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Article

Effectiveness of Advanced Fire Prevention and Emergency Response Training at Nursing Homes

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Abstract: Background: In long-term care facilities, there are many residents who do not have the ability to seek shelter by themselves in the case of an emergency. Thus, it is extremely important that the staff of nursing homes are equipped with correct disaster prevention concepts, emergency survival responses, and hazard mitigation measures. **Purpose:** Discuss the intervention effectiveness of different fire prevention and emergency response trainings at nursing homes and the relationship and predictivity of awareness to self-efficacy. **Method:** Recruit staff from two nursing homes through purposive sampling, using a two-team pre- and post-test design to collect results from 41 individuals in the experiment group and 40 individuals in the control group. The research tool is the "Nursing Home Fire Prevention and Emergency Response Awareness and Self-Efficacy Scale," to compare the effectiveness of advanced and general fire safety trainings. **Result:** After receiving improved advanced fire safety training, the total score and the result of the experiment group on fire prevention and emergency response awareness and self-efficacy had both performed better than the control group who received general fire safety training ($p < .001$); fire prevention and emergency response awareness has significant and positive correlation with self-efficacy (r=.601, $p < .001$), and awareness is a significant predictor variable to self-efficacy ($p < .001$). **Conclusion/Practical Application:** This study finds that the key to improving learning effectiveness includes adding fire science concept chapter when creating fire safety training material in order to strengthen basic awareness; fire safety training should comprehensively introduce all related duty responsibilities of staff fire defense formation, in turn enabling mutual responsive support for the needs of the site; also, to become familiarized with the knowledge requires appropriate frequency of training and enhancing the staff's awareness to fire prevention and emergency response, which is the most important key of learning effectiveness.

Keywords: nursing home; advanced fire prevention; emergency response training

1. Introduction

According to the definition by the World Health Organization (WHO), the population of Taiwan has officially become an aged society, and is progressing towards a super-aged society. In the WHO's response to aging, it is proposed that all countries are required to establish long-term care systems in order to fulfill the needs of older people [1]. The average life expectancy of all Taiwan nationals had come to 81.32 years in 2020. From the three population age groups measured in the aging index statistics, the percentage of those aged 65 years or over is as high as 16.15% in January 2021 [2]. It is clear that long-term care requirements for the Taiwan nationals are increasing by each passing day, and various types of long-term care service have sprung from such needs. Up to the end of 2020, the number of general care and psychiatric care homes have reached 599, increased by 62 compared to 537 homes at the end of 2015 [3]. Studies indicated that in welfare institutions for the elderly, the policy and the execution of fire prevention

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management system has not been as effective as predicted, and there are a lot of room for improvement [4]. According to the data from Taiwan's National Fire Agency, between 2012 and June of 2017, there had been 14 fires in the country's facilities such as nursing homes and welfare institutes for the elderly, causing 27 deaths and 167 injuries [5]. Through collecting and analyzing the data, the cause of the 14 fires include arson, accidents involving cigarettes, lighters, or candles, and electric fires. Of all the above causes, arson had caused the most severe casualties and is the most difficult factor to grasp. In addition, most residents in long-term care facilities cannot seek shelter by themselves and require help of others in the case of emergency, and are often extremely challenging to move during rescues and evacuations. Therefore, not only the functions of fireproof facility and fire hazard equipment in long-term care facilities must meet related regulations such as the Building Act and the Fire Services Act, the disaster prevention concept and emergency response abilities of all the staff in the facility appear to be of utmost importance. Vigorous training and internalization of the knowledge should be carried out to prevent the predicament of being legal but not logical. Thus, the goals of this study are to (1) discuss the intervention effectiveness of different fire prevention and emergency response trainings at nursing homes, (2) understand the correlation and predictability of self-efficacy and the awareness of nursing home staffs on fire prevention and emergency response. It is aimed that the study result can provide directions to trainings in long-term care facilities and become a reference for standards and regulations set in evaluations.

According to Paragraph 2 in Article 16 of the Nursing Personnel Act, the establishment of nursing home must meet the regulations set in the "List of Standards for Establishing Nursing Facilities." As indicated in the List, nursing facilities can be classified as general nursing homes and psychiatric nursing homes, with each type regulated by different establishment standard items, including personnel, nursing service equipment, the design, structure, and equipment of the building, and others. For general nursing homes, regulation requires the total number of nursing staff must meet both the minimum 1 nursing staff per 15 beds and there must be a nursing staff on duty at any time of the day; 1 or more nursing aide must be available every 5 beds, at any time the total number of nursing staff and nursing aides to the number of residents must not be lower than 1 out of 15, and must increase manpower suitably to accommodate the duties carried out in each work shift. According to Article 15 of the Nursing Personnel Act, the targets of service of nursing homes are patients with chronic illnesses and require long-term care and patients who are discharged from hospital but continue to require care. The nursing homes are supervised and managed by health authorities and provide various nursing care, regular doctor treatment, physiotherapy and occupational therapy activities, nutritional evaluation, and daily care. Other than establishing personnel and equipment based on the "List of Standards for Establishing Nursing Facilities," the nursing homes must accept supervision and inspection through regular evaluations. Cai et al. (2012) studied the first national nursing home evaluation in Taiwan in 2009. The study indicates that the competent authority should exert enhanced counseling to nursing homes to improve in four major aspects: health care services, personnel management, operation management and environment safety [6].

