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ORIGINAL ARTICLE

Current status of support for Automated External Defibrillators (AEDs) in public places and factors influencing their use in China: a cross-sectional study

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Abstract

Aim To investigate the support of residents in China for the provision of AEDs in public places and the factors affecting support.

Subject and methods A cross–sectional study was conducted with questionnaires among residents of 120 sampled cities, and ANOVA analysis and stepwise regression were used to assess the factors related to the public's intention for the provision of AEDs in public places.

Results 11,031 valid questionnaires. In the overall population, the mean score of public support for the provision of AEDs was 80.31. Female (β=0.070, $P<0.001$), highly educated groups[undergraduate (β=0.066, $P<0.001$), and graduate (β=0.042, P=0.002)], and those who had higher scores on social support (β=0.050, P=0.002), family health (β=0.238, $P<0.001$) and health literacy (β=0.073, $P<0.001$), had higher support for provision of AEDs in public. In a subgroup analysis of gender and place of residence, gender, literacy, presence of emergency necessities in the household, family type, social support, family health, and health literacy were factors that influenced support for AEDs.

Conclusion Residents' willingness to support the provision of AEDs was generally high. Gender, education level, social support, family health, and health literacy were the main factors influencing their willingness to support. The government can develop AED-related policies based on the findings of the study.

Keywords Automated external defibrillator · Public · Social support · Family health · Health literacy

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Introduction

Cardiac arrest (CA) is a series of symptoms and signs, including loss of consciousness, syncope, and loss of aortic pulsation, resulting from the sudden cessation of cardiac ejection and circulatory arrest (Chinese Medical Association et al. 2019). Due to its rapid onset, limited treatment window, poor prognosis, and low survival rate, cardiac arrest continues to be a common occurrence throughout the world and has raised public health concerns globally (Xu et al. 2017; Virani et al. 2021).

Cardiac arrest can be divided into in–hospital cardiac arrest (IHCA) and out–of–hospital cardiac arrest (OHCA), depending on whether the cardiac arrest occurs in a hospital (Andersen et al. 2019). The majority of cardiac arrests happen outside of hospitals, and the most frequent locations are sports arenas, transportation hubs, sizable supermarkets, and other crowded locations where it is challenging to get timely, qualified emergency care. The incidence of OHCA is increasing globally (Myat et al. 2018). The majority of cardiac arrest deaths worldwide—2.5 million patients annually—occur in China, where the incidence of OHCA is 80% (Gu et al. 2020). In the case of OHCA, the most important emergency measures are early cardiopulmonary resuscitation and rapid defibrillation with an Automated External Defibrillator (AED) to restore cardiac autonomic circulation.

AEDs are portable, life–saving medical devices that can be used by laypeople to resuscitate cardiac arrests. They are intended to treat patients in cardiac arrest and automatically diagnose specific arrhythmia and administer electrical defibrillation. They can be found in airports, community centers, schools, government buildings, hospitals, and other public places (Wang et al. 2019). Several studies have shown that rapid defibrillation with AEDs by the public before the arrival of emergency personnel can effectively improve survival rates by more than 50% (Holmberg et al. 2017). Therefore, AEDs are needed to be strategically and effectively installed in public spaces.

At present, there are many challenges of the provision of AEDs in China, such as uneven development, imperfect provision, and non–standardized procedures. Only a few major cities with more complete emergency medical systems, such as Hangzhou, Shenzhen, Shanghai, and Haikou, have formulated regulations on emergency medical services and released maps of AEDs, while most of the remaining cities are still in the initial stage of development (Lv et al. 2020). The current average AED allocation per 100,000 people is 700 units in the United States and 276 units in Japan, while the data in China are 17.5 units in Shenzhen, Guangdong, 13 units in Haikou, Hainan, 11 units in Pudong New Area, Shanghai, and 5 units in Hangzhou, Zhejiang (Lv et al. 2020). These data reflect that despite the increasing AEDs provision in public places in major cities, there is still a large gap between the number of AEDs in mainland China and abroad.

Most of the current studies on the public and AEDs have explored public attitudes, perceptions, and willingness of using AEDs, such as several studies on public perceptions and willingness of using AEDs in the United States and the Netherlands (Schober et al. 2011; Gonzalez et al. 2015). A study conducted in the Netherlands found that less than half of the respondents were able to use AED in emergency situations (Schober et al. 2011). In urban communities of the United States, two–thirds (66%) of respondents were able to correctly understand AEDs and their uses (Gonzalez et al. 2015). Similar studies have been conducted in individual cities in mainland China (Zhang et al. 2019; Chen et al. 2023). However, there is still a lack of research on public support for government policy actions related to the provision of AEDs in public places.

The will of the public is crucial to the formulation of public policies by the government. As a tool and instrument of public management, public policy serves society by solving public problems, achieving public goals and realizing public interests. Public policies, in terms of their public nature, must meet the fundamental interests of the broadest public. It can be said that in the process of governmental public policy formulation, extensive public participation and expression of public opinion is core elements. Considering and satisfying the interests of the greatest number of members of society is the logical premise of a public policy formulation. The public's will is what the government must take into account when deciding whether to have AEDs in public places because it affects decisions about the distribution of public health resources and the public interest. In addition, the public's attitude towards configuring AEDs in public places may affect the public's willingness to use AEDs to save lives in case of sudden cardiac arrest. For example, an Austrian study found that almost all respondents(97%) correctly believed that AED was a device that could protect patients' lives by electric shock. 57% reported that they could use AED, and 50% reported that they were willing to use AED equipment when they witnessed cardiac arrest (Krammel et al. 2018). By conducting a large sample survey in a number of Chinese provinces and cities, this study aims at filling a research gap by examining public support for the government's decision for the provision of AEDs in public places.

Social support

Social support refers to psychological help or material support such as care, respect and need from family, friends, group organizations and other members (Sarason

et al. 1991). A study found that the stronger the perceived sense of social support, the higher the emotional experience and satisfaction of individuals to be respected, supported, and understood in society, the higher willingness of residents reducing irrational drug use and thus protect their life and health through legislation on licensed pharmacists (Bo-chao et al. 2022) . As a result, this study hypothesized a positive correlation between the public perceived social support and public support for the provision of AEDs in public places.

