoons, landslides, floods, and industrial accidents. In the past several decades, the most devastating disaster to occur in Taiwan was the earthquake, particularly the Chi-Chi earthquake in 1999, which resulted in 2415 deaths and 11,305 injuries. According to a previous report of disaster epidemiology in the Chi-Chi earthquake of Taiwan, the mortality rate increased with proximity to the epicentre, and mortality was higher among the elderly than among young people. Additionally, 30% of the victims died from head injuries caused by the collapse of dwellings, and the peak of medical demand occurred 12 h after the earthquake, with significantly increased demand for care lasting as long as 3 days [3]. This highlights the importance of a timely disaster response for medical personnel in Taiwan.

Given the frequency with which disasters occur and their negative impacts, nurses' readiness to respond to them is important in reducing the negative consequences to the health of the affected people. Furthermore, public health emergencies, such as the COVID-19 pandemic, highlight the necessity of having a national nursing workforce prepared with the knowledge, skills, and abilities to respond adequately and appropriately [4]. All efforts, including attempts to decrease unexpected consequences and employ interventions for effective disaster risk reduction, comprise disaster management [5,6]. Readiness for disaster response, an important component of disaster management, refers to the state of preparedness of individuals, organizations, or communities to effectively respond to a disaster occurred. It encompasses having the necessary resources, plans, and capacities in place to quickly and efficiently manage the immediate impacts of a disaster, protect lives, and prevent further damage [6]. Therefore, responding quickly and appropriately to disasters or public health emergencies is crucial and depends on frontline nurses' well-prepared readiness for disaster response in saving lives, reducing negative impacts on the health of the affected population, and/or preventing additional damage and loss of property [5,7].

In disaster areas or local hospitals near affected sites, a robust frontline medical workforce, especially nurses, is required [8,9]. Mobilising hospital nurses in response to disasters is a necessary response, particularly in hospitals affiliated with the national government or the military. Nurses' readiness for disaster response includes personal preparedness, self-protection ability, and clinical management, along with emergency response/critical care knowledge [7]. During disaster, nurses provide first aid and, advanced clinical care, including assessing and triaging victims, administering lifesaving medications, monitoring ongoing physical and mental health needs, and allocating resources [10]. Nurses also assist in the care of frail older people [11] and in childbirth, to ensure healthy women and babies even amidst a disaster [12]. Furthermore, nurses participate in incident command systems, oversee the use of personal protective equipment, and provide crisis leadership and communications, often at risk to their own health. Therefore, disasters place unprecedented demands on healthcare systems and challenge nurses' competencies, readiness for disaster response, as well as their personal commitment as healthcare professionals [13]. However, hospital nurses might not be competent or even perceived well-readiness in disaster response due to the unexpected nature of such occurrences, even though they might have received pre-deployment training. A recent study advocated that organizations must regularly conduct preparedness exercises to maintain and promote the readiness of medical personnel in responding effectively to disasters [14]. Hence, more disaster nursing research are necessary to enhance the knowledge, skills, and particularly the readiness of nursing professionals for the management of global disaster challenges [10]. Therefore, designing integral and effective disaster training programs to prepare hospital nurses well in providing disaster care is imperative.

Prior to design disaster nursing training programs, nurse educators and administrators must understand how well-prepared hospital nurses must be to provide disaster care, and be aware of the determinants of hospital nurses' readiness for disaster response. Nurses work in a wide array of settings and practice within a broad range of professional levels, in hospitals and elsewhere. Identifying the potential background characteristics or work units/specialties of nurses who perceive higher levels of readiness for disaster response would be an optimal and imperative step in the preparedness phase of disaster management. Disaster management competency among public hospital nurses is most associated with the willingness and readiness to respond in a disaster after adjusting for level of education and self-efficacy [9]. However, the predictors of nurses' readiness for disaster responses may necessitate further evaluation and discussion across diverse cultures to construct a well-organised plan for disaster response, which may reduce the fatality rate and preventable suffering of many survivors. In addition, there remains a knowledge gap in comprehending the critical determinants that influence hospital nurses' readiness for disaster response effectively. By identifying the critical determinants that contribute to nurses' readiness for disaster response, this study can not only offer a comprehensive understanding of the predictors that affect nurses' readiness, transcending geographical and contextual boundaries but also provide valuable insights to healthcare organizations and policymakers. Consequently, this study aimed to assess hospital nurses' readiness for disaster responses and identify the determinants that contribute to their readiness for disaster responses.

