ORIGINAL RESEARCH

Adverse Events and Risk Management in Residential Aged Care Facilities: A Cross-Sectional Study in Hunan, China

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Purpose: Adverse events threaten residents' safety. Risk management is important to provide proper care and maintain quality in residential aged care facilities (RACFs). However, there is little data on adverse events, risk management, and risk early warning in RACFs in the Chinese mainland. This study aimed to fill this gap by investigating the prevalence of the aforementioned aspects and related factors in China.

Participants and Methods: Using a cross-sectional design, a field survey of 272 RACFs in Hunan Province was conducted from January 25 to June 1, 2020. Data were collected using four main tools on prevalence of nursing adverse events, risk management, risk early warning, and general information. Descriptive statistics were described by frequency (percentage) and median (interquartile range). Mann–Whitney U-test and Kruskal–Wallis H-test, and Spearman coefficient were used for statistical analysis.

Results: RACFs experienced an average of five (15) adverse events in 2019, with falls and pressure ulcers being the most common. The total average score of risk management in RACFs was 4.72 (0.98) out of 5, with the environment and personnel management dimensions scoring the highest with 4.75 (1) and the service management dimension scoring the lowest with 4.60 (1). Only 72.79% had trained their staff on ethical and legal knowledge and 84.56% had utilized pre-hospital first aid. Further, 30% to 40% were unprepared for contingency plans of suicide, electric shock, gas poisoning, and drowning. There were significant risk management differences among the following variables: facilities' locations, accreditation with the Practice Certificate of Social Welfare Facilities, bed-size, nursing hours per resident day, requirement for nursing staff with certificates, and payment for nursing staff ($p < 0.05$).

Conclusion: RACFs are facing safety challenges with a high prevalence of nursing adverse events. These facilities need to improve risk early warning and management to ensure residents' safety.

Keywords: safety measures, quality of nursing care, nursing homes, geriatric care

Introduction

Regarding urbanization and industrialization, population aging is one of the most urgent problems globally, specifically for developing countries with limited resources for old-age care.[1] China has the highest number of older adults; it is also one of the countries with the fastest aging population.[2] The proportion of adults over 65 years has increased from 13.3% in 2010 to 18.7% in 2020.[3] Residential aged care facilities (RACFs), a thriving way of old-age care, have become increasingly important in China, because of the "one-child" policy, increase in life expectancy, and weakening role of family care.[4] Currently, less than 200,000 nurses provide nursing care for about 2.146 million older adults in 42,300 RACFs.[5] Due to the decline of physical strength and physiological functions of older adults, their chances of suffering from chronic physical diseases, mental disorders, and disabilities have increased.[6] Along with the shortage of nursing staff, insufficient professional skills, and other problems,[7] older adults living in RACFs are at a high risk of suffering from care accidents and nursing adverse events (eg falls, burns, choking, aspiration, wandering away, and pressure sores),[8] which negatively impact their physical and mental wellbeing and can cause disputes, economic and property losses, among others. The role of risk management in effectively reducing nursing adverse events and maintaining older adults' safety has been widely documented.[9,10] Given various risks

faced by RACFs, managers urgently need to actively adopt risk management and early warning strategies to reduce the potential mistakes in care delivery for older adults.

Background

Risk management is a complicated process of implementing and maintaining countermeasures to reduce risk impact to an acceptable level.[11] In the past decade, governments, researchers, and RACFs have been devoted to exploring nursing risk indicators, establishing nursing risk early warning systems, and formulating nursing risk prevention strategies. For example, the UK and the US have applied a standardized assessment tool, namely the Minimum Data Set (MDS), to systematically assess and review nursing practices, identify nursing home residents at risk of deterioration, and protect residents' integrity and autonomy.[12,13] Australia developed nursing risk assessment indicators for older adults, which involve pressure sores, falls or fractures, use of physical restraints, and psychological and behavioral symptoms.[14] Several risk analysis methods such as Failure Mode and Effects Analysis (FMEA),[15] Fine–Kinney method,[16] SHEL model (software, hardware, environment, and liveware),[17] Swiss cheese model,[18] are widely applied to identify potential human mistakes in practice. With the wide application of information technology (IT) in healthcare, risk management information systems (RMIS) are often applied for data collection, information analysis, and statistical reports to identify and monitor preventable incidents. In the UK, through the National Early Warning Score (NEWS) system[19] as well as the National Reporting and Learning System, a supportive environment for actively reporting and sharing errors is created, and related experiences and lessons are widely disseminated.