Family health

"Family health" is defined as "resources at the level of the family unit, developed from the intersection of each family member's health, abilities, behaviors, dispositions, and internal interactions of members and the family's external resources such as physical, social, emotional, economic, and medical" (Weiss–Laxer et al. 2020). A study showed that increasing family closeness and adaptability can increase family members' involvement in health issues (Yun et al. 2019). Therefore, in this study, we hypothesized a positive correlation between residents' family health and public support for the provision AEDs in public places.

Self–efficacy

Social cognitive theory proposes that self–efficacy affects the public's motivation to act and is an important factor in determining the behavior adopted by individuals (Bandura 1977). One study found that self–efficacy was associated with positive willingness to administer cardiopulmonary resuscitation (CPR),and the total CPR knowledge score was positively correlated with positive willingness to give help and high CPR self–efficacy to give help (Navalpotro et al. 2019; Alaryani et al. 2021). Therefore, in this study, we hypothesized a positive correlation between residents' self–efficacy and residents' support for the provision of AEDs in public places.

Health literacy

Health literacy is an individual's ability to access health information and understand disease–related knowledge, and good health literacy facilitates residents to accurately determine and appropriately use health information and thus maintain their health (De Wit et al. 2017). Health literacy is an important factor associated with health care utilization, and inadequate health literacy has a significant impact on a variety of health behaviors and outcomes, including lower utilization of preventive measures and emergency services, higher hospitalization rates, and higher health care costs (Kim et al. 2016; Tian et al. 2020). There are several studies exploring the role of public health literacy in public health and health care (Almubark et al. 2019). A study conducted in Ontario, Canada, on public perceptions of the use of drones to deliver AEDs, which found the feasibility of drone–delivered AEDs, but also highlighted the need for a higher level of health literacy among community residents (Sedig et al. 2020). Therefore, in this study we hypothesized a positive correlation between public health literacy and public support for the provision of AEDs in public places.

Media

Social media platforms have been recognized as an important tool for health promotion practice in public health and the use of social media has become very common among the public. Media can play an important role in disseminating health knowledge such as first aid skills to the public (Benis 2022). This study aimed at investigating the frequency of public use of different media (e.g., cell phones, computers, television, newspapers, etc.) and the correlation between the frequency of media use and AED support, while we hypothesized that residents would be influenced by media, and that higher frequency of media use would be more likely to be exposed to more first aid knowledge, showing a positive correlation with support for the provision of AEDs in public places.

In conclusion, this study aimed to conduct a cross–sectional study in mainland China with a large sample to examine the support of Chinese citizens for the allocation of AEDs in public places and factors influence their support. The specific contents included examining the current level of support among residents for the government's allocation of AEDs in public places, the relationship between demographic and social factors among residents, social support, self–efficacy, family health, health literacy, support for the allocation of AEDs in public areas, and support for media exposure, as well as providing theoretical references for the government's policy planning and training on the allocation of AEDs.

Data and methods

Research subjects

Inclusion criteria: ① age ≥ 12 years; ② nationality of the People's Republic of China; ③ permanent residence in mainland China (time spent away from home ≤ 1 month per year); ④ voluntary participation with the signed informed consent form; ⑤ have the capability of completing the web–based questionnaire on their own or with the help of

the investigator; ⑥ understanding of the meaning expressed in each entry of the questionnaire.

Exclusion criteria: ① those who are delirious or mentally disordered; ② those who are participating in other similar researches; ③ those who are unwilling to cooperate.

Survey methodology

The survey was conducted from July 10, 2021 to September 15, 2021.

This study adopted a multi–stage sampling method. First, the provincial capitals of 23 provinces and 5 autonomous regions, and 4 municipalities directly under the central government (Beijing, Tianjin, Shanghai, and Chongqing) in mainland China were directly included, and 2–6 cities were selected from each of the non–capital prefecture–level administrative regions of each province and autonomous region using the random number table method, with a total of 120 cities. Next, surveyors or survey teams (≤10 people) were recruited in these cities, and based on the results of the "7th National Population Census in 2021", a quota sampling (quota attributes are gender, age, and urban–rural distribution) was conducted on the residents of the 120 cities selected, so that the gender, age, and urban–rural distribution of the sample obtained generally matched the demographic characteristics. The gender, age, and urban–rural distribution of the obtained samples were basically in line with the population characteristics. At least one surveyor or one survey team was recruited in each city, and each surveyor was responsible for collecting 30–90 questionnaires, and each survey team was responsible for collecting 100–200 questionnaires.

Investigators distributed questionnaires one–on–one and face–to–face to residents in their respective areas of responsibility with the help of the web–based Questionnaire Star platform (https://www.wjx.cn/). Respondents answered by clicking on the links, and informed consent was obtained from the subjects during the survey, and questionnaire numbers were entered by the investigators. If the respondents had the ability to think but not enough action to answer the questionnaire, they were asked one–on–one by the surveyor and answered instead.

Research tools

The purpose of this study was to explore the current status of Chinese residents' support for the provision of AEDs in public places and the factors influencing it. The questionnaire included demographic and sociological information (e.g., region, age, gender, education level, and marital status), social support, self–efficacy, family health, health literacy, media exposure, and support for the provision of AEDs in public places.

The support of Chinese residents for the provision of AEDs in public places was self–reported by respondents. A visual analogue scale (VAS) was applied to evaluate willingness to support, using a scale from 0 to 100, with higher scores indicating greater willingness. Respondents chose the score according to their willingness. Before the questionnaire was distributed, the investigator introduced the background and meaning of AED to the respondents for their information.

The Perceived Social Support Scale (PSSS) was used to measure social support. PSSS is a 12–item self–report that assesses emotional support from friends, family, and others (Zimet et al. 1988). Respondents indicate their level of agreement with the items on a 7–point Likert scale, ranging from "strongly disagree" to "strongly agree". The Cronbach's alpha coefficient for the PSSS scale was 0.87, indicating that the scale has good internal consistency reliability.

The New General Self–Efficacy Scale (NGSES) was used to measure people's self–efficacy (Chen et al. 2001). NGSES consists of 8 items, all of which are positively scored, and each item is scored on a 5–point Likert scale ranging from strongly disagree (1) to strongly agree (5), with a total score of 8–40. The Cronbach's alpha coefficient for the NGSES scale was 0.79, indicating that the scale has good internal consistency and reliability.