2. Materials and methods

2.1. Design

A cross-sectional study was conducted to investigate the determinants of readiness for disaster responses among Taiwanese hospital

nurses. This study adhered to the recognized reporting guidelines encompassed in Strengthening the Reporting of Observational Studies in Epidemiology.

2.2. Participants and settings

The target participants were initially screened by the principal investigator using the employee records of a military medical centre in northern Taiwan, affiliated with the national government and responsible for dispatching nurses to affected areas across Taiwan or overseas during disasters (e.g., typhoons, earthquakes, etc.). We used a convenience sample and eligible nurses were selected from staff nurses at the military hospital that provides care to military service members on active duty, patients with national medical insurance, and the general public. The inclusion criteria were: (1) registered hospital nurses aged 20–65 years; (2) at least three months' work experience at the local medical centre; (3) a full-time worker; (4) able to speak and understand Mandarin; and (5) agreed to participate in the research. Excluded nurses were: those who had not yet signed contracts with the hospital because they were unable to work independently in the assigned work units/specialty; trainee nurses without nursing licences; and nurses who did not provide direct care to patients.

The sample size was estimated using G-Power version 3.1 analysis and calculated based on multivariable linear regression (random model) with an effect size (f2) of 0.1, assuming 30 predictors/covariates, an alpha of 0.05, and a power of 0.8, resulting in 282 participants [15]. Considering a conservative estimation of an 80% response rate, an estimated sample of 376 hospital nurses was required.

2.3. Measures

Data on sociodemographic characteristics (age, gender, marital status, educational level), length of nursing work (year), position (military or civilian nurse), nursing leader (yes or no), work unit/specialty (critical care units/emergency, general/medical-surgical ward, or other such as outpatient department, operation room, etc.), previous disaster training (yes or no), previous disaster nursing experience (yes, no, or not yet but on list), and readiness for disaster responses were collected using self-administered questionnaires. The length of nursing work was represented by the duration (in years) during which a nurse is registered to engage in clinical nursing practice. In this study, participants responsible for overseeing the nursing staff, coordinating patient care, and managing resources, including head nurses and assistant head nurses in the hospitals, were categorized as nursing leaders. In addition, participants with previous disaster nursing experience indicated that they had prior involvement in providing healthcare or nursing services during or after disaster or emergency situations, such as earthquakes, floods, or aviation accidents. The individuals on the list had undergone comprehensive training and had been designated to take charge of medical rescue and healthcare in future unexpected disaster events.

2.3.1. Readiness for disaster responses

The 40-item self-administered Readiness for Disaster Responses Scale with well-established reliability and validity was used to measure the nurses' readiness for disaster responses in four domains: personal preparedness (16 items), self-protection (11 items), emergency response (6 items), and clinical management (7 items) [7]. The internal consistency reliabilities of the entire questionnaire and its four subscales were 0.96, 0.97, 0.88, 0.86, and 0.85, respectively. Each item was scored from 1 (strongly disagree or very low readiness) to 5 (strongly agree or very high readiness) on a five-point Likert scale, and the total score ranged from 40 to 200 (personal preparedness: 16–80, self-protection: 11–55, emergency response: 6–30, clinical management: 7–35). Higher scores represent higher levels of readiness for disaster responses. The percentage of total scores was also presented. Score percentages above 50% and 75% indicated 'moderate readiness' and 'high readiness', respectively, while score percentages below 50% and 25% indicated 'low readiness' and 'very low readiness', respectively. Before our study, we conducted a pilot test to ensure the content validity of the scale, involving 5 disaster-related experts (content validity index: 0.91). In addition, the Cronbach's alpha for the scale and its four subscales (personal preparedness, self-protection, emergency response, and clinical management) in the present study were 0.96, 0.96, 0.90, 0.80, and 0.76, respectively.

2.4. Ethical considerations

Ethical approval (TSGHIRB No: 2-103-05-018) was obtained from the institutional review board of the local medical centre before the commencement of the study. All nurses participated voluntarily and were informed of the study purpose, procedures, and confidentiality of the study and were compensated with seven USD after completing the questionnaires. All the questionnaires remained anonymous and were returned in sealed envelopes to the same research assistant mentioned above.