The "Fire Safety Management Guide 2.0 for General Nursing Homes" amended by the Ministry of Health and Welfare in June 2018 emphasizes that through "Increased Fire Hazard Self-Management," "Fire Hazard Identification and Communication," and "Simulation and Situational Exercise," consensus can be formed and the goal of self-managed hazard prevention can be achieved [7]. Such material can be provided to the nursing homes to establish fire prevention and emergency response protocol and training. Studies indicate that the chronic medical care institutions within the country have a great gap with the evaluation standards of the joint commission on accreditation of healthcare organizations (JCAHO) regarding emergency response planning, hazard prevention and mitigation measures, personnel training, and manager operation ideologies. It had been proposed that if staff in the institutes have proper hazard prevention and response

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concepts, they can easily formulate suitable response measures, thus response abilities can be enhanced rapidly [8]. With better fundamental awareness of hazard response, the level of emergency response ability will also be better [9]. Thus, the focus of fire prevention and emergency response training at nursing homes should be on the instillation of concept and awareness. The current practices at general nursing homes on fire prevention and emergency response training are mostly drafted by the institutes' manager or fire prevention manager, who incorporate it into one of the units in staff trainings according to the required contents indicated in the evaluation standard. The material is usually brief and promotional, and more of a traditional routine training. The fire extinguishing and evacuation process is explained and advised, but there is no emphasis on the awareness and fire and fire hazard response. Chen (2016) indicated that to gain awareness and understanding of fire, fire science concepts must be incorporated, including the characteristics of fire hazard, the fire triangle, types of ignition source, progression of fire, methods of extinguishing fire, and the dangers of fire. The key factor that effects the successfulness of fire fighting and hazard reduction is the staff's level of understanding and grasp of the progression of fire [10]. Thus, the advanced fire safety training material drafted in this study has incorporated a unit on fire science concept in addition to the Fire Safety Management Guide 2.0 for General Nursing Homes by the Ministry of Health and Welfare.

According to studies, different intervention methods of training has increased the effectiveness on the students' awareness of the subjects. For students with lower awareness, personalized or adjusted training content can be administered, and the students' personal background should also be considered when executing training intervention [11]. Chen and Wang (2006) found the involvement in the training has significant positive correlation to training effectiveness. The method of evaluating training effectiveness has been widely studied by various scholars from different angles, including the evaluation to the trainee's result level and the evaluation of contribution to enterprise management result [12]. Kirkpatrick (1994) proposed that result levels be graded on the performance index based on the effects produced through the training. The performance index of each result level has different evaluation methods, including the usage of questionnaire, interview, reflection report, structured test, technical operation, and etc. [13]. Bushnell (1990) believed through training, companies can facilitate the staff to obtain knowledge and skills. Summing the viewpoints of the above scholars [14], this study will use questionnaire scales to evaluate fire hazard training effectiveness.

Lin et al. (2005) and Huang et al. (2010) proposed that to achieve good learning effectiveness, one needs to have a full grasp of the trainees' basic characteristics such as age, level of education, work seniority, etc. Research found that communication skill is one of the stressors for foreign nursing aides, and may impact training effectiveness [15,16]. Liu's (2011) study indicated that individuals older in age and with high level of education have higher self-efficacy, meaning training effectiveness is relatively better [17]. Zhu et al. (2015) indicated that different types of professionality and the length of work seniority leads to significant differences in the knowledge retained after training. In summary of above, this study incorporates nationality, age, level of education, work seniority, and job position into variables to explore [18].

2. Materials and Methods

2.1. Study Design and Participant

Through quasi-experimental study and purposive sampling, data from two affiliated nursing homes of private hospitals registered with the Taichung City Government was collected and research sample was retrieved for data analysis. The sampling criteria were: 1. Full time employees of all job positions within the study establishments, meaning the staff members who work regularly at the nursing homes, including: nursing staff, Taiwanese nursing aides, foreign nursing aides, human resources, finance or administrative staff etc. 2. Employed at the current institution for over 3 months. 3.

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Consent to join this study. Pretest-posttest design in two groups was utilized, with the control group trained with general fire hazard training, and the experimental group accepting intervention through advanced fire hazard training. The "Nursing Home Fire Prevention and Emergency Response Awareness and Self-Efficacy Scale" was created to compare and analyze the self-efficacy and the fire prevention and response emergency awareness of the staff of the two nursing homes. The Awareness and Self-Efficacy Scale underwent expert validity check, grading the importance, appropriateness, and text clarity of each question in the Scale, which had a total CVI of 0.95. Internal consistency method was used to check reliability, and the Cronbach'α of the internal consistency was 0.954. G power 3.0 software had estimated the required number of samples to be 82. This study had 41 subjects in the advanced fire safety training and 40 subjects in the general fire safety training, with a total 81 subjects.