The Family Health Scale–Short Form (FHS–SF) is composed of 2–3 items with higher factor loadings and weights from 4 dimensions of the Family Health Scale–Long Form (FHS–LF): family social and emotional health processes, family health lifestyle, family health resources, and external social support (Crandall et al. 2020). The Cronbach's alpha coefficient of the FHS–SF scale was 0.849, indicating that the scale has good internal consistency reliability.

The Health Literacy Scale Short Form (HLS–SF12) was used to measure health literacy (HL) (Duong et al. 2019). The perceived difficulty of each item was scored according to the Likert scale (1 = very difficult, 2 = difficult, 3 = easy, 4 = very easy). The total score is 12–48, with higher scores indicating higher levels of health literacy. In this study, the Cronbach coefficient of the scale was 0.940, and the Cronbach coefficients of the three subscales of health care, disease prevention, and health promotion were 0.856, 0.860, and 0.868, respectively, indicating that the scale has good internal consistency reliability (Zhang et al. 2022a).

The self–administered questionnaire on media exposure was designed by members of the China Family Newspaper Research Center and is applicable to the measurement of media exposure for all populations. The questionnaire consists of 7 items, which measure the frequency of exposure to seven types of media: newspapers, magazines, radio, television, books (not textbooks), personal computers (including tablets), and smartphones. It is based on the number of days of exposure to each type of media in a week, and each item

is scored on a 5–point Likert scale, ranging from never (1 point) to almost every day (6–7 days/week) (5 points), with a total score of 7–35. Higher scores indicate more frequent media exposure of the respondent. The Cronbach's alpha coefficient for the media use scale is 0.70 (Gong et al. 2022).

Statistical methods

We performed data analysis using SPSS™, version 26.0 (SPSS, Inc., Chicago, IL, USA). Data analysis included means and standard deviations for continuous variables, number and percentage of categorical data, and p–values for each variable. ANOVA analysis was used to compare factors of variation in the public's intention to have AEDs in public places. In addition, stepwise regression analysis was used to assess the difference variables associated with the intention to have AEDs in public places (inclusion and exclusion criteria: *P=0.05 and P=0.10*). Stepwise regression analyses were also performed on intention scores by gender, usual residence, and education level.

Results

The survey concluded a total of 11031 valid questionnaire results from 23 provinces, 5 autonomous regions and 4 cities in mainland China, shown by Fig. 1. The number of subjects from eastern, central and western China respectively accounted for 50.87%, 25.85% and 23.29% of the total. Figure 1 also visualized AED support willingness scores of each area through blue shades from the darkest to the lightest. Tibet Autonomous Region has the darkest color and the highest score; Gansu Province and Tianjin City have the next darkest color and higher score; from Hunan, Anhui, Guizhou, Guangdong Province to Shanghai City and Fujian Province, the shades of blue decreases, indicating that the score of their corresponding provinces gradually decreases; Heilongjiang Province and Chongqing City have the lightest color and lower score.

Descriptive statistics and one–way ANOVA

As outlined in Table 1, there are 11031 sample cases in total, among which 5998 (54.4%) were female, 8008 (72.6%) were urban residents, 6360 (57.7%) were non–agricultural households, and there was a predominance of residents below the age of 50 (80.5%). The household type was mainly nuclear families (59.3%), nearly 40% of the respondents had jobs, and most of them had college education or above (58.8%), most of the households had a per capita monthly income of less than RMB 6,000 (68.0%), and most of the residents had household emergency necessities (81.8%). The item of whether the residents' occupation is medical personnel only counts working and