2.5. Analysis

Statistical analyses were performed using SPSS statistical software (SPSS/PC, version 16.0 for Windows). Descriptive data were presented as mean (standard deviation [SD]) and number (percentage) for the continuous and categorical variables, respectively. Pearson product-moment correlation and a general linear model (GLM) were used to assess the associations between demographic characteristics, nurses' readiness for disaster responses and its four domains, for univariate analysis. Multiple linear regression models were applied to investigate the associations between independent variables of 'demographic characteristics', and dependent variable

'of nurses' readiness for disaster responses', after adjusting for potential covariates from univariate analysis. All analyses were two-tailed, and a p-value <.05 was considered statistically significant.

3. Results

3.1. Characteristics of participants

Of the 399 hospital nurses who consented to participate, 365 completed the study with a response rate of 91.5%. Table 1 presents the demographic characteristics of the participants. The average score and percentage of total score of the readiness for disaster responses, including its four subscales (personal preparedness, self-protection, emergency response, and clinical management), were 114 (SD = 25.6)/46.3%, 47.8 (SD = 12.2)/49.7%, 28.0 (SD = 8.0)/38.6%, 16.3 (SD = 4.2)/42.9%, and 22.7 (SD = 5.0)/56.1%, respectively.

3.2. Determinants of nurses' readiness for disaster responses

Table 2 presents the univariate analyses between demographic characteristics, the nurses' readiness for disaster response, and its four domains. The finding revealed that age, marital status, educational level, length of nursing work, position, nursing leader, work unit/specialty, previous disaster training, and previous disaster nursing experience, were associated with the readiness for disaster responses.

In multiple linear regressions (Table 3), we ignored the age variable since collinearity existed in both variables of age and length of nursing work, and found that length of nursing work and previous disaster training were significantly associated with the nurses' readiness for disaster responses and with all four subscales when adjusting for potential covariates. Additionally, nurses with master's degrees and above had higher readiness for disaster responses ($\beta = 0.13$, $p = .032$), emergency response ($\beta = 0.13$, $p = .030$), and clinical management ($\beta = 0.14$, $p = .022$) than those with bachelor's degrees. Similarly, participants working in intensive care units (ICUs)/emergency rooms had greater readiness for disaster responses ($\beta = 0.14$, $p = .024$), emergency response ($\beta = 0.15$, $p = .010$), and clinical management ($\beta = 0.33$, $p < .001$) than those working in other units. Furthermore, nurses working in ICUs or emergency rooms also had higher emergency response ($\beta = 0.13$, $p = .033$) than those working in general/medical-surgical wards. Nursing leaders

Table 1
Participants' demographic characteristics and scores in readiness for disaster responses (N = 365).

		Mean ± SD	n (%)
Age (year)		32.6 ± 8.1	
Length of nursing work (year)		12.6 ± 8.5	
Gender			
	Female		327 (89.6)
	Male		38 (10.4)
Marital status			
	Married		143 (39.2)
	Single		222 (60.8)
Educational level			
	Associate		88 (24.1)
	Bachelor		244 (66.9)
	Master and above		33 (9.0)
Position			
	Military nurse		73 (20)
	Civilian nurse		292 (80)
Nursing leader			
	Yes		33 (9.0)
	No		332 (91.0)
Work unit/specialty			
	Critical care units/Emergency		126 (34.5)
	General/Medical-Surgical ward		162 (44.4)
	Other		77 (21.1)
Previous disaster training			
	Yes		70 (19.5)
	None		295 (80.5)
Previous disaster nursing experience			
	Yes		14 (3.8)
	Not yet (prepared in list)		49 (13.4)
	None		302 (82.7)
Nurses' readiness for disaster responses (total scores: 40–200)		114 ± 25.6/46.3%[a]	
Personal preparedness (total scores: 16–80)		47.8 ± 12.2/49.7%[a]	
Self-protection (total scores: 11–55)		28.0 ± 8.0/38.6%[a]	
Emergency response (total scores: 6–30)		16.3 ± 4.2/42.9%[a]	
Clinical management (total scores: 7–35)		22.7 ± 5.0/56.1%[a]	

Note: [a] Percentage of total scores.

Table 2
Univariate analysis between demographic characteristics and nurses' readiness for disaster responses (N = 365).