2.2. Measurement

The "Nursing Home Fire Prevention and Emergency Response Awareness and Self-Efficacy Scale" was created as the measuring tool for the study, with reference to the key points in the "Fire Safety Management Guide 2.0 for General Nursing Homes" published by the Ministry of Health and Welfare. The content includes three main areas: "Personal Background Profile of Nursing Home Staff," "Awareness of Nursing Home Staff Towards Fire Prevention and Emergency Response," and "Self-Efficacy of Nursing Home Staff Towards Fire Prevention and Emergency Response."

2.2.1. Personal Background Profile of Nursing Home Staff

The designed through referencing literature reviews and the variables that would like to be discussed, the items include nationality, age, level of education, job position, and work seniority in long-term care.

2.2.2. Awareness of Nursing Home Staff Towards Fire Prevention and Emergency Response

This is to investigate the awareness nursing home staff to fire prevention and emergency response, including three main topics of "Fire Safety Equipment Awareness," "Fire Prevention Awareness," "Awareness of Emergency Response Measures in Case of Fire."

2.2.3. Self-Efficacy of Nursing Home Staff Towards Fire Prevention and Emergency Response

The researcher would like to investigate the self-efficacy of nursing home staff to fire prevention and emergency response, including three main topics of "Fire Safety Equipment Self-Efficacy," "Fire Prevention Self-Efficacy," and "Self-Efficacy towards Emergency Response Measures in Case of Fire." Five fire safety related experts in the country were invited to grade the importance, appropriateness, and text clarity of each variable contents in the Scale through a three-point scale. The validity CVI used medium-standard as determination standard, and revised the appropriateness and text clarity of the variables in the Scale according the expert recommendation. The final number of questions in the Scale remained at 76, and the total CVI was 0.95. Internal Consistency method was used to check the reliability, using 30 staff members in similar hospital affiliated nursing homes as pretest subjects. The awareness scale used yes-no-unknown questions as scoring standard, with answers being yes, no, or don't know. Right answers grant 1 point, and wrong answers and Don't Know's grants no point. The self-efficacy scale used multiple choices, which is the 5-Point Likert Scale to score, 1 being very unconfident, 2 being not confident, 3 being neutral, 4 being confident, and 5 being very confident. Calculation was done separately through question difficulty and degree of discrimination, and the final number of questions in the scale was reduced from 76 to 62 questions. The pretest's total internal consistency Cronbach'α was 0.954, indicating that

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the "Nursing Home Fire Prevention and Emergency Response Awareness and Self-Efficacy Scale" can stably reflect the nursing home staff's awareness and self-efficacy towards fire prevention and emergency response.

2.3. Ethical Considerations

This study conducted data collection after receiving the approval from the Central Regional Research Ethics Committee of China Medical University (IRB No. CRREC-109-079). Prior to the test, the researcher explained the research objectives, process, and rights to the test subjects. After gaining the test subjects' voluntary consent, the method to filling in the questionnaire was explained and informed that all data retrieved from the subjects would be anonymous and processed by numbering. If the test subject experienced any physical or psychological discomfort, they had the right to exit or terminate the research at any time, and that their involvement and questionnaire results would not impact their assessments or any rights within the institution. The research subjects could contact the researcher at any time if they have questions, and the researcher has the obligation and responsibility to protect and respect the subjects' privacy to ensure their personal data are absolutely classified. All collected data would be used for academic research analysis only, with absolutely no exposure to the public, clear adherence to research ethics, and protection of the research subjects' right to privacy and personal information.

2.4. Data Analysis

The data of this study was collected from two affiliated nursing homes of private hospitals registered with the Taichung City Government, and only commenced after the approval of the two institutes' managers and passing the review of the Institutional Review Board. The researcher of the study hand-delivered the "Nursing Home Fire Prevention and Emergency Response Awareness and Self-Efficacy Scale" to the two nursing homes. To ensure the completion and correctness when filling in the questionnaire, face-to-face oral explanation was conducted to explain the goal of the study and the key points when filling in. The two groups completed the pretest Scale and arranged the "advanced fire safety training" for the experimental group and the "general fire safety training" for the control group. Posttest was conducted after two weeks, with a 100% recovery rate of the Scale.

The collected Scale results were numbered and entered into computer, using SPSS for Windows 20.0 software to conduct data statistics analysis. Frequency distribution was used on description statistics, percentage description on basic profile data, average and standard deviation was used to describe pretest/posttest scores and training related effectiveness, and finally the chi-squared test was used to inspect the basic profile differences between test subjects. Inferential statistics was checked using independent sample t-test, paired sample t-test, and analysis of covariance to analyze the differences in fire prevention and emergency response awareness and self-efficacy between staff members with different basic profiles. Pearson correlation coefficient was used to investigate the correlation of self-efficacy against fire prevention and emergency response awareness in nursing home staff, then simple regression analysis was used to inspect the predictivity of awareness to self-efficacy.

