Perception of Telephone-assisted Cardiopulmonary Resuscitation Among Emergency Medical Personnel in China: a Web-based Survey

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Abstract

Background: To investigate the perception of telephone-assisted cardiopulmonary resuscitation (T-CPR) after out-of-hospital cardiac arrest (OHCA) among emergency medical service (EMS) providers in China.

Methods: A multicentre, cross-sectional, descriptive, online questionnaire survey study was conducted on the perception among emergency centres in various regions across China from December 2018 to June 2019. Answers to questions concerning baseline characteristics of survey respondents, cognition and implementation of T-CPR, and use of automated external defibrillators were surveyed.

Results: Of 1,191 questionnaires obtained from 15 provinces in China, 1,187 were valid. Among the 1,187 respondents, the mean age was 38.0±1.1 (20–60) years; 436 (36.7%) were male and 751 (63.3%) female; there were 256 dispatchers, 494 emergency doctors, 400 emergency nurses, and 37 medical emergency assistants; 960 (80.9%) had previously learned T-CPR and 227 (19.1%) had not. Of the 960 participants who knew T-CPR, 796 (82.9%) recognised CA, 714 of whom (89.7%) would further implement T-CPR. The difference in the cognition rate of T-CPR was statistically significant among EMS providers (chi-square test, 38.1; P<.001). In multivariate analysis, dispatchers had a significantly improved knowledge of T-CPR as their workload increased (P<.001; OR=1.002; 95%CI, 1.001–1.003).

Conclusion: Substantial and important differences in the perception and implementation of T-CPR among EMS personnel were observed throughout China. Further professional training in T-CPR is urgently required for improvement in outcomes of OHCA countrywide.

Trial registration: not applicable.

Strengths And Limitations Of This Study

Strengths of this work are mainly below. First, we investigated the perception of telephone-assisted cardiopulmonary resuscitation (T-CPR) after out-of-hospital cardiac arrest (OHCA) among emergency medical service (EMS) providers in China for the first time by a multicentre, cross-sectional, descriptive, online questionnaire survey study from December 2018 to June 2019. Second, Substantial and important differences in the perception and implementation of T-CPR among EMS personnel were observed throughout China. And, further professional training in T-CPR is urgently required for improvement in outcomes of OHCA countrywide.

Limitations of the work are below. First, this questionnaire was distributed online and was not distributed widely to EMS personnel across every city in China, so the sample cohort was lacking in size. Although there is a risk of selection bias, it is assumed that the EMS population in general has similar, if not greater, difficulties when facing T-CPR. Second, because the order of survey questions in the questionnaire was not randomised, a learning effect in the course of responding to all scenarios cannot be excluded. Finally, this survey may not have fully captured the complexity of different responses to OHCA across China.

Therefore, there may be other questions to be asked that have not been considered in this survey. Though, we have largely reduce the bias by selecting 15 provinces across China.

Background

Out-of-hospital cardiac arrest (OHCA) is a leading cause of mortality worldwide, although the incidence and mortality of OHCA treated by emergency medical services (EMS) is uncertain, with variations influencing the exact nature of the global burden.[1] Every year more than 350,000 people fall victim to sudden, unexplained OHCA in the United States, and reports from 35 communities suggested an incidence of 55 per 100,000 person-years. Unfortunately, only about 10% of victims survived this dramatic event.[2] In Europe, it is estimated that 275,000 people have all-rhythm OHCA, with incidence of about 37.2/100,000 and only 10.55% surviving to hospital discharge.[3] OHCA affects 110,000 individuals in Japan annually[4] with a survival rate of 7.6%. In China, the incidence is 48.1/100,000,[5] i.e. 583,000 victims in a total population of 1.4 billion, while the survival rate in Beijing is a dismal 1.3%.[6]

OHCA is a time-critical disease, and early cardiopulmonary resuscitation (CPR) is associated with a favourable prognosis. The emergency medical dispatcher is an essential link in the chain of survival,[7] and many countries have implemented telephone-assisted CPR (T-CPR) and related training programmes. T-CPR is an effective means for the first witness to perform CPR in timely fashion, which not only improves the CPR ratio of the first witnesses[8] but can also improve the effectiveness of CPR and improve the prognosis.[9,10] The European Resuscitation Council Guidelines for Resuscitation 2010 first indicated that a protocol for suspected CA should be devised for dispatchers.[11] In 2015, the International Guide issued by the American Heart Association emphasised the importance of T-CPR[12] under the moniker “dispatch-assisted CPR”, which involves dispatchers providing CPR instruction to callers or bystanders by telephone.[13] Because little is known about T-CPR in China, we investigated the cognition of T-CPR among EMS staff by means of an online questionnaire survey[14] conducted among the different levels of emergency centres in China from December 2018 to June 2019.

