Analysis of the effectiveness of public training based on the "Red Cross Rescuer" training course in China

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Introduction

The "Healthy China Action (2019-2030)" proposes that by 2030, the overall health literacy of the population will significantly improve, healthy lifestyles will be widely adopted, and the main health determinants for residents will be effectively controlled, leading to a significant reduction in premature mortality caused by major chronic diseases. One of the important goals set forth in the "Healthy China 2030 Planning Outline" is to reduce the premature mortality rate from major chronic diseases by 30%. Cardiac arrest is a significant cause of premature death from chronic diseases [1]. As a populous country, China sees up to 540,000 deaths due to Out-of-Hospital Cardiac Arrest (OHCA) each year, with a survival rate of approximately 1% [2]. Relying solely on professionals for first aid is no longer sufficient to meet the current demands, and the role of the general public in emergency response should be increasingly emphasized. Bystander-initiated rapid defibrillation is a critical link in the chain of survival for OHCA patients, and the survival rate of patients receiving on-site assistance from laypersons using Automated External Defibrillators (AEDs) and performing CPR has significantly increased, with a substantial increase in the proportion of patients with good prognosis [3].

According to the "China Cardiac Arrest and Cardiopulmonary Resuscitation Report (2022 Edition)" prepared by the National Health Commission, Chinese Center for Disease Control and Prevention, and other departments, the overall incidence of cardiac arrest in China is 97.1 per 100,000 population. It has shown an increasing trend compared to ten years ago. The proportion of the public performing cardiopulmonary resuscitation is 17.0%, which has significantly improved compared to ten years ago but still remains much lower than that of developed countries in Europe and America. Red Cross first aid training is mainly targeted at non-emergency or non-medical professionals and is generally organized and assessed by local Red Cross societies (provinces and cities). This study relies on the activities of "Red Cross First Aid Volunteers" organized by provincial Red Cross societies to recruit the general public for training in cardiopulmonary resuscitation and the operation of automated external defibrillators.

Abstract

Objective: The community plays a crucial role in emergency treatment, and their readiness to provide aid and mastery of basic first aid skills are essential in saving lives within the golden hour. Therefore, this study aims to assess the impact of the "Red Cross Rescuer" training course on the community's knowledge and attitude towards Cardiopulmonary Resuscitation (CPR) and provide practical guidance for the promotion of CPR training among the public.

Methods: Following the principle of voluntary registration for CPR training, a questionnaire survey was conducted before and after the "Red Cross Rescuer" training course from May to August 2023 among 650 members of the public who actively participated in the complete course.

Results: Before the training, the average score for knowledge of Automated External Defibrillator (AED) was 58.81±26.79, which increased to 86.29±18.66 after the training. Similarly, before the training, the average score for CPR knowledge was 60.93±25.91, which increased to 71.55±12.82 after the training. After the training, the willingness of the public to use AED rose from 70.8% to 84.15%, and the number of people who were "very likely" or "somewhat likely" to perform CPR on strangers increased from 343 to 422.

Conclusion: The "Red Cross Rescuer" training course for the community can significantly enhance theoretical knowledge and improve attitudes towards CPR.

Keywords: Red Cross; Training; Cardiopulmonary resuscitation; Public; Training effectiveness.

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Methods

Design and sample

From May to August 2019, residents from 14 prefecture-level cities/autonomous prefectures in Hubei Province, including Wuhan, Xiangyang, Shiyan, Yichang, Xianning, and Huanggang, were selected as the research subjects. Inclusion criteria: age ≥18 years, Hubei Province residency with a minimum of 6 months of residence in the local area within the past year, ability to understand the questionnaire content, voluntary participation in the survey, and full legal capacity. Exclusion criteria: patients with mental disorders, individuals with speech impediments, individuals with poor health conditions unable to complete the survey.