3. Results

3.1. Participants Demographics

With regard to nationality distribution of nursing home staff, both experimental group and control group were majority Taiwanese nationals, at 27 (66%) and 25 people (63%) respectively; On level of education distribution, the experimental group mostly had education of college and above at 25 people (61%), the control group mostly had education of high school or below at 22 people (55%); On job position distribution, both experimental and control group had more nursing aides, at 26 (63%) and 27 people (68%) respectively. On age distribution, both experimental and control group were mostly 45 years and under

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at 33 (80%) and 27 people (68%); On work seniority in long-term care, the majority in the experimental group had under 3 years of experience, at 35 people (85%), whereas the control group mostly had over than 3 years of experience at 28 people (70%). The nationality distribution of subjects in the experimental and control group had χ^2=0.099, p = 0.753; age distribution χ^2 =1.778, p = 0.182, level of education χ^2 =2.075, p = 0.150, job position distribution χ^2 =0.149, p = 0.699, work seniority in long-term care χ^2 =25.482, p < 0.001. In summary, other than the difference in long-term care work seniority, there was no significant differences between the experimental and control group in their basic profiles, including nationality, age, level of education, and job position are presented in Table 1.

Table 1. Participants basic profile distribution and difference comparison (n=81).

Variables	All (n=81)	Experimental Group (n=41)	Control Group (n=40)	X^2Value	*P* Value
	n(%)	n(%)	n(%)		
Nationality				0.099	0.753
Taiwanese	52 (64)	27 (66)	25 (63)		
Foreign	29 (36)	14 (34)	15 (38)		
Age				1.778	0.182
45 Years and Below	46 (57)	33 (80)	27 (68)		
46 Years and Above	35 (43)	8 (20)	13 (33)		
Level of Education				2.075	0.150
High School and Below	38 (47)	16 (39)	22 (55)		
College and Above	43 (53)	25 (61)	18 (45)		
Job Position				0.149	0.699
Nursing Aide	53 (65)	26 (63)	27 (68)		
Medical Administration	28 (35)	15 (37)	13 (33)		
Work Seniority in Long-term care				25.482	<0.001 ***
Below 3 Years	47 (58)	35 (85)	12 (30)		
Above 3 Years	34 (42)	6 (15)	28 (70)		

Note: *p < 0.05, ** p < 0.01, *** p < 0.001.

3.2. Difference analysis of awareness and self-efficacy of nursing home staff on fire prevention and emergency response prior and after fire safety training intervention

Prior to fire safety training intervention, through analysis of covariance, it was learned that homogeneity of variance test had a result of *F(1,79) = 3.166, P = 0.079, not reaching the significance of 0.05. The variables in the two groups (posttest average) did not have significant difference in the error variance, suggesting homogeneity, thus homogeneity of variance was established; when controlling the covariate variable results (pretest average), the between-group effect (through variable effect) between experimental and control group resulted in significant level F(1,78) = 130.500, p* < 0 .001, effect size 0.626. *This indicated independent variable (2 groups) had high explanatory power at posttest and there was significant difference between groups. Through multiple comparison, it was shown that experimental group surpassed control group* (Table 2). *After fire safety training intervention, the two groups' total average score in the first section of awareness and the second section of self-efficacy were: experimental group scored* 3.264 (*SD* =0.266), control group scored 2.673 (*SD* =0.286), p < 0 .001, indicated significant difference in overall performance of the two groups and that the experimental group performed better than the control group (Table 3). Through paired-*t* test, the posttest minus pretest average score of the two groups were analyzed, the result of paired variable difference was shown that experimental group's posttest score improved from pretest 0.850(*SD* =0.462), p < 0 .001, reaching statistical significance. The control group had improvement of 0.023(*SD* =0.220), p = 0.519, but did not reach statistically significant difference (Table 4). Through independent *t* test, the posttest minus pretest average score

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between the two groups was analyzed for difference in effectiveness. It was shown that the respective total score of the experimental and control group were 0.850 (*SD* =0.462) and 0.023 (*SD* =0.220), $p < 0$ .001, indicating the overall performance of the experimental group was better than the control group and had statistically significant difference (Table 5).

Table 2. Analysis of covariance on research subject training effectiveness (N=81).

Source of Variable	Type I Sum of Square	Degree of Freedom	Average Sum of Square	*F*	*P*	Effective Size	Multiple Comparison
Pretest	0.053	1	0.053	0.854	0.358	0.011	Experimental Group > Control Group
Two Groups	8.16	1	8.160	130.5	<0.001***	0.626	
Within Group (deviation)	4.848	78	0.063				
All	728.414	81					

Note: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3. Comparison of research subject awareness and self-efficacy of fire prevention and emergency response after fire safety training intervention (N=81).