Methods

China has an area of ≈ 9,600,000 km^2 and its population in 2019 was ≈ 1,395 million, covering 34 provincial administrative units. The free emergency number 120 is used to call for an ambulance in most areas of China. Emergency services are provided 24 hours every day. An ambulance is dispatched from the nearest emergency station when called. EMS systems are single-tiered and government-funded—some are independent emergency stations, some are hospital-based stations, and others are mixed. At least one emergency driver and one emergency doctor are deployed in an ambulance, with an accompanying nurse and/or first-aid assistant in some areas.

Study Design and Population

The survey respondents were EMS staff including emergency doctors, emergency nurses, emergency dispatchers and first-aid assistants in 15 provinces, representative across China. To be eligible for inclusion in the study, each EMS system had to be an independently operated EMS unit, meaning the unit must have its own dispatch system.

After three rounds of expert consultation of the questionnaire, we presented it from site registration forms and an electronic Internet-based survey of all participating EMS systems in the study. A standardised survey form was constructed online (wjx.cn), delivered by the WeChat App and filled out via android/iOS smartphone or the website. Respondents to the survey were eligible if specified as EMS providers in the 15 provinces.

Patient and Public Involvement

No patient involved.

Survey Content and Administration

A cross-sectional descriptive study was conducted from December 2018 to January 2019 using a Web-based system. A survey of perception of T-CPR among EMS providers in China was filled out by personnel from emergency centres. Each EMS involved had a designated local principal investigator who was responsible for verifying data. In addition, the completed questionnaires were re-verified by statisticians, and uncompleted or logistically wrong questionnaires were excluded.

Data Analysis

Data collation, statistical description, and statistical analysis were performed using IBM SPSS Statistics 22 software (IBM, Armonk, NY, USA). Continuous variables were summarised by mean ± standard deviation; the composition distribution and rate were used to describe the basic distribution characteristics of the research objects. We assessed the differences in the perception of T-CPR among responding EMS providers in China by either chi-square test or Fisher exact test. Multivariable analysis was used to assess factors associated with the cognition of T-CPR among EMS respondents by using logistic regression models; odds ratios (OR) and their 95% confidence intervals (CI) were calculated. All tests were two-tailed, and P values of < .05 were considered statistically significant.

The authors had full access to, and take responsibility for, the integrity of the data.

Results

Characteristics of survey respondents

A total of 1,191 questionnaires were collected. Four invalid questionnaires were eliminated, leaving 1,187 valid completed questionnaires. The survey covered 15 provincial administrative units from Beijing, Qinghai, Jiangxi, Ningxia, Xinjiang, Chongqing, Guangdong, Zhejiang, Guizhou, Shanghai, Hainan, Jiangsu, Shanxi, Inner Mongolia, and Hebei. The distribution of questionnaires in each province is shown

in Fig. 1 Distribution of questionnaires in provinces that participated in the survey (The map in Fig. 1 is made from the website, http://c.dituhui.com/apps.).

The number of respondents at provincial capital level, city level, and county level was 266 (22.4%), 714 (60.2%), and 207 (17.4%), respectively. Among the respondents, 436 were male (36.7%) and 751 were female (63.3%). Age distribution ranged between 20 and 60 years old (Table 1). The average age was 38.0 ± 1.1 years, with 85.2% in the 20- to 39-year-old age group. A total of 256 dispatchers (21.6%), 494 emergency doctors (41.6%), 400 emergency nurses (33.7%), and 37 medical emergency assistants (3.1%) was involved in the survey. Most of the respondents (503 [42.4%]) had professional work experience of less than 5 years, followed by 356 (30.0%) with 5–10 years' experience. There were 713 (60.1%) respondents with junior professional titles, 309 (26%) at intermediate level, 66 (5.6%) at senior level, and 99 (8.3%) at other levels (Table 1).

Workload of emergency personnel and recognised OHCA via telephone in 12 hours

Number of cardiac arrests recognised in 12 hours by dispatchers receiving emergency calls

The distribution of the number of emergency telephone calls accepted by 256 dispatchers within 12 hours is presented in Table 2. The largest proportion was within 50 (80/256, 31.3%), followed by 50–100 (43/256, 16.8%) and 101–150 (39/256, 15.2%).