Chinese scholars and healthcare professionals tried to conduct preliminary studies of risk management in RACFs. For example, Li et al[20] used FMEA to analyze various internal risks regarding infectious diseases, injuries, falling, and accidents in RACFs. Zhou[21] tried to establish risk prevention and management systems for RACFs including external, internal, and economic risks. Based on the prevention, preparedness, response, and recovery (PPRR) risk management model, Zhang[22] established an emergency practical path for public health emergencies in RACFs. China's government departments such as the China National Committee on Aging, Ministry of Civil Affairs, China Academy of Social Management have tried to improve RACFs care quality and have promulgated relevant policies and regulations. China's Ministry of Civil Affairs created requirements for the room environment and older adults' sanitation as well as safety measures in RACFs, such as barrier-free design and smooth and non-slip floors. The establishment of such facilities should pass the evaluation by local authorities regarding construction, fire protection, sanitation, and epidemic prevention. Additionally, the national mandatory standard-basic specification of service safety for senior care organizations requires each RACF to reduce risks of choking, pressure ulcer, scald, fall, and so on through standardized operation procures and risk management.[23]

Effective risk management activities usually include the following stages: identification, analysis, evaluation and treatment, and communication and consultation.[24] Evaluation and feedback are essential to accumulate long-term evidence and guarantee the care outcomes and older adults' safety regarding risk management and early warning in RACFs. However, existing studies fail to provide a clear picture of the prevalence status, risk management, and risk early warning of nursing adverse events in RACFs. Thus, this study aims to (1) investigate the prevalence of nursing adverse events, risk management, and risk early warning status and (2) explore the factors associated with risk management in RACFs in China.

Materials and Methods
Design
This study used a cross-sectional design and employed an online questionnaire to investigate RACFs in Hunan Province.

Participants
A convenience sample (a type of non-probability sampling method where the sample is drawn from a group of people easy to contact and obtain their participation)[25] of 272 RACFs were recruited in Hunan Province. RACFs' managers were invited to respond to the survey. The inclusion criteria were 1) license for establishment and registration in the local

civil affairs department; 2) operation duration of at least one year; 3) equipped with ten or more beds; 4) consent to participate in the study.

Survey Tools

The self-administered questionnaire used had four sections: prevalence of nursing adverse events, risk management, risk early warning, and general information survey scales.

Prevalence of Nursing Adverse Events

This section is used to inquire about the prevalence of nursing adverse events in RACFs in the past year (2019), including 14 fill-in-the-blank questions. Respondents were required to provide an accurate figure in each blank. The type of adverse events in this study included falls,[26] falling out of beds (or chairs), fractures,[27] food poisoning,[28] burns or scalds,[29] choking,[30] aspiration or swallowing of foreign bodies,[31] wandering away,[32] accidental death, pressure sores,[33] medication errors,[34] adverse events caused by physical restraints,[35] and accidental catheter removal (ie cannula, endotracheal tube, nasogastric tube, and urinary catheter).[36]

Risk Management Scale

The risk management scale was self-developed from our previous research[37] to evaluate the status of RACFs. It includes 28 items and four management dimensions: environment (4 items), personnel (4 items), service (10 items), and safety (10 items). Each item is scored on a five-point Likert scale ranging from 1 (completely inappropriate) to 5 (completely appropriate). The scale is scored by summing the numerical ratings for each item and dividing the result by the total number of items. Possible scores ranged from 1 to 5. The higher the score, the better risk management. The overall Cronbach's α coefficient of this scale was 0.974, and its split-half reliability (used to measure the internal consistency reliability of survey instruments and assessed by splitting the items of survey instrument in half, and then calculating the correlation of the scores for each half)[38] was 0.951. Cronbach's α coefficients for the environment personnel, service, and safety management dimensions were 0.842, 0.905, 0.924, and 0.943, respectively.

Risk Early Warning Scale

The risk early warning scale was self-designed from our previous study[39] to evaluate the early warning status of RACFs. The scale comprises four dimensions with 26 items: nursing staff training (six items), a contingency plan for public security incidents (eight items), a contingency plan for age-related safety incidents (seven items), and emergency management (five items). Participants respond "Yes" or "No" to each item (1 = Yes; 0 = No). The total score ranges from 0 to 26, and a higher score signifies better risk early warning. In this study, the Cronbach's α coefficient of the entire scale was 0.874 and the split-half reliability was 0.786. Cronbach's α coefficients for the nursing staff training, a contingency plan for public security incidents, contingency plan for age-related safety incidents and emergency management dimensions were 0.720, 0.813, 0.724, and 0.682, respectively.

General Information

This section captured RACFs' demographic characteristics, such as the ownership and location of the facility, whether it has the Practice Certificate of Social Welfare Facilities, operation duration (year), bed-size, number of residents, number of nursing staff, whether it requires nursing staff to work with certificates, and payment for nursing staff (RMB/month).

Data Collection

From February 1 and March 1, 2020, the primary researchers sent the recruitment invitation and informed consent form to the RACF managers in Hunan Province through email and obtained a copy of the written informed consent from 401 eligible RACFs. Then, we recruited sophomore nursing students as investigators, who were not allowed to return to School because of the isolation policy due to COVID-19. From March 5 to May 10, 2020, potential student investigators received curriculum and instructions on the questionnaire survey guidelines, quantitative research design, and data collection methods. The primary researcher distributed the questionnaire link to WeChat groups (the most popular social media application in China) and ensured all student investigators had the survey link. Finally, 114 students participated in

the data collection of RACFs in their county administrative areas (one investigator per county-level administrative region). From May 13 to June 1, 2020, student investigators collected data from nearby RACFs and invited the managers to respond to the survey. In the field survey, the investigators did not conduct the questionnaire survey until they obtained the participants' oral consent. While interviewing the RACF managers according to the survey scale, the investigators recorded the answers into the online questionnaire (https://www.wenjuan.com/s/F3aaUvT/) on their mobile phones.