Item	Experimental Group (n=41)		Control Group (n=40)		*t*	*P*	95% CI	
	M	*SD*	*M*	*SD*			*LL*	*UL*
Awareness								
Fire safety equipment awareness	0.959	0.077	0.588	0.160	13.205	<0.001**	0.315	0.427
Fire prevention awareness	0.963	0.105	0.656	0.257	6.994	<0.001**	0.219	0.395
Emergency response awareness in case of fire	0.930	0.093	0.569	0.144	13.363	<0.001**	0.307	0.415
Awareness Total Average	0.949	0.068	0.593	0.138	14.641	<0.001**	0.307	0.405
Self-Efficacy								
Fire safety equipment self-efficacy	4.473	0.437	3.929	0.377	6.000	<0.001**	0.363	0.724
Fire prevention self-efficacy	4.580	0.430	3.782	0.478	7.908	<0.001**	0.598	1.000
Emergency response self-efficacy in case of fire	4.551	0.459	3.738	0.473	7.853	<0.001**	0.607	1.019
Self-Efficacy Total Average	4.537	0.410	3.816	0.415	7.857	<0.001**	0.538	0.903
Total Average	3.264	0.266	2.673	0.286	9.625	<0.001**	0.469	0.713

Note 1: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

2: t value is the Independent Samples t-test result.

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Table 4. Effectiveness comparison of pretest posttest of two groups (N=81).

Item	Pretest		Posttest		Posttest minus Pretest		*t*	*P*	95% CI	
	M	SD	*M*	*SD*	*M*	*SD*			*LL*	*UL*
Awareness										
Fire safety equipment awareness										
Experimental Group	0.512	0.154	0.959	0.077	0.446	0.176	16.219	<0.001 ***	0.390	0.502
Control Group	0.558	0.126	0.558	0.160	0.030	0.124	1.525	0.135	-0.010	0.070
Fire prevention awareness										
Experimental Group	0.500	0.358	0.963	0.105	0.463	0.373	7.952	<0.001 ***	0.346	0.581
Control Group	0.469	0.331	0.656	0.258	0.188	0.276	4.298	<0.001 ***	0.099	0.276
Emergency response awareness in case of fire										
Experimental Group	0.476	0.177	0.930	0.093	0.454	0.207	14.063	<0.001 ***	0.389	0.520
Control Group	0.447	0.147	0.567	0.144	0.122	0.161	4.777	<0.001 ***	0.070	0.173
Awareness total average										
Experimental Group	0.497	0.158	0.949	0.068	0.452	0.178	16.238	<0.001 ***	0.396	0.509
Control Group	0.501	0.141	0.593	0.138	0.092	0.115	5.049	<0.001 ***	0.055	0.129
Self-Efficacy										
Fire safety equipment self-efficacy										
Experimental Group	3.447	0.704	4.473	0.437	1.026	0.680	9.662	<0.001 ***	0.812	1.241
Control Group	3.919	0.431	3.929	0.377	0.010	0.350	0.174	0.863	-0.102	0.122
Fire prevention self-efficacy										
Experimental Group	3.623	0.728	4.581	0.430	0.958	0.743	8.253	<0.001 ***	0.723	1.192
Control Group	3.828	0.504	3.782	0.478	-0.047	0.417	-0.708	0.483	-0.180	0.087
Emergency response self-efficacy in case of fire										
Experimental Group	3.297	0.741	4.551	0.459	1.254	0.816	9.842	<0.001 ***	0.997	1.512
Control Group	3.742	0.535	3.738	0.473	-0.004	0.410	-0.064	0.949	-0.135	0.127
Self-efficacy total average										
Experimental Group	3.468	0.674	4.537	0.410	1.069	0.693	9.872	<0.001 ***	0.850	1.288
Control Group	3.832	0.433	3.816	0.415	-0.016	0.336	-0.294	0.770	-0.123	0.092
Total Average										
Experimental Group	2.414	0.450	3.264	0.266	0.850	0.462	11.780	<0.001 ***	0.704	0.996
Control Group	2.650	0.304	2.673	0.286	0.023	0.220	0.650	0.519	-0.048	0.093

Note 1: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

2: t value is the Paired Samples t-test result.

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Table 5. Difference analysis of two groups effectiveness pretest and posttest (N=81).

Item	Experimental Group (n=41)		Control Group (n=40)		*t*	*P*	95% CI	
	M	*SD*	*M*	*SD*			*LL*	*UL*
Awareness								
Fire safety equipment awareness	0.446	0.176	0.030	0.124	12.256	<0.001**	0.349	0.484
Fire prevention awareness	0.463	0.373	0.188	0.276	3.790	<0.001**	0.131	0.421
Emergency response awareness in case of fire	0.454	0.207	0.122	0.161	8.051	<0.001**	0.250	0.415
Awareness Total Average	0.452	0.178	0.092	0.115	10.822	<0.001**	0.294	0.427
Self-Efficacy								
Fire safety equipment self-efficacy	1.026	0.680	0.010	0.350	8.487	<0.001**	0.777	1.256
Fire prevention self-efficacy	0.958	0.743	-0.047	0.417	7.526	<0.001**	0.738	1.271
Emergency response self-efficacy in case of fire	1.254	0.816	-0.004	0.410	8.800	<0.001**	0.972	1.544
Self-Efficacy Total Average	1.069	0.693	-0.016	0.336	8.993	<0.001**	0.843	1.326
Total Average	0.850	0.462	0.023	0.220	10.332	<0.001**	0.667	0.988

Note 1: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

2: t value is the Independent Samples t-test result.