Among the 256 dispatchers, the number of sudden CAs that could be recognised by telephone among the emergency calls received within 24 hours was the highest in 1–3 cases (95 respondents, 37.1%), followed by 0 cases (79, 30.9%), 4–10 cases (60, 23.4%), and more than 10 cases (16, 6.3%). The other six dispatchers were unsure in determining the number of cases recognised to be CA in a 12-hour period.

Number of cardiac arrests recognised in 12 hours by other staff receiving emergency calls

The distribution of the number of ambulance runs in 24 hours among 931 other emergency personnel is also shown in Table 2. Respondents most frequently did 5–9 runs, i.e., 352 (37.8%); followed by 387 (30.8%) with 0–4 runs, 180 (19.3%) with 10–14 runs, 59 (6.3%) with 15–19 runs, and 46 (4.9%) with ≥ 20 runs. In addition, 7 respondents (0.8%) were uncertain about the number of runs.

Before arriving at the scene, 512 (55.0%) of the 931 emergency personnel never recognised whether the patient had a CA by phone; 261 (28.0%) could recognise 1–3 CA patients, 90 (9.7%) were able to recognise 4–10 cases, and 24 (2.6%) recognised more than 10 people with CA. In addition, 44 (4.7%) rescuers were unsure of the number of CA patients.

Knowledge of T-CPR

Among the 352 respondents who believed that the implementation of T-CPR should include the quality of CPR by bystanders, the top three operations to detect the quality of CPR conducted by bystanders were the frequency of chest compression (337, 95.7%), position of hands when compressing (324, 92.0%), and

compression duration and number of compression interruptions (298, 84.7%), followed by depth of chest compression (290, 82.4%), frequency of ventilation (if any) (278, 79.0%), whether the chest rebounded during compression (266, 75.6%), and ventilation time (if any) (253, 71.9%).

Differences among respondents' characteristics concerning knowledge about T-CPR

Baseline characteristics of respondents showed differences among various aspects of knowledge about T-CPR (Table 3), for which chi-square test values were calculated. Among the 960 (80.9%) respondents who know about T-CPR, the knowledge rate varies among EMS providers (chi-square = 38.1, P < .001). Level of EMS (chi-square = 27.4, P < .001), education background of EMS providers, vocation (chi-square = 47.9, P < .001), and professional title (chi-square = 13.7, P = 0.032) differed in respect of the medical priority dispatch system (MPDS). Gender (chi-square = 9.6, P = 0.008) and vocation (chi-square test = 82.6, P < .001) varied with regard to monitoring the quality of bystander CPR among 428 out of 1,187 (59.9%) respondents.

EMS provider factors associated with knowledge of T-CPR in China

In the multivariate analysis (Table 4), a higher workload among dispatchers (P < .001; OR = 1.002; 95% CI, 1.001–1.003) was significantly associated with better knowledge of T-CPR. Being male (P = .002; OR = 0.531; 95% CI, 0.353–0.798), dispatcher (P < .001; OR = 0.051; 95% CI, 0.019–0.138), emergency doctor (P = .011; OR = 0.347; 95% CI, 0.154–0.786), emergency nurse (P = .012; OR = 0.337; 95% CI, 0.145–0.784), and having a junior professional title (P = .006; OR = 0.436; 95% CI, 0.240–0.792) were associated with worse knowledge of T-CPR.

Implementation of T-CPR

As shown in Table 5, of the 960 participants who knew T-CPR, 213 (22.2%) occasionally recognised CA by phone for patients with unconsciousness, 205 (21.4%) sometimes recognised CA, 190 (19.8%) often recognised CA, 188 (19.6%) always recognised CA, and 164 (17.1%) never recognised CA.

Of the 796 respondents who recognised CA events, 714 (89.7%) will further implement T-CPR, of whom 236 (29.6%) always, 167 (21.0%) sometimes, 162 often (20.4%), and 149 (18.7%) occasionally would implement T-CPR, while another 82 (10.3%) said they would not implement T-CPR.

In the implementation of T-CPR, the most commonly recommended treatment method for bystanders is chest compression + artificial breathing (310 respondents, 43.4%), followed by simple chest compression (216, 30.3%) and chest compression + artificial respiration + AED (140, 19.6%).

In the implementation of T-CPR, the percentage of bystanders who could start CPR according to telephone instructions was 5% (202 respondents, 28.3%), followed by 50% and above (153, 21.4%) and 10% (124, 17.4%).

The proportion of onlookers who continued to implement CPR until arrival of first responders was 5% (222 respondents, 31.1%), followed by 50% and above (131, 18.3%) and 10% (92, 12.9%).