Variable	Nurses' readiness for disaster responses		Personal Preparedness		Self-protection		Emergency response		Clinical management	
	r/Mean (SD)	*p*	r/Mean (SD)	*p*	r/Mean (SD)	*p*	r/Mean (SD)	*p*	r/Mean (SD)	*p*
Age		<.001	.139[a]	.008	.188[a]	<.001	.325[a]	<.001	.111[a]	.03
Gender										
Female (n = 327)	114 (25.5)	.40	47.7 (12.2)	.43	27.8 (8.0)	.18	16.2 (4.1)	.30	22.5 (5.0)	.06
Male (n = 38)	120 (25.8)	Ref	49.3 (12.2)	Ref	29.6 (8.0)	Ref	17.0 (4.2)	Ref	24.1 (4.9)	Ref
Marital status										
Single (n = 222)	113 (24.9)	.01	47.3 (12.3)	.27	27.4 (7.6)	.07	15.8 (4.0)	.001	22.4 (4.8)	.28
Married (n = 143)	118 (26.4)	Ref	48.7 (12.1)	Ref	28.9 (8.5)	Ref	17.2 (4.3)	Ref	23.0 (5.4)	Ref
Educational level										
Associate (n = 88)	111 (25.7)	.02	46.1 (12.3)	.02	27.3 (7.2)	.82	15.9 (4.2)	.08	21.6 (5.3)	.01
Bachelor (n = 244)	115 (25.6)	.07	47.9 (12.1)	.07	28.3 (8.3)	.71	16.3 (4.2)	.16	22.8 (5.0)	.14
Master and above (n = 33)	121 (23.7)	Ref	52.1 (11.7)	Ref	27.7 (7.3)	Ref	17.4 (4.5)	Ref	24.2 (4.4)	Ref
Length of nursing work	.420[a]	<.001	.128[a]	.01	.172[a]	.001	.310[a]	<.001	.110[a]	.04
Position										
Military nurse (n = 73)	123 (28.1)	.01	51.3 (13.1)	.01	29.4 (9.7)	.09	17.6 (4.3)	.003	24.3 (4.7)	.001
Civilian nurse (n = 292)	113 (24.5)	Ref	47.0 (11.8)	Ref	27.6 (7.5)	Ref	16.0 (4.1)	Ref	22.2 (5.1)	Ref
Nursing leader										
No (n = 332)	114 (25.8)	<.001	47.4 (12.3)	.03	28.0 (8.0)	.91	16.1 (4.1)	<.001	22.5 (5.1)	.102
Yes (n = 33)	123 (21.7)	Ref	52.3 (10.3)	Ref	28.1 (7.5)	Ref	18.5 (4.2)	Ref	24.0 (4.2)	Ref
Work Unit/Specialty										
Intensive care centre/ Emergency room (n = 126)	121 (25.5)	<.001	50.2 (12.4)	.02	28.9 (8.7)	.35	17.5 (3.9)	.01	24.3 (4.3)	<.001
General/Medical-surgical ward (n = 162)	113 (25.0)	0.53	46.9 (11.8)	.58	27.3 (7.7)	.63	15.7 (4.2)	.79	22.7 (5.0)	<.001
Other (n = 77)	110 (25.3)	Ref	45.9 (12.4)	Ref	27.8 (7.3)	Ref	15.8 (4.2)	Ref	19.9 (5.1)	Ref
Previous disaster training										
None (n = 295)	111 (24.6)	<.001	46.4 (12.0)	<.001	27.1 (7.5)	<.001	15.8 (4.0)	<.001	22.1 (5.0)	<.001
Yes (n = 70)	130 (24.2)	Ref	54.0 (10.9)	Ref	31.9 (8.8)	Ref	18.6 (4.2)	Ref	25.0 (4.5)	Ref
Previous disaster nursing experience										
Yes (n = 14)	128 (29.8)	<.001	54.6 (12.58)	.02	30.7 (14.7)	.11	17.6 (4.5)	.112	25.4 (4.6)	.015
Not yet (prepared in list) (n = 49)	128 (28.3)	<.001	53.2 (13.1)	<.001	31.7 (8.7)	<.001	18.8 (4.3)	<.001	25.1 (5.0)	<.001
None (n = 302)	112 (24.0)	Ref	46.6 (11.7)	Ref	27.2 (7.2)	Ref	15.9 (4.0)	Ref	22.1 (4.9)	Ref

Note: [a] Pearson correlation coefficient; *p*-values were from either Pearson correlation or General linear model; Reference group: gender (male), married status (married), education (master), position (civilian nurse), nursing leader(yes), work unit/specialty (other), previous disaster training (yes), previous disaster nursing experience (none).

were associated with higher self-protection (β = 0.13, $p = .048$) after adjusting for potential covariates.