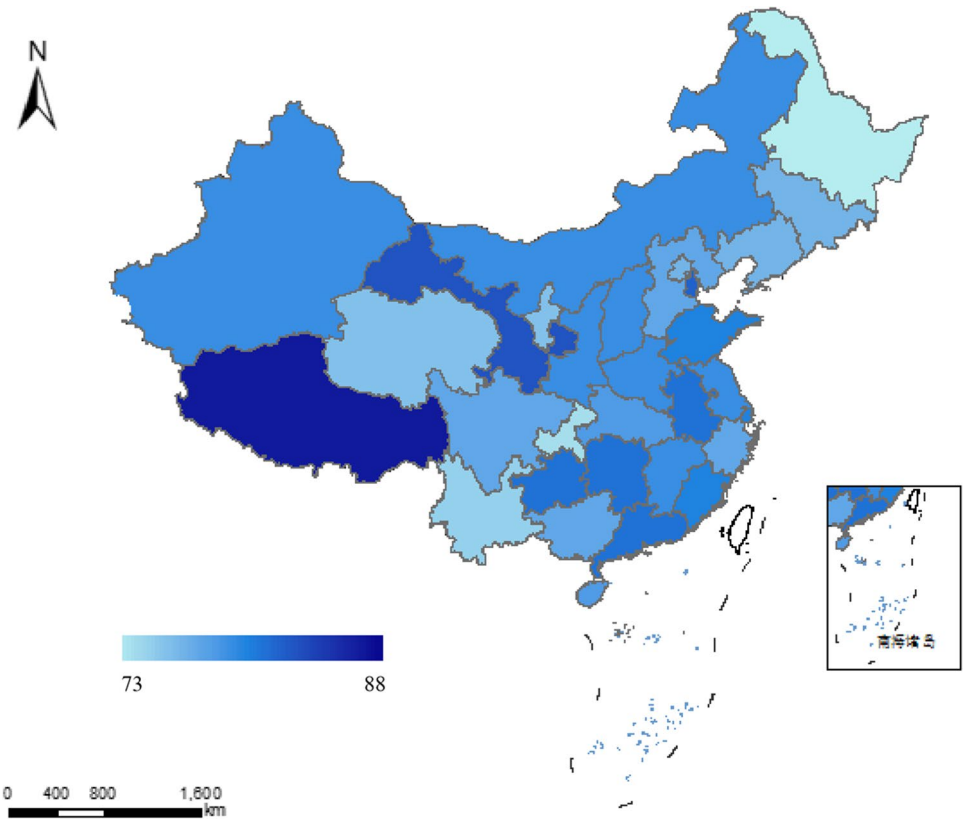

Fig. 1 Level of public support for having AEDs in public places in China

Table 1 Descriptive statistics and one-way ANOVA

Variables		Quantity	Percentage (%)	Average value	Standard deviation	F	P
Total		11031	100.0	80.31	25.09		
Gender							
	Male	5033	45.6	78.43	25.50	52.202	<0.001
	Female	5998	54.4	81.89	24.63		
Age (years)							
	≤18	1065	9.7	82.19	25.43	5.545	<0.001
	19-35	4533	41.1	81.18	24.60		
	36-50	3280	29.7	79.37	25.04		
	51-65	1278	11.6	78.97	25.58		
	≥66	875	7.9	79.01	26.38		
Ethnicity							
	Han Chinese	10386	94.2	80.49	25.00	9.216	0.002
	Ethnic Minorities	645	5.8	77.40	26.35		
Nature of household registration							
	Agriculture	4671	42.3	78.46	26.16	44.507	<0.001
	Non-agricultural	6360	57.7	81.67	24.18		
Education level							
	Elementary school and below	1127	10.2	76.6	28.39	33.302	<0.001
	Secondary Schools	3417	31.0	77.87	26.04		
	College	1445	13.1	78.76	25.24		
	Undergraduate	4305	39.0	83.15	23.27		
	Graduate Students	737	6.7	83.75	22.87		
Marital Status							
	Unmarried	4363	39.6	81.52	24.86	5.773	0.001
	Married	6226	56.4	79.54	25.15		
	Divorced or widowed	442	4.0	79.25	26.07		
Place of residence for the last three months							
	East	5613	50.9	80.53	25.27	0.451	0.64
	Middle	3078	27.9	80.17	24.92		
	West	2340	21.2	79.99	24.88		
Place of permanent residence							
	Rural	3023	27.4	77.90	26.52	38.741	<0.001
	Cities and towns	8008	72.6	81.22	24.47		
Family Type							
	Couple Family	1763	16.0	75.92	27.00	23.692	<0.001
	Nuclear Family	6546	59.3	81.55	24.55		
	Main family	1345	12.2	80.5	24.30		
	Other forms of family*	1377	12.5	79.85	25.25		
Monthly per capita household income (RMB)							
	0-3000	3246	29.4	78.92	26.30	5.444	0.001
	3001-6000	4254	38.6	80.52	24.83		
	6001-9000	1860	16.9	81.25	24.11		
	≥9001	1671	15.1	81.45	24.27		
Religious beliefs							
	None	10709	97.1	80.50	24.96	21.785	<0.001
	There are	322	2.9	73.89	28.49		
With or without children							
	None	5062	45.9	81.30	24.73	14.533	<0.001
	There are	5969	54.1	79.47	25.36		

Table 1 (continued)

Variables		Quantity	Percentage (%)	Average value	Standard deviation	F	P
Have any siblings							
	None	2564	23.2	80.95	24.90	2.191	0.14
	There are	8467	76.8	80.12	25.14		
Anyone living with you in the last two months							
	None	1059	9.6	75.79	27.52	38.210	<0.001
	There are	9972	90.4	80.79	24.77		
Career Status							
	Students	3314	30.0	82.21	24.43	42.395	<0.001
	On-the-job	4637	42.0	81.61	23.95		
	Retirement	884	8.0	79.17	26.01		
	No fixed occupation	2196	19.9	75.16	27.26		
Whether the occupation is medical personnel (active and retired)							
	No	5020	45.5	80.91	24.48	9.556	0.002
	Yes	501	4.5	84.42	22.23		
With or without medical insurance							
	Self-financed	2299	20.9	77.12	26.37	20.455	<0.001
	Resident Health Insurance	5352	48.5	80.47	25.00		
	Employee health insurance	2937	26.6	82.56	23.99		
	Other forms of health insurance*	443	4.0	80.00	24.79		
With or without diagnosed chronic diseases							
	None	8997	81.6	80.49	25.00	2.502	0.11
	There are	2034	18.4	79.52	25.46		
Smoking or not							
	Never smoked	8845	80.2	80.91	24.83	12.756	<0.001
	Smoking	1399	12.7	77.79	26.08		
	Have quit smoking	787	7.1	78.08	25.78		
Frequency of alcohol consumption							
	Never had one	6581	59.7	80.22	25.19	12.130	<0.001
	Less than 1 day/month	1775	16.1	82.50	24.62		
	1-3 days/month	1079	9.8	82.12	23.29		
	1-6 days/week	1399	12.7	77.36	25.86		
	Daily	197	1.8	74.71	27.07		
Availability of household emergency necessities							
	None	2004	18.2	77.22	27.99	37.327	<0.001
	There are	9027	81.8	81.00	24.35		
Social support score		11031	100	48.22	13.03	11.186	<0.001
Self-efficacy score		11031	100	28.66	5.45	14.042	<0.001
Family Health Score		11031	100	37.99	6.64	32.880	<0.001
Media exposure score		11031	100	19.34	4.96	6.736	<0.001
Health literacy score		11031	100	36.70	6.04	18.015	<0.001

*Other forms of families: including joint families, single-parent families, butch families, intergenerational families, single families, reconstituted families, cohabiting families, homosexual families, etc.

*Other forms of health insurance: commercial health insurance, public funding

retired medical personnel, with a total number of 501 (4.5% of the total number). The mean score on the Public Perceived Social Support Scale was 48.22 ± 13.03, the score on Self–Efficacy Scale was 28.66 ± 5.45, the Family Health Scale 37.99 ± 6.64, the Media Exposure Scale 19.34 ± 4.96, and the Health Literacy Scale 36.70 ± 6.04, respectively.