Discussion

This study reports for the first time the results of nationwide implementation of a detailed questionnaire survey among EMS personnel on the perception of T-CPR after the occurrence of OHCA. For the current comprehensive and systematic implementation of T-CPR, further improvement in the prognosis of patients with OHCA has fundamental importance. The survey addressed EMS personnel's awareness of T-CPR, its implementation, and the current state of the implementation of CPR by bystanders and telephone instruction for AED use.

Globally it is estimated that, on average, less than 10% of all patients with OHCA will survive.[15] T-CPR can effectively improve bystander CPR, pre-hospital return of spontaneous circulation (ROSC), and even the prognosis of OHCA patients. A before-and-after interventional trial of dispatcher-assisted CPR for out-of-hospital CA in Singapore showed a significant increase in bystander CPR and ROSC after the intervention.[16] Implementation of a regional T-CPR programme and outcomes after out-of-hospital CA indicated that implementation of a guideline-based T-CPR bundle of care was independently associated with significant improvements in the provision and timeliness of T-CPR, survival to hospital discharge, and survival with favourable functional outcome.[17] In a study of the effect of a dispatcher-assisted CPR programme and location of out-of-hospital CA on survival and neurological outcomes for out-of-hospital CA cases in private settings, bystander CPR was associated with improved neurological recovery only when dispatcher assistance was provided.[10]

The results of our questionnaire survey showed that there are some regional differences among the 15 provinces surveyed. Knowledge of T-CPR varied among vocation of EMS providers (dispatcher, doctor, nurse, and others). Whether the use of MPDS was significant differed in terms of the level of EMS unit, vocation, and professional title. Monitoring the quality of bystander CPR was also distinguished by gender and vocation. According to the survey, the increased workload of dispatchers may improve their knowledge of T-CPR, whereas male gender and a junior professional title appear to suggest lack of knowledge of T-CPR.

Of particular note is the influence of mobile phone technology on the process of T-CPR. With the development of communication technology, the communication method of T-CPR can now involve traditional telephone voice guidance or remote video telephone online guidance. Video communication has been widely used in social software such as Facebook, WeChat, and QQ. In the future, 5G communication technology will provide T-CPR with wider application prospects. It has been reported that CPR under video guidance is higher in quality and better overall than traditional telephone voice guidance. Chest compressions are significantly faster, the compression position and depth are more accurate, and the time to first ventilation is faster in comparison with audio guidance.[18]

Some additional aspects should be acknowledged as part of these considerations. The survival rate of OHCA patients is still very low globally. Early calls for emergency rescue, early first-witness CPR, and early AED defibrillation are the most important measures to improve OHCA. However, owing to the low

prevalence of CPR in China and insufficient availability of AEDs in public places, the outcome of OHCA patients is still poor, so it will take a long time to implement commonplace T-CPR. The suitability of international CPR guidelines is still an open question, and the degree of implementation is not promising. The CPR process under the guidance of MPDS is also not satisfactory. There is a lack of systematic research on CPR in China, and clinical research on T-CPR is also inadequate. It is necessary to study current guidelines and formulate new ones suitable for China's national circumstances.

Conclusion

Throughout China, there are substantial and important differences in the understanding and implementation of T-CPR among EMS personnel. Further professional training in T-CPR is urgently required to improve outcomes of OHCA in China.

Abbreviations

EMS, emergency medical service

CA, cardiac arrest

MPDS, medical priority dispatch system

T-CPR, telephone-assisted cardiopulmonary resuscitation

Declarations

Ethics approval and consent to participate: see supplemental material: Ethics approval.pdf.

Consent for publication: All authors agreed to publish the paper.

Availability of data and materials: Data are available upon reasonable request.

Competing interests: No.

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Authors' contributions:

J Z, X K Conceptualization;

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S T, J L Formal analysis;

J Z, H L Funding acquisition;

J Z, X K Investigation;

J Z , S T Methodology;

S N Project administration;

J Z Resources;

S T , X K Software;

J Z Supervision;

H L Validation;

X K Visualization;

X K Writing - original draft;

J Z Writing - review & editing.