Training

The training content was based on the AHA "Guidelines for Cardiopulmonary Resuscitation and Cardiovascular Emergency Care." The training combined theory and practical exercises and had a total duration of approximately 8 hours: (1) Collective theoretical knowledge lectures (1-2 hours); (2) Practical exercises in groups of 10 participants: The instructor first explained the standard CPR procedure step-by-step on a human model and demonstrated the complete CPR procedure twice. Then, the participants conducted simulated exercises under the guidance of the instructor until they became proficient (3-4 hours).

Data collection

A unified instruction language was used to explain the survey to the subjects. The questionnaire was distributed on-site and through an online platform called "Wenjuanxing." A total of 660 questionnaires were distributed, and 650 valid responses were collected.

Measures

The survey questionnaire was designed based on relevant literature from domestic and international sources. The questionnaire consisted of three parts: (1) General information, including gender, age, ethnicity, education level, place of residence, occupation, marital status, etc. (13 items); (2) Knowledge test and willingness to perform Automated External Defibrillator (AED) procedures; (3) Knowledge test and willingness to perform Cardiopulmonary Resuscitation (CPR). Before using the questionnaire, a pilot survey was conducted with 50 residents of different age groups and educational backgrounds to assess the appropriateness and clarity of the questionnaire items. Based on the pilot survey results, inappropriate or unclear statements in the questionnaire were modified to ensure that the items were within the understanding range of the residents. The questionnaire was filled out before and after the training.

Scoring criteria

AED Section: The knowledge section of this questionnaire consisted of 10 items. Each correct answer was awarded 10 points, and each incorrect answer received 0 points. The total score was converted to a standardized score on a percentage scale:

Standardized Score = Actual Score / Total Score of the questionnaire × 100%.

Based on the percentage scale, the scores were classified as good, fair, or poor. A score > 80% was considered good, 60-80% was fair, and < 60% was poor.

Table 1: Respondents' demographic characteristics.

Investigation content	Total (n)	Percentage (%)
Gender		
male	229	35.1
female	423	64.9
Age		
Under 16 years old	2	0.3
16-25 years old	105	16.1
26-30 years old	120	18.4
31-40 years old	220	33.7
41-50 years old	152	23.3
51-60 years old	45	6.9
Over 60 years old	9	1.4
Education		
Junior high school or below	63	9.7
High school or technical secondary school	129	19.8
Undergraduate or junior college	415	63.7
Postgraduate or above	21	3.2
Whether the occupation is related to medicine (clinical)		
Yes	241	45.4
No	411	54.6
Place of residence (within the last 3 years)		
Urban	496	76.1
A town or suburb	116	17.8
Rural area	40	6.1
Are there any patients with cardiovascular disease in the same family?		
Yes	300	
No	352	
Do you have cardiovascular disease?		
Yes	65	10
No	587	90
The situation of marriage		
Be married	384	58.9
spinster	239	36.7
divorce or be bereaved of one's spouse	29	4.4
Population density of the place of residence		
High	224	36.9
Middle	277	45.6
Low	47	7.7
Unknown	59	9.7
Are there any family members over the age of 65 living together?		
Yes	256	39.3
No	396	60.7
Have you participated in the training of CPR or automatic external defibrillator?		
Yes	178	27.3
No	474	72.7

CPR section: The knowledge section of this questionnaire consisted of 19 items. Each correct answer was awarded 5 points, and each incorrect answer received 0 points. The total score was converted to a standardized score on a percentage scale:

Standardized Score = Actual Score / Total Score of the questionnaire × 100%.

Based on the percentage scale, the scores were classified as good, fair, or poor. A score > 80% was considered good, 60-80% was fair, and <60% was poor.

Data analysis

The data analysis was performed using SPSS 26.0 software. General information was presented using frequency and percentage. Descriptive statistics were used for count data. The chi-square test and unconditional logistic regression were used for factor analysis.