The differences in public support for the provision of AEDs in public places were statistically significant in terms of gender, age, ethnicity, nature of household

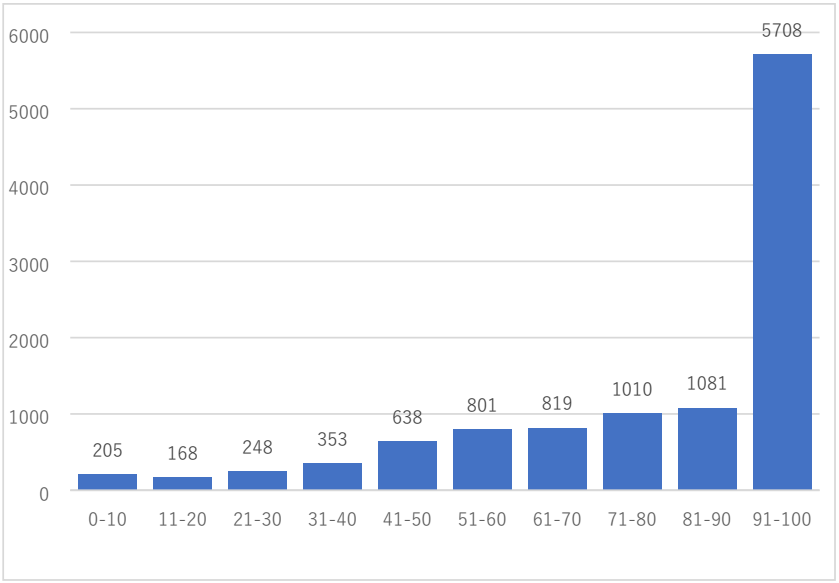

Fig. 2 Level of support for the provision of AEDs in public spaces

registration, education level, marital status, place of residence in the last three months, usual place of residence, family type, per capita monthly household income, religion, household composition, residence status, occupational status, health insurance status, disease status, living habits, and presence of household emergency necessities ($P<0.05$), indicating that these variables had a significant effect on the support for the provision of AEDs in public places.

Summary of public support scores

According to Fig. 2, the mean score of public support for having AEDs in public places was 80.31, with a standard deviation of 25.09. Among them, 5708 people (51.7%) had a support score between 91 and 100, and only 2060 people (21.9%) had a support score ≤ 60 for having AEDs in public places.

Multiple linear regression

Factors associated with public support for the provision of AEDs in public places are shown in Table 2. For women (β=0.070, P<0.001), those with higher education (undergraduate (β=0.066, P<0.001), graduate (β=0.042, P=0.002)), social support score (β=*0.050,* P=0.002), family health score (β=0.238, P<0.001), and health literacy score (β=0.073, P<0.001) had higher public support for having AEDs in public places.

Higher scores of social support, family health, and health literacy all had a significant positive effect on the support score for AEDs provision in public places, and the

Table 2 Stepwise regression model of demographic social factors and total scores of other scales on public support scores for AEDs provision in public places

Projects		Unstandardized coefficient		Standardization factor	*t*	*P*	95% confidence interval	
		B	SE	β			Confidence lower limit	Confidence limit
Gender (Ref: Male)								
	Female	3.394	0.620	0.070	5.476	<0.001	2.179	4.609
Education level (Ref: elementary school and below)								
	Undergraduate	3.329	0.664	0.066	5.016	<0.001	2.028	4.629
	Graduate Students	3.503	1.106	0.042	3.168	0.002	1.335	5.671
Social Support		0.096	0.032	0.050	3.036	0.002	0.034	0.158
Family Health		0.871	0.059	0.238	14.665	<0.001	0.755	0.987
Health Literacy		0.309	0.060	0.073	5.135	<0.001	0.191	0.427

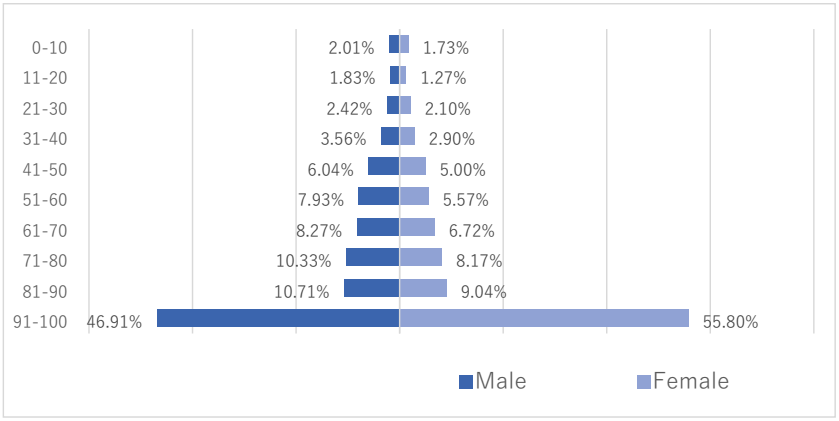

Fig. 3 Support score for AEDs provision in public places by gender

Table 3 Stepwise regression model of support score for the provision of AEDs in public places by gender

Projects	Unstandardized coefficient		Standardization factor	*t*	*P*	95% confidence interval	
	B	SE	*β*			Confidence lower limit	Confidence limit
Male							
Education level (Ref: elementary school and below)							
Secondary Schools	-3.345	1.047	-0.062	-3.195	0.001	-5.398	-1.292
College	-3.358	1.256	-0.051	-2.673	0.008	-5.821	-0.894
Family Type (Ref: Couple Family)							
Other forms of family	2.963	1.374	0.039	2.157	0.031	0.269	5.657
Availability of household emergency necessities (Ref: None)							
There are	4.902	1.292	0.069	3.794	<0.001	2.369	7.436
Family Health	1.052	0.074	0.281	14.285	<0.001	0.908	1.196
Health Literacy	0.331	0.086	0.076	3.872	<0.001	0.164	0.499
Female							
Education level (Ref: elementary school and below)							
Undergraduate	3.528	0.850	0.074	4.149	<0.001	1.861	5.195
Family Type (Ref: Couple Family)							
Nuclear family	1.731	0.837	0.037	2.069	0.039	0.091	3.372
Social Support	0.112	0.044	0.059	2.559	0.011	0.026	0.198
Family Health	0.755	0.082	0.211	9.220	<0.001	0.594	0.915
Health Literacy	0.343	0.081	0.083	4.232	<0.001	0.184	0.501

higher the scale score, the higher the public support for AEDs provision in public places.

Subgroup analysis

Subgroup analysis of support for AEDs provision in public places by gender

Considering the statistical differences in gender shown in Fig. 3, we further performed stepwise regression analysis for gender subgroups in Table 3. In male subgroup, family type [other forms of family (β=0.039, P=0.031)], presence or absence of household emergency necessities [presence (β=0.069, P<0.001)], family health score (β=0.281, P<0.001), and health literacy score (β=0.076, P<0.001) had a significant positive effect on the support score of AEDs provision in public places, while literacy [secondary school (β=–0.062, P=0.001), and college (β=–0.051, P=0.008)] had a significant negative effect on the score.