Ethical Considerations

Before collecting data, the investigators explained the purpose, process, as well as potential benefits and risks to the RACF managers. The collected data did not contain the identifiable information of the RACFs or managers. This study conforms to the provisions and ethical principles of the 1995 Declaration of Helsinki (revised in Edinburgh in 2000). The Institutional Review Board of the Affiliated Hospital of Xiangnan University approved this study (registration number: KY–201508001).

Data Analysis

We excluded questionnaires with more than 20% data missing, which could not be supplemented by other means. The questionnaires were sorted by the principal researchers, and the data were analyzed using SPSS 25.0 statistical software. The Kolmogorov–Smirnov normality test was performed on continuous data. The normality tests showed that all continuous variables had a non-normal distribution. In this study, continuous variables were described by median (interquartile range, IQR), and categorical variables were described as frequency and percentage and presented in bar charts. The statistical analysis was conducted using the Mann–Whitney U-test and Kruskal–Wallis H-test, and Spearman correlation was used to analyze the association with the main independent variables. The significance level was set as 0.05.

Results

General Characteristics of the Sample

In total, 328 questionnaires were collected; after excluding 56 questionnaires, 272 valid questionnaires were obtained. Figure 1 shows the distribution of the sample RACFs.

Finally, this study analyzed 152 (55.88%) public and 120 (44.12%) private RACFs. Most were in rural areas (n = 150; 55.15%), obtained the *Practice Certificate of Social Welfare Facilities* (n = 234; 86.03%), and required nursing staff to work with certificates (n = 239; 87.87%). The operation duration of RACFs was 1 to 62 (11; IQR: 12) years. The number of beds in RACFs ranged from 10 to 10,000 (70; IQR: 97), among which 81 (29.78%) had 10 to 49 beds, 86 (31.62%) had 50 to 99 beds, 60 (22.06%) had 100 to 199 beds, and 45 (16.54%) had 200 or more beds. During the survey period, the number of older adult residents was between four and 7216 (40, IQR: 54), the number of nursing staff was between one and 4000 (7, IQR: 14), and the nursing hours per resident day (HPRD) ranged between 0.16 and 16.84 (1.48, IQR: 1.64; calculated according to nursing staff working 8h per day; Table 1, Figure 2).

Prevalence of Nursing Adverse Events, Risk Management, and Risk Early Warning in RACFs

We found that an average of five (15) adverse events occurred in RACFs in 2019, with falls (2, IQR: 5) and pressure sores (0, IQR: 1.75) at the highest level, and accidental death (0, IQR: 0) and food poisoning (0, IQR: 0) at the lowest level (Figure 3).

This study revealed that the facility's risk management score was at an acceptable and relatively desirable level. The total average score of risk management in RACFs was 4.72 (0.98) out of 5. The score of environment management and personnel management dimensions was the highest at 4.75 (1), followed by safety management at 4.70 (1), while the score of service management dimension was the lowest at 4.60 (1; See Table 2).