Results

Participants

A total of 673 questionnaires were distributed, and 652 valid questionnaires were collected, resulting in a valid response rate of 96.58%. The age of the subjects ranged from 15 to 70 years, with an average age of 34.58 years. Among the subjects, 631 were Han Chinese (96.8%) and 21 were from ethnic minorities (3.2%).

Unifactor analysis of the respondents' willingness to implement knowledge at different levels before training

Univariate analysis was performed on the knowledge scores of the survey subjects. Gender, marriage, whether there were cardiovascular disease patients in their relatives, population density, whether they had cardiovascular disease, whether there were elderly people over 60 years old living with them, age, education, whether they had participated in CPR training, place of residence (in recent three years), and whether they had participated in cardiopulmonary resuscitation training were divided into groups to compare the scores. The results showed that gender, education background and residence (in the last three years) had statistical significance in knowledge scores (P<0.05). At the same time, the implementation will be compared. The results showed that whether relatives had cardiovascular disease, age, educational background, whether they had participated in CPR training, and whether occupation was related to medicine had statistical significance in implementation intention (P<0.05). The differences in the willingness to perform CPR among people with different characteristics are shown in the table.

Public perception and knowledge score: After the training, the proportion of people with "good" or "medium" cognitive status increased, and the proportion of people with "good" cognitive status increased significantly, from 9.8% before the training to 48.3%.

Table 3: Comparison of assessment results of cognition before and after training (n, %).

Cognitive situation	pre-training	Post-training	皮尔逊卡方	p
Good	64 (9.8)	314 (48.3)	1160.000	0.001
Middle	153 (23.4)	181 (27.8)		
Pool	442 (67.8)	155 (23.9)		

Table 2: Single factor analysis of knowledge score and implementation intention before training.

Item	knowledge score	P	Willing to save		x²	P
			Yes	No		
Sex						
Male	65.60±23.61	0.001	169	60	1.322	0.248
Female	54.12±27.72		294	129		
The situation of marriage						
Be married	60.59±27.08	0.326	275	109	0.382	0.944
Spinster	57.75±25.97		168	71		
Divorce or be bereaved of one's spouse	50.00±27.08		20	9		
Are there any patients with cardiovascular disease in the same family?						
Yes	58.75±26.58	0.979	227	73	5.848	0.016
No	58.82±26.88		236	116		
Population density of the place of residence						
High	60.57±26.71	0.672	169	55	7.26	0.064
Middle	60±26.56		188	81		
Low	48.75±23.56		31	16		
Unknown	59.39±25.36		35	24		
Do you have cardiovascular disease?						
Yes	54.07±26.92	0.34	46	19	0.002	0.964
No	59.18±26.68		417	170		
Are there any family members over the age of 65 living together?						
Yes	57.01±26.99	0.297	189	67	1.624	0.203
No	60.04±26.48		274	122		
Age						
16-25 years old	53.88±24.52	0.433	58	47	18.139	0.006
26-30 years old	59.31±27.9		91	28		
31-40 years old	59.65±26.32		164	56		
41-50 years old	57.6±28.32		113	39		
51-60 years old	73.33±2.45		29	16		
Over 60 years old	50		7	2		
Education						
Junior high school or below	60.00±23.45	0.030	31	32	19.272	0.001
High school or technical secondary school	44.66±27.63		87	42		
Undergraduate or junior college	59.85±26.58		313	102		
Postgraduate or above	62.50±24.36		32	13		
Place of residence (within the last 3 years)						
Urban	49.42±23.689	0.030	352	144	1.959	0.375
A town or suburb	39.01±21.505		86	30		
Rural area	37.12±22.299		25	15		
Have you participated in the training of CPR or automatic external defibrillator?						
Yes	57.28±24.78	0.495	157	157	35.147	0.001
No	59.42±27.49		306	21		
Whether the occupation is related to medicine (clinical)						
Yes	58.69±25.49	0.963	193	48	15.281	0.001
No	58.83±27.33		270	141		

The average standardized score for automatic external defibrillator knowledge before training was (58.81±26.79), indicating a poor level of knowledge. After training, the average standardized score increased to (86.29±18.66), indicating a good level of knowledge. The cardiopulmonary resuscitation knowledge score was (60.93±25.91) before training and (71.55±12.82) after training. The difference between pre-training and post-training scores was statistically significant (p<0.001).