In female subgroup, similar to the overall population, education level [undergraduate (β=0.074, P<0.001)], social support score (β=0.059, P=0.011), family health score (β=0.211, P<0.001), and health literacy score (β=0.083, P<0.001) were associated with higher public support for

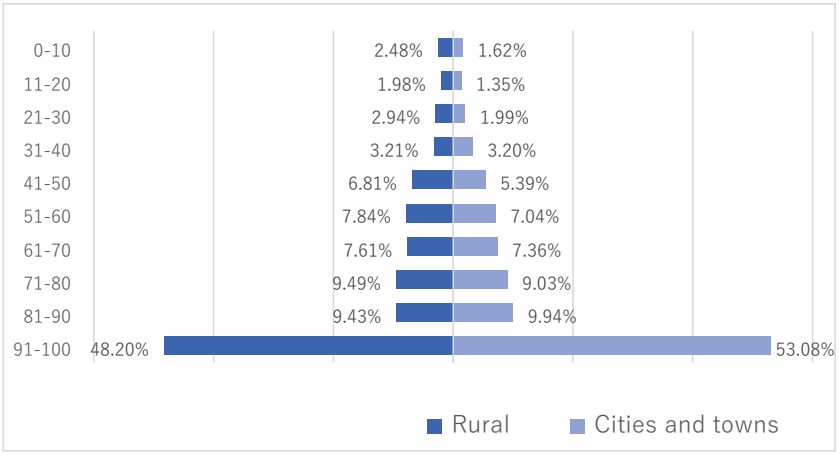

Fig. 4 Support score for AEDs provision in public places by usual residence

Table 4 Stepwise regression model of support scores for the provision of AEDs in public places by usual place of residence

Projects	Unstandardized coefficient		Standardization factor	*t*	*P*	95% confidence interval	
	B	SE	*β*			Confidence lower limit	Confidence limit
Rural							
Education level (Ref: elementary school and below)							
Secondary Schools	-4.766	1.563	-0.092	-3.049	0.002	-7.833	-1.699
Family Type (Ref: Couple Family)							
Main family	6.158	1.949	0.096	3.160	0.002	2.334	9.982
Social Support	0.249	0.073	0.132	3.423	0.001	0.106	0.392
Family Health	0.670	0.146	0.176	4.584	<0.001	0.383	0.957
Health Literacy	0.646	0.150	0.144	4.316	<0.001	0.352	0.939
Cities and towns							
Gender (Ref: Male)							
Female	3.360	0.674	0.070	4.985	<0.001	2.039	4.682
Education level (Ref: elementary school and below)							
Undergraduate	3.439	0.720	0.070	4.777	<0.001	2.027	4.850
Graduate Students	3.666	1.154	0.047	3.176	0.002	1.403	5.929
Family Type (Ref: Couple Family)							
Nuclear Family	3.251	0.870	0.068	3.736	<0.001	1.545	4.957
Main family	2.337	1.169	0.034	1.999	0.046	0.045	4.629
Other forms of family	4.191	1.208	0.057	3.469	0.001	1.823	6.559
Family Health	0.967	0.055	0.266	17.583	<0.001	0.859	1.075
Health Literacy	0.284	0.064	0.067	4.456	<0.001	0.159	0.409

having AEDs in public places, while family type [nuclear family (β=0.037, P=0.039)] was also associated with it.

Subgroup Analysis of Support for AEDs provision in public places by usual residence place

Although the difference in permanent residence was not significant in the multiple regression results, the respective analysis of residents in urban and rural areas may facilitate the provision of AEDs in public places in the two areas, shown by Fig. 4. Therefore, the study further conducted stepwise regression analysis for urban and rural subgroups, which outlined in Table 4. In the rural subgroup, the social support score (β=0.132, P=0.001), family health score (β=0.176, P<0.001), and health literacy score (β=0.144, P<0.001) were consistent with the overall population, and

the main family type (β=0.096, P=0.002) population had higher support for having AEDs in public places, while those with secondary education (β=–0.092, P=0.002) had lower support for this.

In the urban subgroup, gender [female (β=0.070, P<0.001)], education level [(undergraduate (β=0.070, P<0.001), graduate (β=0.047, P=0.002)], family health score (β=0.266, P<0.001), and health literacy score (β=0.067, P<0.001) also showed correlations consistent with the overall trend. Also family type [nuclear family (β=0.068, P<0.001), primary family (β=0.034, P=0.046), and other forms of family (β=0.057, P=0.001)] had a significant positive effect on the support score for AEDs provision in public places.

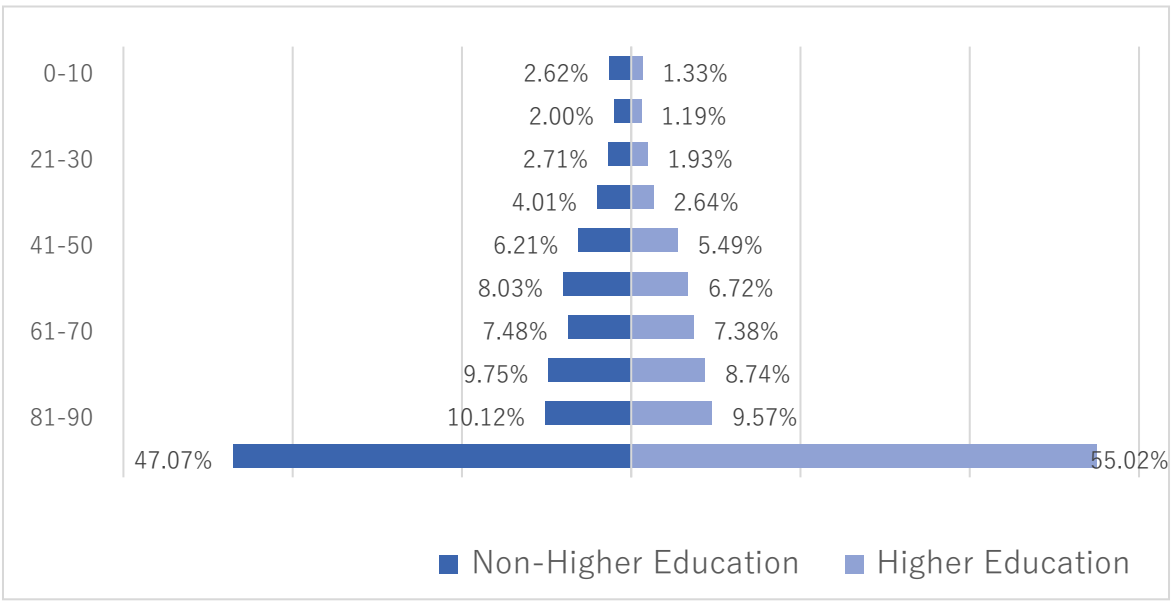

Fig. 5 Support score for AEDs provision in public places by education level

Table 5 Stepwise regression model of support score for the provision of AEDs in public places by education level