Regarding the nursing staff training of RACFs, as shown in Graph A of Figure 4, more than 90% had trained their nurses on nursing knowledge and rehabilitation skills, but only 72.79% on relevant ethical and legal considerations. In
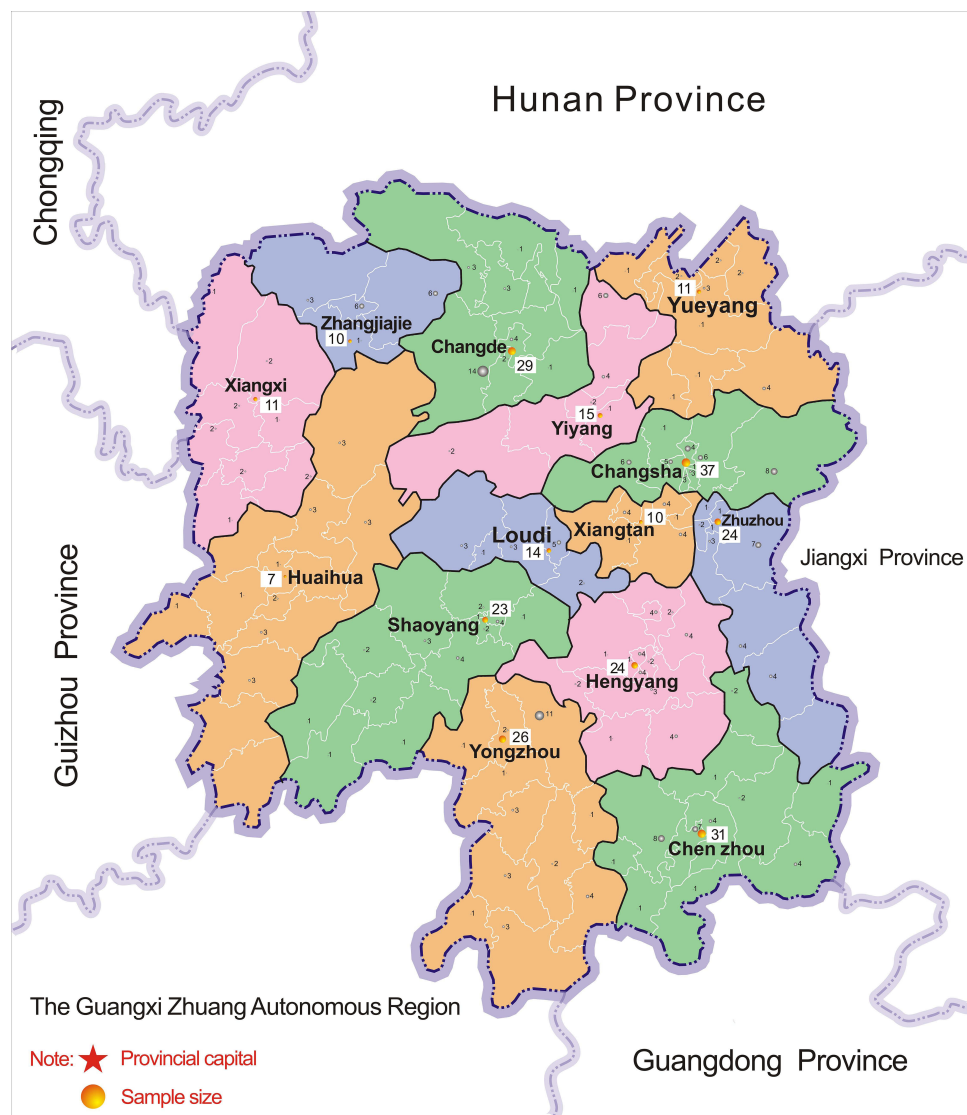
Figure 1 Distribution of the research residential aged care facilities in the Hunan Province.

terms of contingency planning for public safety incidents, most RACFs had made contingency plans for fire (96.31%) and food poisoning (92.28%), but only 66.91% and 56.99% had formulated contingency plans for gas poisoning and drowning, respectively, as shown in Graph B of Figure 4. Regarding contingency planning for age-related safety incidents, Graph C of Figure 4 shows that 95.96% and 90.81% of RACFs had made contingency plans for falls and sudden changes of diseases, respectively. However, only 73.53% reported suicide contingency plans. More than 90% regularly organized nursing staff to conduct emergency drills (92.28%), had set up emergency teams (91.91%), established a safety emergency monitoring system (92.65%), and quickly coordinated and distributed emergency materials and equipment according to critical situations (94.12%). However, only 84.56% provided pre-hospital first aid for older adults, as shown in Graph D of Figure 4.

Associated Factors of Risk Management in RACFs

The Mann–Whitney U-test or the Kruskal–Wallis H-test showed that the following factors of RACFs favor risk management: in urban areas, obtaining the Practice Certificate of Social Welfare Facilities, with more than 50 beds, providing higher HRPD, requiring nursing staff to work with certificates, and paying higher salary (all $p < 0.05$; Table 3).

Table 1 Demographic Characteristics of the Research RACFs (n=272)

Characteristic		Frequency, No. (%) (n = 272)
Ownership	Public	152 (55.88)
	Private	120 (44.12)
Location	Urban	122 (44.85)
	Rural	150 (55.15)
Held the Practice Certificate of Social Welfare Facilities	Yes	234 (86.03)
	No	38 (13.97)
Operation duration (year)	<5	72 (26.47)
	5–15	127 (46.69)
	>15	73 (26.84)
Bed-size	10–49	81 (29.78)
	50–99	86 (31.62)
	100–199	60 (22.06)
	>200	45 (16.54)
Nursing hours per resident day (hprd)	<3.5	227 (83.46)
	≥3.5	45 (16.54)
Require nursing staff to work with certificates	Yes	239 (87.87)
	No	33 (12.13)
Payment for nursing staff (RMB/month)	<1500	50 (18.38)
	≥1500	222 (81.62)

Relationships Between Risk Management Scores, Frequency of Nursing Adverse Events, and Risk Early Warning Scores