3.3. Difference analysis of nursing home staff with different basic profile against the awareness and self-efficacy to fire prevention and emergency response

This section presented the improvement extend of posttest minus pretest average score of the staff members with different profiles to analyze the significance of result. From the results shown (Table 6), the nationality factor in the awareness section $p = 0.031$, indicating significant difference and foreign nationals performed better than Taiwanese nationals. However, the self-efficacy section $p = 0.562$ and total average score $p = 0.842$ did not reach statistical significance. On work seniority in long-term care, the posttest results were the same that in the awareness and self-efficacy sections and overall average score $p<0$ .001, showing that long term-care work seniority attributes to significant difference, and that those with less than 3 years of experience performed better than those over 3 years. Other factors such as staff age, level of education, and job position did not achieve statistically significant difference whether in the awareness section, self-efficacy section, or the total average score. This overthrows the hypothesis that nursing home staff's differing personal background would lead to significant difference in the training effectiveness of fire prevention and emergency response.

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Table 6. Analysis of staff members with different basic profile and their fire safety training effectiveness (N=81).

Items	Awareness			Self-efficacy			Total Average		
	M	*SD*	*P*	*M*	*SD*	*P*	*M*	*SD*	*P*
Nationality									
Taiwanese	0.233	0.221	0.031*	0.571	0.785	0.562	0.451	0.556	0.842
Foreign	0.350	0.245		0.466	0.751		0.425	0.551	
Age									
45 Years and Below	0.299	0.241	0.108	0.581	0.764	0.351	0.481	0.546	0.279
46 Years and Above	0.203	0.207		0.398	0.789		0.329	0.562	
Level of Education									
High School and Below	0.269	0.249	0.851	0.501	0.775	0.722	0.419	0.569	0.727
College and Above	0.279	0.225		0.562	0.774		0.462	0.541	
Job Position									
Nursing Aide	0.306	0.250	0.072	0.538	0.849	0.938	0.456	0.614	0.725
Medical Administration	0.214	0.194		0.525	0.606		0.415	0.421	
Work Seniority in Long-term care									
Below 3 Years	0.362	0.233	<0.001***	0.797	0.822	<0.001***	0.643	0.579	<0.001***
Above 3 Years	0.154	0.180		0.168	0.509		0.163	0.362	<0.001***

Note 1: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.4. Correlation and predictivity of nursing home staff's awareness of fire prevention and emergency response to self-efficacy

Through Pearson correlation analysis, the correlation between nursing home staff's awareness of fire prevention and emergency response against self-efficacy had r=0.601 and $p < 0.001$. This high effect size indicated the positive correlation between awareness and self-efficacy, and the higher the awareness score, the higher the self-efficacy score (Table 7). Through simple regression analysis, using the awareness of nursing home staff to fire prevention and emergency response as predictor and the self-efficacy as criterion variable (dependent variable), the standard regression coefficients were $\beta = 0.601$, $t = 6.688$, $p = 0.011$, $F(1,79)=44.725$, $R^2= 0.361$. It is thus theorized that the awareness of nursing home staff to fire prevention and emergency response is a significant predictor variable to self-efficacy, and it has high level of effect size to self-efficacy and can explain 36.1% of variability (Table 8).

Table 7. Correlation analysis between awareness of fire prevention and emergency response with self-efficacy (N=81).

	Pretest		Posttest		Posttest minus Pretest	
	Awareness	Self-efficacy	Awareness	Self-efficacy	Awareness	Self-efficacy
Pearson Correlation	1	0.281	1	0.641	1	0.601
Significance (Two Tailed)		0.011*		<0.001***		<0.001***
Number	81	81	81	81	81	81

Note 1: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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Table 8. Predictivity analysis between awareness of fire prevention and emergency response to self-efficacy (N=81).

	Standardized Coefficient	R^2 Value	*F* test value	*t* Value	*p* Value	95% CI	
	Beta					*LL*	*UL*
Dependent variable							
Self-efficacy							
Predictor variable							
Awareness	0.601	0.361	44.725	6.688	<0.001***	1.384	2.556