Table 4: Score comparison of first aid skills and knowledge before and after training (±s, points).

Time	Number	AED knowledge score	CPR knowledge score
Pre-training	652	58.81±26.79	60.93±25.91
Post-training	650	86.29±18.66	71.55±12.82
t		16.606	7.203
p		0.001	0.001

Table 5: Comparison of skill intensity scores before and after training (the stronger the ability, the higher the score).

| Capacity intensity | The ability to judge your own breathing | | The ability to apply pressure to your chest | | The ability to give yourself mouth-to-mouth resuscitation | |
	Before training (number)	After training (number)	Before training (number)	After training (number)	Before training (number)	After training (number)
1	53	54	56	53	60	82
2	74	87	66	84	81	86
3	105	167	103	150	100	154
4	63	135	73	148	61	132
5	61	119	58	127	54	108

Comparison of skill confidence scores before and after training

After the training, the general public increased their confidence in their ability to judge their breathing, their ability to perform chest compressions, and their ability to perform mouth-to-mouth resuscitation.

Willingness to perform AED and CPR before and after public training

Regarding the willingness to perform AED procedures, before training, 70.8% of the subjects were willing to perform AED procedures, while after training, the willingness increased to 84.15%. The difference between pre-training and post-training willingness was statistically significant (p<0.001).

Table 6: If someone falls to the ground after pulse respiratory arrest, whether they are willing to use AED for rescue.

	Before training	After training
Yes	462	547
No	190	103

The number of "more likely" and "very likely" people willing to perform CPR on a stranger increased from 343 to 422.

Table 7: Willingness to perform CPR would you give CPR to a stranger?

	Before training	After training
No way	46	27
Unlikely	108	84
I don't know	155	117
High probability	220	289
Very likely	123	133

The hindrance factors, promoting factors and influencing factors of public rescue before and after the training

The results of this study found that among the people who are not willing to rescue, it can be found that "fear of not being able to use it correctly" has become the biggest factor interfering with rescue. The main reasons for the willingness to rescue are "instinct to save" and "responsibility", and the highest proportion of factors affecting rescue are "whether the environment is safe" and "public opinion pressure".

Table 8: Hindering factors, promoting factors and influencing factors of public rescue.

Item	After training
1. Obstacle factors affecting public rescue (Choose not to save)	
A. Fear of no legal guarantee and fear of liability	22
B. Worry that you won't be able to use it properly	41
C. Fear of accidentally injuring patients	27
D. Unwilling to take risks, will call 120 for help	12
E. Other factors	1
2. Promoting Factors affecting public rescue (Choose to save)	
A. The instinct to save people	481
B. Where the responsibility lies	329
C. I can use AED	286
D. I have confidence in myself	157
E. Other factors	0
3. Factors affecting rescue (multiple choices)	
A. Personal values	352
B. Whether the environment is safe	498
C. Pressure from public opinion	275
D. Personality traits	184
E. I don't know	45

Discussion

The results of this survey shown that only 350 (53.6%) of 652 community residents have heard of cardiopulmonary resuscitation related knowledge, indicating that the penetration rate of community residents' cardiopulmonary resuscitation related knowledge is low, which is similar to the literature reports that Yang Mingzhu et al. found that the public awareness rate of the first step of CPR is only 38.24%. In this survey, 178 people (27.3%) received relevant training, and 474 people (72.7%) did not receive training, which was lower than that in Sweden (70%)

[4], Japan (50%-60%) [5], Washington (79%) [6], and similar to that in Hong Kong and Singapore [7]. The study found that urban residents and men with a master's degree or above performed best in knowledge scores. This may be because city dwellers generally have easier access to more knowledge resources and educational opportunities, while highly educated populations also have an advantage in accepting and understanding new knowledge. This also reflects that education activities in the community and campus can more effectively broaden the way and awareness of residents to receive pre-hospital first aid training.