In this study, frequency of adverse events was weakly negatively correlated with the risk management scores ($r_s = -0.208$, $p < 0.01$), as well as environment ($r_s = -0.151$, $p < 0.05$), personnel ($r_s = -0.212$, $p < 0.01$), service ($r_s = -0.205$, $p < 0.01$),
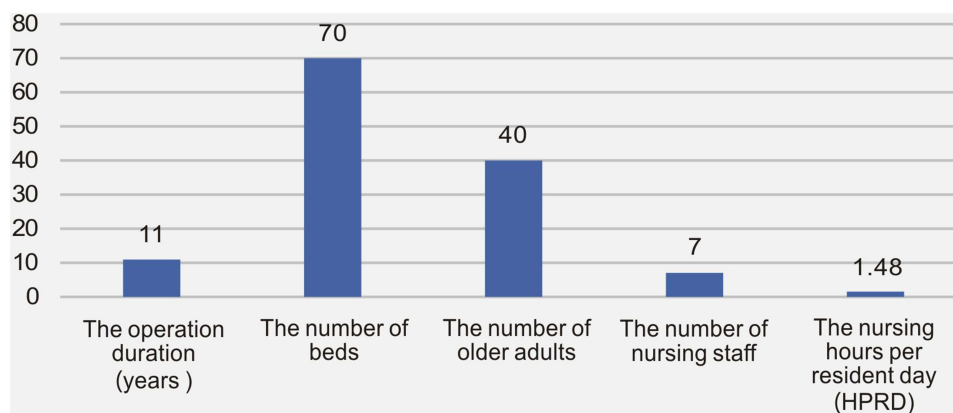
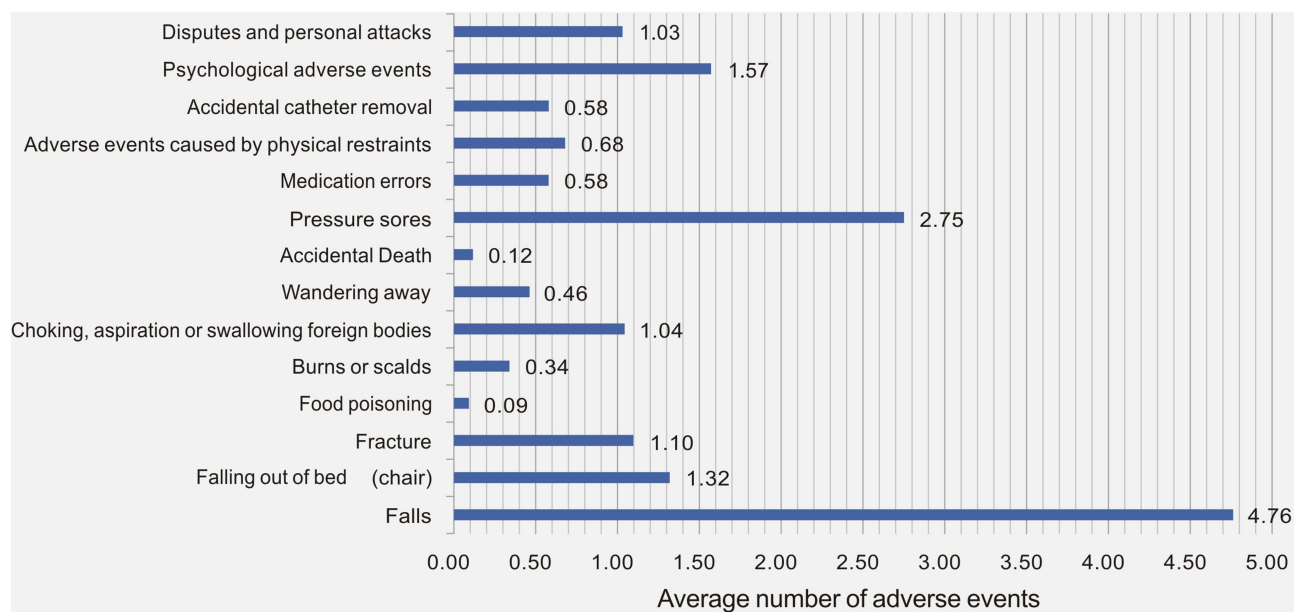Figure 2 General characteristics of the sample (median, n=272).

Figure 3 The prevalence of nursing adverse events in 2019.

and safety management ($r_s = -0.204$, p < 0.01). Moreover, risk early warning scores was moderately positively correlated with the risk management scores ($r_s = 0.516$, p < 0.01), as well as environment ($r_s = 0.434$, p < 0.01), personnel ($r_s = 0.461$, p < 0.01), service ($r_s = 0.497$, p < 0.01), safety management ($r_s = 0.511$, p < 0.01) scores, as shown in Table 4.

Discussion

We found RACFs experienced an average of five (15) adverse events in 2019, which is significantly higher than that in Italian nursing homes.[40] This may be related to the differences in survey methods (field survey vs online survey), the healthcare environment, and the time period (one year vs six weeks). However, these numbers may be significantly lower than actual incidents. Generally, most RACFs try to underreport any adverse events, which might affect their quality ratings and reputation in the community.[41,42] Kapoor[43] reported that the prevalence of adverse events in patients transitioning from hospitals to long-term care facilities was 37.3%. According to a study by Health and Human Services Inspector General Office, about 22% of older adults experienced at least one adverse event during their stay in the nursing home, and the total cost leading to rehospitalization was about USD 208 million.[44] The trend of adverse events is similar to those in other countries;[43,45,46] for instance, falls, pressure sores, psychological adverse events, falling out of bed (or chair), choking, and aspiration or swallowing foreign bodies were common adverse events in RACF settings. These may have potentially negative impacts on residents' health outcomes, quality of life, and mental health. Thus, RACFs and healthcare professionals need to make effective resident-safety interventions to reduce adverse events.