*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

Through analysis results, it is shown that improved advance fire safety training surpasses general fire safety training, and that staff members in the experimental group who received advanced fire safety training performed better in the awareness and self-efficacy sections than the control group who received general fire safety training. The result is similar to Huang et al. (2009)'s "A Study of the Relationship of Employee Self-Efficacy, Learning Strategy, and E-Learning Effectiveness," which states that when employees' self-efficacy feel high, their learning satisfaction is also higher, with better learning effectiveness [19]. It is also found that after receiving training, the trainees' knowledge and self-efficacy are both increased when compared with the score before receiving training [20]. In the difference of nursing home staff with different basic profile and their fire prevention and emergency response awareness, self-efficacy, and total score, it is found that staff who are Taiwanese nationals performed significantly better than foreign nationals on the awareness, self-efficacy, and total score prior to fire safety training intervention. This result and the result published by Chen et al. (2019) show that in residential long-term care facilities, the staff who are Taiwanese nationals are better conformed on their performance in fire management awareness, attitude, and behavior compared to foreign nationals [21]. With fire safety training intervention, although the self-efficacy and total score is still high with Taiwanese nationals compared to foreign nationals and reach significant difference, there is no significant difference of the two in the awareness section. In the effectiveness analysis, foreign national's performance in awareness is better than Taiwanese nationals and reach significant difference, although there is no significant different in self-efficacy and total score. It is evident that after receiving training, foreign nationals' improvement in awareness is more than Taiwanese nationals, and self-efficacy and total score also reach the same level as Taiwanese nationals. This indicates that foreign nationality staff indeed require fire safety training and that after training, whether in awareness, self-efficacy, and total average, they can reach the same level as Taiwanese nationals. This signifies that fire safety training has good effectiveness and is more important to foreign national staff members. The age of 45 years and below and 46 year and above had no statistical difference in total average score whether it is prior or after training intervention, or in the effectiveness analysis. This result corresponds to the result by Wang et al. (2014) [11], but different from Liu (2011) who noted that the older the age, the higher the self-efficacy and training effectiveness [17]. On the level of education with college and above or high school and below, there is no significant difference in the effectiveness analysis. This result is similar to the result from Bi et al. [22]. As for the job position factor, the effectiveness analysis total average of nursing aides and medical administration staff did not reach significant difference, which is different from results by Zhu et al. (2015) [18]. The presumed reason is the difference of fire safety education from medical professional training. Through effectiveness analysis, it is found that those with long-term care work seniority of under 3 years performed better than those over 3 years and reached statistically significant difference. It is different from the findings by Wang et al. (2014) [11], but similar to that by Zhu et al. (2015). It is found that prior to training, the knowledge score is not related to work seniority. However, through training, the knowledge score has increased in each seniority level, but those who

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had 6-10 years of work experience still scored lower than other groups, indicating that better performance is not linked to higher work seniority [18]. Through Pearson Correlation analysis, it is found that the nursing home staff's awareness of fire prevention and emergency response has significant positive correlation with self-efficacy, and that when awareness score is higher, self-efficacy is also higher. This result corresponds with Chen (2014) and indicate that the better the fire response basic awareness is, the better the emergency response ability will be [9]. Huang et al. (2009) noted that when staff self-efficacy feels high, their learning awareness effectiveness is also higher [19]. Through simple regression analysis results, it is learned that there is significant predictivity of the awareness of nursing home staff to fire prevention and emergency response to self-efficacy. This result is consistent with results by Chen et al. (2019), showing that when long-term care facility's staff perform better at fire prevention management, their attitude and behavior are more confident [21]. It is similar to the results by Luo (2001) and Wang (2002) who noted that believe in self-efficacy and training effectiveness are positively correlated [23,24].

The research subjects of this study are limited to the two nursing homes in Taichung City and are of the same hierarchy. It does not cover the whole Taichung City or the whole country. It is recommended that future researchers can expand the data collection scope in order to investigate the training effectiveness of fire prevention and emergency response in long-term care facilities of different hierarchy and scale. Also, the main manpower that provide care in long-term care facilities are nursing aides, of which foreign nationals are abundant. Thus, the prior creation of questionnaire, pretest posttest explanation, and training intervention are all highly challenging to the researcher. It is recommended that future researchers can try to minimize the gap between languages and text communication.

5. Conclusion

Through multiple verifications, this study has found that improved advanced fire safety training method and curriculum surpasses traditional fire safety training. Although fire safety knowledge and material can be found on the websites of the National Fire Agency, Ministry of the Interior, and the Ministry of Health and Welfare, the contents tend to be general or mainly written documents. It is recommended that government and health agencies can design custom material for different types of long-term care facilities and include fire science concept unit to enhance the staff's basic awareness of fire science. This can also be provided to trainers for all long-term care facilities to download and utilize. Also, the fire safety trainers in long-term care facilities should comprehensively instruct staff members of all fire related duties and responsibilities to enable their response to support the needs on-site. This is to prevent confusion and inability to act when the scenario or personnel changes. Moreover, to be familiar with the knowledge obtained needs appropriate frequency of training. The study result indicates that staff member profile is not the main reason that impacts training effectiveness, meaning that each staff may start at different levels, but through correct and effective training material and method, the effectiveness of fire safety training can still be achieved. This study also found that the higher the performance on awareness, the higher the self-efficacy and the grasp on incident response becomes more confident. Therefore, the enhancement of staff awareness to fire prevention and emergency response by their managers or trainers will be a key focus in increasing learning effectiveness.