The Global Resuscitation Alliance mentions that Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) training in schools and communities can improve survival rates for Out-of-Hospital Cardiac Arrest (OHCA) patients. The Children Save Lives Statement and Initiative highlights the overwhelming evidence that school-age children learn CPR and AED first aid techniques more easily and quickly than adults, and that they maintain good practical and theoretical skills months after training, playing a key role in improving OHCA survival rates [8]. According to the consensus recommendation of China Cardiopulmonary resuscitation training experts in 2018 [9], CPR training should be included in the basic quality content of primary and secondary school students, and first-aid elective courses should be set up among college students to teach them to master the main points of CPR. For special groups, such as police, firefighters, soldiers, etc., CPR training should be targeted according to their professional characteristics. In addition, community volunteers and community health workers should also receive relevant training on first aid knowledge, such as lectures, videos and brochures, so as to broaden the way for the public to receive training to master basic first aid skills. Studies have found that timely and coordinated pre-hospital interventions can save lives. In communities with high-performance emergency medical services, the overall survival rate is 20 percent; The survival rate of ventricular fibrillation can exceed 50% [10]. At present, the public access to CPR related information mainly depends on the media or the Red Cross sponsored ambulance training program, but how to expand the coverage of CPR training is still in the exploration stage in China. Germany is a good example, according to the regulations of the country, all applicants for a driver's license must attend CPR training and obtain a certificate, otherwise they are not allowed to take the driving test. This provision is an important reason for the popularization of first aid knowledge among the German people. According to statistics, more than 1 million people attend first aid training courses in Germany every year, with an overall penetration rate of 80%. In order to encourage more community people to participate in first aid, the Singapore government has also launched the "Rapid First Aid Training Program" for people's clubs and schools and other institutions, through about an hour of training, to popularize the simple version of cardiopulmonary resuscitation, how to use AED and other first aid knowledge. In this program, elementary and middle school students must receive theoretical training on the signs of cardiac arrest and emergency management methods, while middle school students need additional practical training. Since 2016, in order to vigorously promote and popularize cardiopulmonary resuscitation skills, and effectively implement high-quality cardiopulmonary resuscitation, China has successively carried out the "National cardiopulmonary resuscitation popularization into 100 million health projects" - 525+ (I Love my family) project (that is, popularize cardiopulmonary resuscitation 200 million people

in 5 years, and popularize 5 families per trainer), and hundred trillion safe precision health projects to accelerate the implementation of the "Healthy China" strategy [11].

In terms of implementation intention, people aged "31-40", with bachelor's degree or college degree, who have participated in cardiopulmonary resuscitation training, and those related to occupation and medicine have the highest implementation intention. People from 31 to 40, as pillars and responsible persons of society, community and family, this sense of responsibility may make them more willing to take action to protect the lives and health of others, and they have a better ability to accept knowledge with a bachelor's degree or a college degree, which suggests that training activities can be carried out in relevant work units. The popularization of family core members began to increase the possibility of effective training [12]. Family members of people who are prone to out-of-hospital cardiac arrest also have a higher awareness of CPR, which also suggests the feasibility of increasing AED publicity to improve the popularity of AED from the perspective of disease publicity and the corresponding chronic disease management approaches in hospitals and public health. People with CPR training and occupations related to medicine are more willing to perform rescues, which may be due to their greater self-efficacy when performing bystander CPR on patients [13].