Table 2 Risk Management in Residential Aged Care Facilities (n=272)

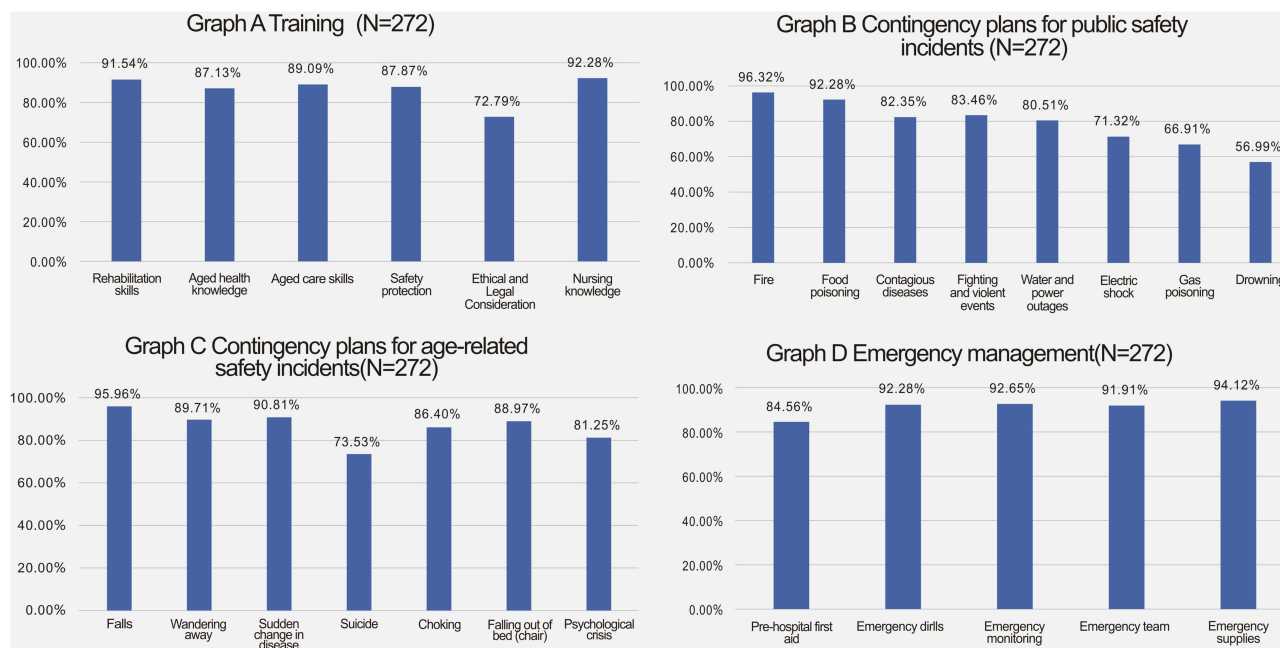| Dimension	Minimum	Maximum	Total Average Score [Median (Interquartile Range)]
Environment management	2.50	5.00	4.75 (I)
Personnel management	1.75	5.00	4.75 (I)
Service management	2.30	5.00	4.60 (I)
Safety management	2.50	5.00	4.70 (I)
Total average score of risk management	2.39	5.00	4.72 (0.98)

Figure 4 Risk early warning status in residential aged care facilities.

Although the facility's risk management score is at an acceptable and relatively desirable level, it might be reasonable to increase it to a more optimal level, specifically in the safety management and service management domains. In RACFs, numerous quality and safety issues, such as minor mistakes, missing and rushed care, and disruptions in care, can negatively impact the physical and mental health of older people over time.[47,48] A significant amount of previous research[49,50] has shown that RACFs need to establish a safety culture and encourage active and unpunished error reporting of nursing adverse events to reduce potential harm. In China, the safety management and service quality provided by RACFs are highly variable due to weak quality regulation, insufficient inspections, and poor enforcement of rules.[51] To ensure quality care in supporting independence, autonomy, dignity, and safety of the older adults, it is imperative to establish an effective long-term care regulatory framework and quality assurance system.

Regarding staff training in RACFs, only about 70% had trained nursing staff regarding relevant ethical and legal considerations. Legal knowledge is often neglected in the training and education of nursing staff.[52] Typically, geriatric care training conducted by RACFs focuses on the daily-life care of older individuals and basic nursing knowledge, such as diet care, oral cleaning, pressure ulcer prevention, and use of crutches and wheelchairs. However, nursing staff in RACFs shoulder complex ethical responsibilities, take ethical care actions, and balance moral dilemmas and legal issues related to health and safety.[53] Thus, it is important to emphasize nursing staff's understanding of the legal and ethical framework for geriatric care to provide the better care.