4. Discussion

This study examined the determinants of readiness for disaster responses among hospital nurses and revealed that length of nursing work, educational level, working unit/specialty, and previous disaster training were associated with readiness for disaster responses. Hospital nurses with longer experience in nursing work, a master's degree, working in ICUs or emergency rooms, and who previously received disaster training were associated with greater readiness for disaster responses. These findings can help nurse administrators or educators recognise significant determinants of hospital nurses' readiness for disaster responses in responding to unexpected disasters, which they can then consider for future recruitment of nurses for deployment in disaster management assistance, and for designing disaster training programs for use in continuous education in clinical settings.

Disasters are increasing all over the world, and Taiwan, in particular, is one of the high-risk countries in this regard. This highlights the necessity of preparing hospitals as crucial response centers during disasters, which the situation also observed in Iran [16]. Therefore, to increasing readiness for disaster responses is essential for healthcare professionals, particularly frontline nurses, for effective and timely response to save lives and minimise damage [14]. However, most hospital nurses from northern Taiwan in our study reported relatively low-to-middle readiness for disaster responses, consistent with previous findings [17], including those in Hong Kong [18], the Philippines [19], Australia [20], and Iran [16]. This highlights that governments across countries should partner with healthcare organizations and invest in disaster management training for hospital nursing staff to ensure their preparation in handling emergencies and responding effectively. Our study demonstrated that among the four domains of readiness for disaster

Table 3
Predictors of nurses' readiness for disaster responses based on multiple linear regression models (N = 365).

Model	Parameter	β	*p*
1. Nurses' readiness for disaster responses			
	Length of nursing work	0.28	< **.001**
	Educational level/Master and above (Reference group: bachelor)	0.13	**.032**
	Working unit/Intensive care centre or Emergency room (Reference group: other units/specialty)	−0.14	**.024**
	Previous disaster training	0.24	< **.001**
2. Personal preparedness			
	Length of nursing work	0.20	**.003**
	Previous disaster training	0.21	< **.001**
3. Self-protection			
	Length of nursing work	0.24	< **.001**
	Nursing leader	0.13	**.048**
	Previous disaster training	0.24	< **.001**
4. Emergency response			
	Length of nursing work	0.39	< **.001**
	Educational level/Master and above (Reference group: bachelor)	0.13	**.030**
	Working unit/Intensive care centre or Emergency room (Reference group: other units/specialty)	−0.15	**.010**
	Working unit/Intensive care centre or Emergency room (Reference group: medical-surgical ward)	−0.13	**.033**
	Previous disaster training	0.22	< **.001**
5. Clinical management			
	Length of nursing work	0.25	< **.001**
	Educational level/Master and above (Reference group: bachelor)	0.14	**.022**
	Working unit/Intensive care centre or Emergency room (Reference group: other units/specialty)	−0.33	< **.001**
	Previous disaster training	0.15	**.005**

Note: *p*-values were from linear regression models; all models included independent variables such as length of nursing work, marital status, educational level, position, nursing leaders, work unit/specialty, previous disaster training, and previous disaster nursing experience for adjustment, and only the significant independent variables were presented. The R-squared values for each model with only the significant independent variables were 0.158 (Model 1), 0.121 (Model 2), 0.100 (Model 3), 0.209 (Model 4), and 0.172 (Model 5), respectively.

responses, three subscales, namely: personal preparedness, self-protection, and emergency response, showed only low-to-middle among the participants. Self-protection garnered the lowest scores across the four subscales. The participants reported the highest readiness for disaster responses in clinical management, which includes physical assessment, traumatic wound care, and equipment operation in an austere environment, consistent with a previous study [7]. This is possibly because participants performed clinical skills during their daily practice, and related clinical management was included regularly in their continuing education programmes. However, readiness in clinical management may not guarantee effective responses in disaster situations. The other three subscales of readiness for disaster responses–personal preparedness, self-protection, and emergency response–are highly recommended for future disaster education for hospital nurses. Moreover, it is important for healthcare organizations to regularly review and update their disaster management plans and education programs to reflect changes in technology, best practices, and lessons learned from past disaster events. For instance, a recent study assessed the emergency response capabilities of hospitals when confronted with the novel challenge of incidents stemming from mass gatherings. The study revealed that hospitals exhibited a moderate level of readiness for emergency response, indicating the need for health systems to formulate comprehensive strategic plans aimed at enhancing hospitals' preparedness and capacity for prompt and effective disaster response during mass gatherings [21]. Such improvement can be achieved through focused training initiatives and the implementation of thorough deliberation. Investing in disaster management training and planning can ensure that hospital nurses are equipped to respond to disaster situations and provide optimal care to victims during disasters.