In emergencies, if the public can take initial first aid measures at the first time, it can often win precious time for the treatment of professional medical personnel, which plays a very crucial role in the whole process of first aid. Reducing accidental injuries and casualties caused by critical illness must rely on the active participation of the community residents [14]. Therefore, this study recruited 652 members of the public to participate in the training of "Red Cross ambulance workers", and compared them before and after the training, the results showed that the proportion of people with "good" or "medium" cognitive status increased significantly after the training, and the proportion of people with "good" cognitive status increased significantly, from 9.8% before the training to 48.3%. The average standardized score of automatic external defibrillator knowledge before training was (58.81±26.79), the knowledge level was poor, and the average standardized score after training was increased to (86.29±18.66), the knowledge level was good. The score of cardiopulmonary resuscitation knowledge before training was (60.93±25.91) points, and that after training was (71.55±12.82) points. The difference between the scores before and after training was statistically significant (p<0.001). Because CPR is performed locally and immediately, successful resuscitation usually requires the first witness to respond quickly and professionally, to provide early CPR, and to remove and apply an AED to ensure the best chance of survival and recovery [15]. At the same time, the public's confidence in "their ability to judge breathing", "their ability to perform chest compressions" and "their ability to perform mouth-to-mouth resuscitation" all increased after training. This also reflects that intervention methods of cardiopulmonary resuscitation education can improve learning performance, and key indicators include attitude towards cardiopulmonary resuscitation, willingness to perform cardiopulmonary resuscitation, and degree of cardiopulmonary resuscitation knowledge and skills [16].

The AHA's emphasis on "implementation and training" goes hand in hand, focusing both on knowledge and skill training and on improving the behavioral intent of the rescuer. The results of this study found that among the people who are not willing to

rescue, it can be found that "fear of not being able to use it correctly" has become the biggest factor interfering with rescue. The main reasons for the willingness to rescue are "instinct to save" and "responsibility". Among the factors affecting rescue, the highest proportion are "whether the environment is safe" and "public opinion pressure", which is similar to the reasons of previous studies [17]. The study also showed that the willingness of the public to implement AED after training increased from 70.8% to 84.15%, which indicates that China's CPR training has a broad social group. While training can provide needed skills for the general population, this learner-task-oriented approach may not be effective in increasing a person's motivation to actually perform CPR. The factors influencing rescue in this study refer to the "will-centered" bystander model, which believes that theories can change behavior, such as the theory of planned behavior or the theory of rational behavior. An individual's willingness to perform CPR is determined by their beliefs [18]. From these beliefs, individuals derive their personal attitudes towards CPR (positive or negative, i.e., personal values), their perceived social norms (what people will think if they do not help, what they will do if they do not help), and what they will do if they do not help. Social pressure) and their ability to act on perceived predictable outcomes (self-efficacy, or personality traits). The results of this study found that among the factors affecting rescue, the highest proportion was "whether the environment is safe" and "public opinion pressure", that is, in the results of this study, in addition to saving the environment, people believed that social opinion pressure could most affect the rescue behavior. The decision to start or continue CPR is usually not a straightforward one and may be influenced by information obtained from personal experience, public media, the Internet, or from friends and family [19]. Therefore, in addition to CPR training, China can improve the potential role of public knowledge on first aid of cardiopulmonary resuscitation through various forms of mass media and online publicity and education activities, and suggest that regular mass media intervention can immediately and sustainably reduce the incidence of OHCA injury [20]. Promoting the importance of the implementation of AED and CPR, studies have shown that heart disease incidence and mortality decreased substantially during and shortly after the public awareness campaign [21]. Therefore, the importance of CPR in saving the lives of OHCA patients can be emphasized, and the public can overcome and reduce their fear through relevant knowledge education to improve their willingness to rescue.

Conclusion

The results of this study suggest that public knowledge and confidence in emergency cardiac care can be significantly improved through targeted training and ongoing awareness and education efforts. It is of great significance to improve the success rate of cardiac emergency and reduce the death rate of patients with heart disease.

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