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References

1. News/Ageing and health. *World Health Organization.* 2021.
2. Latest Indicators. Department of Statistics, Ministry of the Interior. Taipei Taiwan **2021**.
3. Number of Nursing Homes. Department of Gender Equality, Executive Yuan. Taipei Taiwan **2021**.
4. Chen, T. C. A Study on Fire Protection System in Welfare Institutions of the Elderly-Take an Example of Taichung City. *.Feng Chia University. Taichung Taiwan* **2015**.
5. Architecture and Building Research Newsletter, Issue 97. Architecture and Building Research Institute, Ministry of the Interior. Taipei Taiwan **2017**.
6. Cai, S. F.; Lin, Y. X.; Liang, Y. W. Factors Associated with the Outcome of Accreditation of Nursing Homes: Results from the 2009 Taiwan Nursing Home Accreditation Survey. *Taiwan Journal of Public Health.* **2012**, *31*, 2, 119-132.
7. Fire Safety Management Guide 2.0 for General Nursing Homes. Department of Nursing and Health Care, Ministry of Health and Welfare. Taipei Taiwan **2020**.
8. Cai, G. C.; Shi, F. Y.; Shi, C. L.; Lin, F.U. Evaluating Emergency Responses Ability in Chronic Healthcare Facilities Using JCAHO Standards. *Journal of Emergency and Critical Care Medicine.* **2006**, *17*, 1, 1-12.
9. Chen, P. H. The Research of the Staff Awareness of Fire Strain in Elderly Welfare and Nursing Agencies : As an Example to the Shalu、Wuci、Qingshui、Longjing District. *National Changhua University of Education. Changhua Taiwan* **2014**.
10. Chen, H. Y. Fire Science (Version 10). *Dingmao Book Publishing House. Taipei Taiwan* **2016.**
11. Wang, Y. X.; WU, L. L.; LU, M. X. Effectiveness of Different Training Methods on Improving the Knowledge of Infection Control among Nurse Assistants in Long-Term Care Units.*Taipei City Medical Journal.* **2002**,*11*(3),73-85.
12. Chen, M. X.; Wang, Y. T. Input-Process-Effectiveness: A Model for Evaluating Training. *Journal of Human Resource Management.* **2006**, *6*,1, 75-99.
13. Kirkpatrick, D. L. Evaluating training programs:The four levels. *Berrett -Koehler Publishers. San Francisco USA* **1994.**
14. Bushnell, D. S. Input, process, output: A model for evaluating training. *Training and Development Journal.* 1990, March: 41-43.
15. Lin, P. F.; Gao, C. H.; Su, S. J.; Lin, W. J.;Ciou, S. F.;Lin, H. R. Teaching Principles: The Applications in Nursing Practice . *Farseeing Publishing Group. Taipei Taiwan* **2005.**
16. Huang, W. Y.; Xie, Y. P.A Study on Work Stress and Its Related Factors for Foreign Nursing Aides in Nursing Homes around Taichung and Changhua Areas. *Journal of Mei Ho Institute of Technology.* **2010**, *29*, 1, 181-198.
17. Liu, Y. Q. The Relationships among Employee's Self Efficacy,Training Needs,and Training Effect. *Hsuan Chuang Journal of Social Sciences.***2011**, 9, 1-20.
18. Zhu, Z. M.; Liu, J. R.; Huang, S. J.; Weng, L. Z.; Chen, S. T.; Wu, M. H.; Huang, Z. C. The Effectiveness of Community-based Palliative Care Training on Knowledge, Attitude and Skills for the Terminal Patients.*Taipei City Medical Journal.* **2015**,*12*,86-108.
19. Huang, J. C.; Wang,Y. Q.; Li, Z. C. A Study of the Relationship of Employee Self-Efficacy, Learning Strategy, and E-Learning Effectiveness. *K.A.U.S. Journal of Humanities and Social Science.* **2009**, *6*, 2, 119-133+135-144.
20. Monteiro, M., Ferraz, A. I. B., & Rodrigues, F. M. P. Assessment of Knowledge and self efficacy before and after teaching basic life support to school children. *Rev Paul Pediatr.* **2021**, *39*, e2019143.
21. Chen, B. Y.;Ye,D. F.; Zhang, Y. J. Knowledge, Attitude, and Practice of Long-Term Care Institution Staff Toward Fire Prevention Management-A Case Study of Dali District in Taichung. *Cheng Ching Medical Journal.* **2019**, *15*, 4, 43-53.
22. Bi, L. L.; Guo, Z. D. A Study of Training Executive and Learning Effect for Walking Activity Volunteers. *Journal of Taiwan Society for Sport Management.* **2010**, *10*, 2, 1-22.
23. Lo, M. C. The Correlation Study of Computer Self-Efficacy, Computer Anxiety, and Self-Appraisal Effectiveness of Web-Based Training Programs. *National Chi Nan University. Nantou Taiwan* **2001.**
24. Wang, Y. R. A Study on the Government Institute of Relationships among Learning Organization, Organization Communication, Personal Factors and Training Performance－Water Resources Agency, Ministry of Economic Affairs as an Example. *National Changhua University of Education. Changhua Taiwan* **2002.**