Projects		Unstandardized coefficient		Standardization factor	t	P	95% confidence interval	
		B	SE	β			Confidence lower limit	Confidence limit
Non-Higher Education								
Gender (Ref: Male)								
	Female	2.447	1.126	0.048	2.173	0.030	0.238	4.655
Availability of household emergency necessities (Ref: None)								
	There are	3.274	1.500	0.048	2.182	0.029	0.331	6.216
Family Health		0.978	0.093	0.246	10.546	<0.001	0.797	1.160
Health Literacy		0.267	0.104	0.060	2.564	0.010	0.063	0.471
Higher Education								
Gender (Ref: Male)								
	Female	3.921	0.736	0.084	5.325	<0.001	2.477	5.364
Medical insurance (Ref: self-pay)								
	Employee health insurance	1.964	0.757	0.041	2.594	0.010	0.479	3.448
Social Support		0.105	0.037	0.056	2.805	0.005	0.031	0.178
Family Health		0.845	0.070	0.242	12.077	<0.001	0.708	0.982
Health Literacy		0.364	0.072	0.087	5.029	<0.001	0.222	0.505

Subgroup analysis of different education levels on support for AEDs provision in public places

Since different levels of education may also have an effect on the results, indicated in Fig. 5, this study further conducted stepwise regression analyses for education level subgroups in Table 5. Based on demographic and sociological characteristics, we defined those with education level of college and above as the higher education subgroup and those with secondary school and below as the non–higher education subgroup. In the non–higher education subgroup, similar to the overall population, public support for having AEDs in public places was higher for gender [female (β=0.048, P=0.030)], family health score (β=0.246, P<0.001), and health literacy score (β=0.060, P =0.010), as well as for the presence or absence of household emergency necessities [with (β=0.048, P=0.029)] were also associated.

In the higher education subgroup, the basic profile was similar to the overall group, with gender [female (β=0.084, P<0.001)], social support score (β=0.056, P=0.005), family health score (β=0.242, P<0.001), and health literacy score (β=0.087, P<0.001) being supportive of the provision of AEDs in public places. AEDs provision in public places was supported, more specifically, the item of health insurance [employee health insurance (β=0.041, P=0.010)] was not reflected in the overall.

Discussion

Up to now, the use of AEDs by the public is still in a poor state, but past related studies have mainly focused on investigations about the location of AEDs, knowledge skills understanding, and their use as bystanders among residents, which lacked the investigation of residents' willingness to support the equipping of AEDs (Gantzel Nielsen et al. 2021; Gonzalez et al. 2015; Ślęzak et al. 2021). This study firstly conducted a large–scale investigation of the extent of residents' willingness to support AEDs provision in public places and the factors influencing it in China, from the perspectives of sociodemographic characteristics, self–efficacy, health literacy, media, social support, and family health. According to the result, the mean score of residents' willingness to support AEDs was 80.3125.09 (out of 100), and this relatively high score indicates that most Chinese residents are willing to accept the provision of AEDs in public places.

In addition, this study identified a number of important factors that may influence residents' supportive attitudes, which provides targeted references for the promotion strategy of having AEDs in public places and the use of AEDs by the bystander public. First, gender can be a factor influencing residents' attitudes. This study found that women were more willing to accept the provision of AEDs in public places compared to men, a finding similar to that of Wang et al. (2022). who found that women were more willing to resuscitate cardiac arrest patients than men regardless of the skills required, and that gender differences between men and women may be due to their different concerns. However, some studies have also found that women are less willing to use AEDs to help strangers (Lee et al. 2021; Pei-Chuan Huang et al. 2021). Therefore, the government also needs to consider developing interventions that promote women to move from accepting AEDS provision to performing rescues, increasing women's motivation to use AEDs as bystanders. Second, the level of education can be a key factor in supporting AED provision. The higher the level of education of people (university and above), the higher the level of support for AEDS provision in public places. This result is similar to the results of a previous study, which found a high positive correlation between knowledge and attitude, with education and AED–related knowledge scores promoting attitudes toward AED use (Chow 2021). Based on the difference of gender factors on the provision and use of AEDs in public places, this study suggests that the popularization of AED use and related first aid skills and training should be increased for females, while the advantages of having AEDs in public places should be promoted for male residents; and the promotion of AED–related knowledge should be strengthened for residents with less than a bachelor's degree.

This study also found that residents with higher scores on social support (PSSS), family health (FHS–SF), and health literacy (HLS–SF12) had more support intentions, indicating that having social resources, family resources, and health resources were positively associated with supporting AED provision. A higher PSSS score indicates that the individual feels more psychological and material support. Studies have shown that social support is a protective factor against stress disorders and secondary injuries among first responders (Greinacher et al. 2019). Social support can enhance residents' sense of involvement and empathy (Chen and Xu 2021). The FHS–SF measures family health in multiple dimensions, both inside and outside the home. A healthy family fosters the responsibility and ability of family members to support each other and care for each other (Naef et al. 2022). Residents with healthy families are more energetic and capable of supporting the state in allocating public emergency resources to society. Previous studies have found that residents with high HLS–SF12 scores are more motivated to accept organ donations (Zhang et al. 2022b). The study found that residents with high HLS–SF12 scores were more motivated to accept organ donation. Health literacy as a potential social determinant of health and as part of the public health response to health inequities has been studied as an asset to individuals and society (Nutbeam and

Lloyd 2021). Residents with high health literacy have better access to health information, better knowledge and understanding, and are able to understand and utilize the resources of AEDs to maintain their health. AEDs, as a layperson–operable, early and most effective treatment for cardiac arrest (Ruan et al. 2021). AEDs can be equipped and popularized in public places to effectively protect the health of residents and save lives. It is recommended to promote AED–related knowledge from multiple dimensions, from the school level, community level, etc., through the promotion of different social role groups of individuals, to achieve the mobilization from various role groups to individuals. At the same time, the level of health literacy education of residents should be strengthened, so that residents have a higher level of willingness to support the provision of AEDs. Currently, some provinces and cities are planning to implement the scientific popularization and strategy of "First Aid on the Spot – First Responders Action" to train residents with first aid knowledge and skills in communities, schools, enterprises, and grassroots organizations (Yan et al. 2022). The first–aid training will be conducted in communities, schools, enterprises and grassroots organizations.