Initially, our study found that senior nurses perceived higher readiness for disaster responses of themselves in all subscales based on multivariate analysis, which was consistent with previous research findings conducted with Iranian nurses of emergency departments [8]. Since collinearity existed in both variables of age and length of nursing work, we selected the variable 'length of nursing work experience' to replace the 'age' variable in multiple linear regression models and found that participants' length of nursing work experience was positively associated with readiness for disaster responses and all of its four subscales. These results are similar to those of previous studies [7,22]. A Sweden study indicated that registered nurses reported a significantly higher readiness for disaster responses than nursing students, both within and outside healthcare facilities [22]. This showed that clinically active nurses with experience in serious clinical challenges may indeed have greater readiness for disaster responses in handling disaster events; and the longer the length of nursing work experience, the greater the readiness for disaster responses of hospital nurses.

A real disaster response experience is closely linked to being well prepared for responding to disasters and coordinating that response with other organizations [23,24]. Our findings confirmed that experiences in disaster response are more likely to result in perceived readiness for disaster responses in future disaster events [7,8,23]. Multivariate analyses which included all independent variables confirmed this in our study. However, in multiple linear regression models which included all significant variables from the univariate analyses except for gender (non-significant) and age (collinearity with length of nursing work), the association became non-significant. This might be because our study had several hospital nurses who had never participated in disaster management (96.2%). Moreover, we conducted further analyses and found that gender was significantly related to previous disaster nursing experience. Given that the participants only comprised 10.5% male nurses, a higher proportion of male nurses had previous disaster

nursing experience (5.3% vs. 3.7%) and were on the standby list for deployment to disaster response (31.6% vs. 11.4%) than female ones. These results without adjustment for gender in multiple linear regression models might possibly contribute to results that differ from previous studies [24]. We also found that nurses with previous disaster training were associated with greater readiness for disaster responses, which is consistent with previous studies [14,23]. This highlights the importance of education and training programs [10].

Nurses' readiness for disaster responses may vary according to their background knowledge, discretionary judgment, and clinical competency [23]. Our study found that nurses with a master's degree had higher readiness for disaster responses overall and in two subscales (emergency response and clinical management) than those with only a bachelor's degree. Similarly, a recent study indicated that nurses with a postdiploma degree and bachelor's degree were perceived to have lower disaster competency and readiness than those with a master's or PhD [8]. Choi & Lee (2021) also concluded that a higher level of education predicted public hospital nurses' willingness to respond to a disaster. Advanced education provides nurses with a more comprehensive understanding of disaster management principles, and equips them with the skills and knowledge necessary to effectively manage emergencies in various disaster situations [9]. Higher levels of education can lead to better critical thinking skills [25], essential in managing complex and unpredictable situations. We conjecture that nurses with higher education may have had more opportunities to receive specialised training and participate in continuing education programs that focus on disaster management. They may also have more experience in leadership roles, which can be invaluable in coordinating disaster response efforts. However, a higher educational level was not associated with greater personal preparedness and self-protection ability in the current study. Possible reasons might be that these dimensions are predicted by other personal characteristics/traits or factors, such as anticipatory disaster stress, motivation or willingness, and self-efficacy [9].

Previous studies revealed that nurses working in ICU or emergency care reported significantly better disaster nursing competency and readiness for disaster responses than those working in other areas of healthcare [7,22], which was confirmed by this study. Our participants working in ICUs or emergency rooms had higher readiness for disaster responses than those working in other units/specialties in the same hospital/medical centre. Taiwanese hospital nurses working in ICUs or emergency rooms are required to undergo a structured critical care training program for at least 120 h. This typically covers a range of sessions and skills such as advanced life support skills, haemodynamic monitoring, pharmacokinetics, pharmacodynamics of commonly used medications in critical care, management of critically ill or emergency patients with specific conditions (i.e. traumatic injuries, burn injuries), and interdisciplinary communication and teamwork. After completing the program, nurses are certified and qualified to work in ICUs or emergency rooms in Taiwan's medical centers. Furthermore, according to our findings, nurses working in different units within the hospital had varying levels of readiness for disaster responses based on their training, experience, and exposure to critical/emergency events. For example, nurses working in emergency rooms are often on the frontline facing numerous casualties or disasters, such as the Formosa Fun Coast Water Park dust explosion in northern Taiwan in 2015. They need to have triage skills, recognise life-threatening conditions, and initiate appropriate interventions effectively and quickly. They also need to be skilled in communicating and coordinating with other healthcare providers and emergency response teams. Additionally, nurses working in critical care units provide advanced care for critically ill patients who require advanced life support, haemodynamic monitoring, and other specialised interventions. Therefore, these nurses may tend to adapt better to limited resources and challenging conditions in disaster situations.