Regarding contingency plans, this survey showed that 30% to 40% of the facilities did not have contingency plans for suicide, electric shock, gas poisoning, and drowning, although China's Ministry of Civil Affairs issued the Administrative Measures for Residential Aged Care Facilities, which requires RACFs to formulate contingency plans for natural disasters, accidents, public health incidents, and social security incidents.[54] Fisher et al[55] stated that contingency planning is a continuous process, which demonstrates personnel responsibilities, response time, corresponding strategies as well as resource preparation before, during, and after the emergency. Moreover, evidence has shown that emergency preparedness and disaster response plan is important in the emergency system and guide timely and effective emergency rescue.[56,57] Our findings demonstrate the need for administrative authorities (eg the Ministry of Civil Affairs and the Central Politics and Law Commission) to strengthen the monitoring of RACFs' emergency system to effectively address emergencies and minimize losses.

Table 3 Differences in Risk Management Scores with Participants' Demographic Characteristics (Score, n = 272)

Variables		Risk Management (Mean Rank)	Z/H value	P value
Ownership	Public	132.92	−0.849	0.396
	Private	141.03		
Location	Urban	148.58	−2.296	0.022
	Rural	126.68		
Held the Practice Certificate of Social Welfare Facilities	Yes	141.21	−2.462	0.014
	No	107.53		
Operation duration (year)	<5	151.89	3.921	0.141
	5–15	132.48		
	>15	128.32		
Bed-size	10–49	108.68	16.766	0.001
	50–99	139.95		
	100–199	159.28		
	>200	149.61		
Nursing hours per resident day (hprd)	<3.5	130.32	−2.928	0.003
	≥3.5	167.69		
Require nursing staff to work with certificates	Yes	146.27	−5.543	0.001
	No	65.74		
Payment for nursing staff (RMB/month)	<1500	96.27	−4.025	<0.001
	≥1500	145.56		

Table 4 Correlations Between Risk Management Scores, Frequency of Adverse Events, and Risk Early Warning Scores (R_s, N = 272)

Variable	Environment Management	Personnel Management	Service Management	Safety Management	Total Average Score
Frequency of nursing adverse events	−0.151*	−0.212**	−0.205**	−0.204**	−0.208**
Risk early warning scores	0.434**	0.461**	0.497**	0.511**	0.516**

Note: *p < 0.05, **p < 0.01.

Regarding emergency management, only 84.56% of RACFs utilized pre-hospital first aid for older adults. In China, to minimize daily operating costs, some small RACFs choose the sharing mode to cooperate with nearby community health service centers and hospitals to address residents' healthcare treatment.[58] However, due to the shortage of qualified employees and equipment, these facilities may experience potential hazards such as missing the prime time for first aid and causing serious life-threatening consequences. Hence, we recommend RACFs make an extensive and sustained effort to develop manpower (eg in-service training, simulation of incident scenes, and operational training)[59] and equipment (eg alarm device, upgraded technologies, necessary emergency rescue equipment, and ambulances)[60] to ensure residents' safety and meet the needs of first aid and high-quality medical services.[61]

The findings revealed that urban RACFs scored significantly higher than those in rural areas. The common assumption is that those in rural areas with higher poverty rates, limited support staff, and lower availability of health promotion and disease projects[62–65] experience more difficulty in creating a physical environment suitable for the older adults, recruiting and training nursing staff with sufficient competences, and establishing effective risk management programs. Moreover, RACFs that have obtained the Practice Certificate of Social Welfare Facilities are better at risk management. In China, they can successfully obtain it only when they meet the basic standards of civil affairs departments for living places, and outdoor activity venues, start-up funds, regulations and personnel, as well as the national fire safety, sanitation, and epidemic prevention standards. Such policy promotes managers to address the risk and safety issues in the application process of the certificate and further improves the scores in all dimensions. Similarly, in the US, the Centers for Medicare and Medicaid Services and health authorities in various states have issued a series of policies (eg Five-Star Quality Rating System) to supervise and inspect nursing homes, to ensure that care delivery meets the necessary legal, quality, and safety standards.[66] We identified lower risk management scores in small-scale RACFs with 10 to 49 beds than those with more than 50 beds, consistent with the previous study by Liu,[67] which found the vast majority of small RACFs are equipped with little emergency medical equipment and tend to recruit rural women with poor professional knowledge and limited emergency nursing skills as nursing aids. Notably, adequate and qualified nurses are important for risk management in RACFs along with nursing HPRD (staffing) and qualified care workers' recruitment. Typically, nursing staff are crucial human resources in reducing pressure sores, falls, use of immobilization devices, and pain and furthering residents' better outcomes.[68,69] However, the results showed that the average nursing HPRD in RACFs in China was 1.48 (1.64), significantly lower than the international standard.[68,70] According to payroll-based journal data, in 2019, nursing homes reported 3.89 nursing HPRD on average (0.68 registered nurse HPRD, 0.88 licensed vocational nurse/licensed practical nurse HPRD, and 2.33 certified nursing assistant HPRD, including all administrative nurses).[71] It is well known that RACFs should recruit sufficient qualified nursing staff with appropriate competencies; however, in this study, although 85.45% of the facilities required nursing staff to work with certificates, many did not recruit on-site registered nurses. Given the low nursing HPRD and limited registered nurses in Chinese RACFs, further efforts are needed to attract nursing staff to geriatric care and retain them, thereby addressing the nursing shortage. Interestingly, the risk management score of RACFs is related to nursing staff's salary. This can be explained as RACFs offering higher salaries for a greater likelihood of better financial resources and higher employee retention. Furthermore, it is well documented that nurses with relatively low incomes are more likely to report higher job burnout,[72] lower prestige, less professional autonomy,[73] and lower work creativity, which may lead to less empathic care delivery, and missing or rushed care. A national survey of 239,312 employees in China RACF settings also revealed that the labor (taking care of six to seven disabled or semi-disabled older adults on average every day) and payment (<3000 RMB) for nursing staff were significantly unbalanced, which leads to a continual decline in their efforts and attitudes toward nursing development and career retention.[74] Recommendations include strengthening national route inspections and enforcement provisions, improving care workers' performance, establishing a reward and punishment mechanism to help risk management of RACFs, specifically for those in a rural area with limited healthcare resources.