Interestingly, when we analyzed by subgroup, we found some additional predictors of acceptance of AEDs in public places. Women's education level, PSSS, FHS–SF, and HLS–SF12 scores were positively associated with willingness to support, whereas men's education level was negatively associated with willingness to support, presumably because men's concern was fear of legal disputes, and as education level increases, awareness and knowledge about the law also increases, which can inversely affect the willingness to support (Lu et al. 2016). The presence of home emergency necessities in men is a positive predictor of having an AED in public places. Home emergency preparedness is the knowledge, ability, and action to respond effectively to emergencies and disasters that are closely related to the intention of AEDs to perform first aid for sudden cardiac arrest (Chen et al. 2019). As a country with a deep agrarian background and complex geography, urban–rural differences are reflected in various aspects of China, such as urban–rural inequalities in health–related issues (Jiang and Wang 2018). This study found that the predicted direction and magnitude of gender, literacy, family type, family health, and health literacy were generally consistent in urban areas, but the opposite was true for literacy in rural areas, where rural residents with secondary education may have more ambiguous knowledge and awareness of AEDs than those with primary education or less, but because of better experience with medical care resulting in greater acceptance of AEDs in this group. greater acceptance (Zhao et al. 2021). The study found that education level was a significant factor in the acceptance of AEDs. In this study, education level was found to be an influential factor in the willingness to support AEDs, and the results of their grouping revealed that females, availability of household emergency necessities, social support, family health, and health literacy were all factors that contributed to the willingness to support AEDs in both the non–higher education and higher education groups. However, it is worth considering that residents in higher education with employee health insurance were more positive about having an AED as opposed to self–paying. Some studies have found that well–educated individuals enjoy more job resources and income (Solomon et al. 2022). This may be related to the fact that the higher the level of education, the more health care coverage and financial support they receive at work, and the less financial personal burden and concern they have about public facility equipping. Subgroup analysis found that family type is also a factor that influences the configuration of support AEDs, and its influential nature can be further explored. It is suggested that at the legal level, the obligation and responsibility of using AEDs for first aid should be improved to minimize legal disputes arising from the use of AEDs for first aid; at the same time, the publicity of family emergency knowledge and first aid knowledge can also increase residents' intention to deploy AEDs; at the same time, more financial support should be given to the provision of AEDs to reduce the corresponding financial burden of residents.

One of the strengths of our study is the use of a quota sampling method to investigate, for the first time, the willingness of Chinese residents to support AED equipping in public places and related influencing factors on a national scale. Second, this study includes scales of social support, family health, and health literacy to explore possible factors influencing support for AED equipping from more perspectives. It provides some valuable insights and references for the policy development, popularization and subsequent knowledge and skills training of AEDs. However, several limitations need to be considered. First, the self–reported information and self–assessment scale results in the study may have unintentional and intentional reporting bias (Simundić 2013). Second, the cross–sectional design of the study was unable to determine the causal relationships between variables. In future studies, a longitudinal design or a controlled design could be conducted to explore the relationship between influencing factors and residents' willingness to support the provision of AEDs in public places. Multiple forms of data collection, such as qualitative interviews and mixed studies, are also considered to enrich the data. The current configuration of AEDs in public places is supported by national policies, and differences in public health strategies in different regions can have an impact and require in–depth research in different regions (Zhang et al. 2019).

Summary

The study found that Chinese residents are more willing to support the provision of AEDs in public places. Gender, education level, social support, family health, and health literacy were the main factors affecting the willingness to support. The government, medical institutions, and educational institutions can take targeted measures to improve the laws and regulations related to the obligation and responsibility of AED use; give more financial support to the provision of AED equipment; at the same time, for different gender groups, carry out different focus on publicity and education; strengthen the level of AED–related health education for residents with low literacy levels; and for different social groups to carry out different focus on training of AED skills and promotion of AED–related knowledge for different social groups. From the perspectives of demographic and sociological characteristics, social support, family support, health and economic resources, this study can fit the psychology and needs of the residents and reduce their concerns, which will promote the popularity of AEDs and other public first aid facilities, improve residents' acceptance and satisfaction with the policy, and facilitate the implementation and enforcement of the relevant policies.

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Authors' contributions Dr Le-Shan Zhou and Dr Yi-bo Wu had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Zi-yun Zhou, Yi-bo Wu, Le-Shan Zhou.

Acquisition, analysis, or interpretation of data: Zi-yun Zhou.

Drafting of the manuscript: Zi-yun Zhou, Jin-zi Zhang, Xian-qi Zhao, Yu-yao Niu, Jing-bo Zhang. Zi-yun Zhou wrote the final manuscript.

Critical revision of the manuscript for important intellectual content: Zi-yun Zhou, Bojunhao Feng, Pu Ge, Xin-yi Liu.

Statistical analysis: Zi-yun Zhou.

Obtained funding: Yi-bo Wu, Le-Shan Zhou.

Administrative, technical, or material support: Yi-bo Wu, Le-Shan Zhou.

Supervision: Yi-bo Wu, Le-Shan Zhou.

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Data availability Data are available, upon reasonable request, by emailing:bjmuwuyibo@outlook.com

Declarations

Ethics approval This study was reviewed and approved by the ethics committees of the IRB of Jinan University (JNUKY-2021-018). All methods were performed by the relevant guidelines and regulations (Declaration of Helsinki).

Ethical statement All procedures performed in studies involving human participants comply with the Institutional Research Committee's ethical standards and relevant guidelines and regulations (Declaration of Helsinki). In the included studies, all individual participants received informed consent.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent to publish The authors affirm that human research participants provided informed consent for publication of the information in the manuscript.

Conflict of interest The authors report no conflict of interest.

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