Substantial evidence supports an association between disaster training and readiness for disaster responses [7,10,14,17]. Having received disaster training can increase disaster-related knowledge and skills based on the forms/methods of disaster training programs (lectures, simulations, problem-solving lessons, flipped classrooms, tabletop exercises, and virtual reality, etc.) and might contribute to better readiness for disaster responses. Continuous research on disaster nursing is recommended due to the ever-changing nature of global disasters. Following the recent spate of natural and human-generated disasters, the Taiwan government expanded the budgets to improve disaster response training and hospitals' coping abilities, particularly military hospitals. Thereby, nursing professionals should actively participate in the development of disaster management education and training programs and initiate the training of disaster nursing specialists.

Government-affiliated hospitals or military hospitals in each country should prepare and recruit the potential disaster nursing workforce list. It is widely reported that nurses are insufficiently prepared and are not perceived confident or competent responding effectively to disasters [26,27], health policymakers and educators should design a robust curriculum in disaster management training programs and incorporate into essential nursing continuing education to prepare for the future of competent nurses for the nation. Administrators must support and encourage nurses to actively participate in educational opportunities and further actual disaster events. The nurses' willingness to assume the risk of involvement in a disaster situation might also be an important factor. Baack and Alfred (2013) indicated that motivation was a significant predictor of nurses' readiness for disaster responses and disaster management competency. Future studies are recommended to develop strategies or interventions for strengthening nurses' motivation to actively engage in disaster care [26].

Several limitations of this study include the lack of causal relationships and generalisability due to the cross-sectional design and convenience sampling method. Conducting the study in a single research site may limit the variability of the data, reducing the ability to observe diverse patterns and associations. The research site might have specific characteristics or unique features that limit the scope and general applicability of the study's findings. In addition, the R-square value obtained from our regression analysis was relatively low, signifying a limited extent of variation in the dependent variable explained by the included independent variables. Given that our model may not have encompassed all pertinent variables contributing to the variability in the dependent variable, we also present a comprehensive exploration of critically significant factors influencing the readiness for disaster response in hospital nurses. Some other factors such as anticipatory disaster stress, motivation, or willingness to engage in disaster response, which were not evaluated in this study, might potentially result in different findings. Additional research is needed to identify the important

predictors in this population through diverse cultures and multi-centers. Moreover, adding qualitative studies and systematic reviews/meta-analyses in future studies would provide more information to clarify nurses' important predictors of readiness for disaster responses.

5. Conclusion

Hospital nurses with longer years of nursing work experience, higher educational level, working in ICUs and ERs, disaster-related nursing experience, and previous training in disaster management had greater readiness for disaster responses. Conducting continuous disaster education and training programs, specifically related to personal preparedness, self-protection, and emergency response skills, to potential disaster-management nurses is important to improve nurses 'readiness for disaster responses. Therefore, nursing administrators must support and encourage nurses to actively enrol in educational opportunities and assist in actual disaster events, because disaster management experience is crucial in honing this skill. Furthermore, prospective research endeavors could delve further into the specific impact of diverse disaster education and training programs in bolstering nurses' preparedness for disaster responses. A potential avenue of investigation involves the development and execution of tailored educational interventions that emphasize personal preparedness, self-protection, and emergency response skills.

Author contribution statement

Chia-Huei Lin Wen-Chii Tzeng; Shang-Lin Chiang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Meei-Shyuan Lee: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Li-Chi Chiang: Conceived and designed the experiments; Wrote the paper.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Chia-Huei Lin reports financial support was provided by National Defense Medical Center. Shang-Lin Chiang reports a relationship with National Defense Medical Center that includes: non-financial support.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e20579.

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