As expected, the lower frequency of adverse events was correlated with better risk management, consistent with the results of Lawati et al[75] and Smith et al,[76] which suggest that successful risk management programs could facilitate creating and maintaining safe systems of care, improving human performance, and reducing adverse events. However, the correlation was not as high as expected,[77,78] with the figure of −0.208 indicating only a weak correlation between adverse event frequency and risk management. It is unclear whether this is related to confounding factors' effect such as RACF characteristics and the validity of the measurement tool. More evidence is needed linking risk management to the incidence of adverse events. Additionally, RACFs' risk early warning favors risk management, which is supported by previous studies.[79,80] Catalyst[11] believed that education and training, contingency plans, response, and mitigation are essential components for all healthcare risk management programs. Prevention beats remediation, with an emphasis on "early warning, risk reduction and managing uncertainties around older residents."[81] With the continuous development of artificial intelligence (AI), applying AI algorithms such as machine learning, and back propagation neural networks in constructing nursing risk early warning models can overcome the shortcomings of traditional integrated prediction

methods and provide managers with decision-making information.[82] RACFs could consider integrating innovative IT across risk early warning and management to address the quality and safety concerns of stakeholder groups.

The risk management and risk early warning of adverse events affect the interactions, attitudes, and practice of leaders, employees, and residents of RACFs, and can help leaders initiate quality improvement interventions. This study contributes to the existing literature on risk management and related factors. It also provides evidence for policymakers and RACF managers and staff to develop strategies to optimize care delivery in these settings.

Limitations

This study has the following limitations. First, the cross-sectional design and potential selection bias limit the results' generalizability. Future longitudinal study can include facilities from other provinces. Second, some facilities might choose to underreport adverse events and increase effective preventive measures to protect their reputation, although we required investigators to check the relevant documents and records of the organizations to minimize data biases. Third, the psychometric properties of the questionnaires and participants' subjective ideas need to be further explored, although the entire scales have good reliability and validity with the Cronbach's α coefficients between 0.874–0.974 and the split-half reliabilities between 0.786–0.951. Fourth, student investigators may lack an in-depth understanding of the questionnaire items, leading to missing important information and inability to guarantee the data accuracy. Moreover, given their low prestige, respondents could skip the question or choose the best answer provided, resulting in some biases on answers. Finally, this study failed to record some types of adverse events (eg suicide, hospital admissions) and did not consider some potential variables (eg star rating, occupancy ratio of disabled older adults, the proportion of residents aged over 80 years, and profit and loss status). Multi-center and cross-sector research is needed to evaluate other factors that may be related to risk management and early warning.

Conclusion

Adverse events in RACFs are the leading causes of morbidity and mortality among residents; facilities should conduct appropriate risk management and risk early warning. The results of our study showed that the staffing level of nursing staff in RACFs in Hunan, China was low, but the frequency of nursing adverse events (eg falls, pressure sore, psychological adverse events, falling out of bed [or chair] and choking) was high. Overall, the risk management level of the surveyed RACFs was at an acceptable and relatively desirable level. Regarding risk early warning, care workers' ethical and legal training and some important contingency plans (eg suicide, electric shock, gas poisoning, and drowning) were often overlooked. Besides, large-scale urban RACFs that obtain the Practice Certificate of Social Welfare Facilities, are equipped with adequate and qualified care workers, pay a higher salary to their employees, and gain higher risk management scores. We observed that the lower the frequency of adverse events, the better the risk management, and the better the risk early warning, the higher is the risk management score. RACFs need to adopt multi-dimensional methods and strategies to address the high prevalence of nursing adverse events and advance risk management and risk early warning, to deliver safe and high-quality care for older adults. The results could inform an empirical study of risk management in RACF settings in China to develop a blueprint for the improvement of care outcomes in the context of global rapid aging.

Ethical Approval

The Ethics Review Committee of the Affiliated Hospital of Xiangnan University approved this study (reg. no. KY–201508001).

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Disclosure

The authors report no conflicts of interest in this work.

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