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Tables

Table 1
Characteristics of survey respondents

		Total (n=1 187)
Level of EMS	Provincial capital	266 (22.4%)
	City	714 (60.2%)
	County	207 (17.4%)
Gender	Male	436 (36.7%)
Age, y	20~29	496 (41.8%)
	30~39	515 (43.4%)
	40~49	144 (12.1%)
	50~60	32 (2.7%)
Education	Technical secondary school	44 (3.7%)
	Junior college	387 (32.6%)
	Undergraduate	708 (59.6%)
	Postgraduate	43 (3.6%)
	Others	5 (0.4%)
EMS providers	Dispatcher	256 (21.6%)
	Emergency doctor	494 (41.6%)
	Emergency nurse	400 (33.7%)
	Medical emergency assistant	37 (3.1%)
Working years	<5	503 (42.4%)
	5-9	356 (30%)
	10-14	196 (16.5%)
	15-19	69 (6%)
	≥20	63 (5.3%)
Professional title	Junior	713 (60.1%)
	Intermediate	309 (26%)
	Senior	66 (5.6%)
	Others	99 (8.3%)

EMS, emergency medical service

Table 2

Workload of emergency personnel and recognised OHCA via telephone in 12 hours

		Total
Calls received by a dispatcher in 12 hours	<50	80 (31.3%)
	50-100	43 (16.8%)
	101-150	39 (15.2%)
	151-200	37 (14.5%)
	201-250	10 (3.9%)
	251-300	16 (6.3%)
	301-350	9 (3.5%)
	>350	20 (7.8%)
	Unsure	2 (0.8%)
	Total	**256(100%)**
OHCA recognised by dispatcher via telephone in 12 hours	0	79 (30.9%)
	1~3	95 (37.1%)
	4~10	60 (23.4%)
	>10	16 (6.3%)
	Unsure	6 (2.4%)
	total	**256**
Runs by an emergency doctor in 12 hours	0-4	287 (30.8%)
	5-9	352 (37.8%)
	10-14	180 (19.3%)
	15-19	59 (6.3%)
	≥20	46 (4.9%)
	Unsure	7 (0.8%)
	total	**931**

OHCA recognised by an emergency doctor via telephone before arrival at the scene in 12 hours	0	512 (55%)
	1-3	261 (28%)
	4-10	90 (9.7%)
	>10	24 (2.6%)
	unsure	44 (4.7%)
	▯▯	**931**

EMS, emergency medical service

Table 3

Differences among respondents' characteristics regarding knowledge about T-CPR

		Know about T-CPR	Use MPDS	Monitor the quality of bystander CPR
Level of EMS	Provincial capital level	218 (82.0%)	102 (46.8%)*	96 (59.3%)
	City level	582 (81.5%)	292 (50.2%)	275 (62.9%)
	County level	160 (77.3%)	44 (27.5%)	57 (49.6%)
Gender	Male	361 (82.8%)	160 (44.3%)	165 (57.7%)*
	Female	599 (79.8%)	278 (46.4%)	263 (61.4%)
Education	Technical secondary school	32 (72.7%)	23 (71.9%)*	20 (80.0%)
	Junior college	322 (83.2%)	159 (49.4%)	144 (64.0%)
	Undergraduate	569 (80.4%)	235 (41.3%)	245 (56.3%)
	Postgraduate	34 (79.1%)	19 (55.9%)	18 (66.7%)
	others	3 (60.0%)	2 (66.7%)	1 (50.0%)
EMS provider	Dispatcher	233 (91.0%)*	122 (52.4%)*	135 (69.9%)*
	Emergency doctor	399 (80.8%)	165 (41.4%)	185 (57.6%)
	Emergency nurse	308 (77.0%)	138 (44.8%)	100 (53.5%)
	Medical emergency assistant	20 (54.1%)	13 (65.0%)	8 (61.5%)
Professional title	Junior	582 (81.6%)	275 (47.3%)*	257 (61.3%)
	Intermediate	248 (80.3%)	101 (40.7%)	109 (56.8%)
	Senior	58 (87.9%)	22 (37.9%)	28 (59.6%)
	Others	72 (72.7%)	40 (55.6%)	34 (60.7%)

* $P<0.01$

EMS, emergency medical service; MPDS, medical priority dispatch system.

Table 4

EMS providers' factors associated with knowledge of T-CPR in China

		Know about T-CPR	P	OR	95%CI
Level of EMS	Provincial capital level	218 (82.0%)	0.057	0.613	0.371-1.014
	City level	582 (81.5%)	0.141	0.733	0.484-1.108
	County level	160 (77.3%)	Reference		
Gender	Male	361 (82.8%)	**0.002**	**0.531**	**0.353-0.798**
	Female	599 (79.8%)	Reference		
Age			0.937	1.002	0.964-1.041
Education	Technical secondary school	32 (72.7%)	0.417	0.429	0.056-3.313
	Junior college	322 (83.2%)	0.163	0.248	0.035-1.756
	Undergraduate	569 (80.4%)	0.236	0.305	0.043-2.176
	Postgraduate	34 (79.1%)	0.276	0.303	0.035-2.600
	others	3 (60.0%)	Reference		
EMS provider	Dispatcher	233 (91.0%)	**0.000**	**0.051**	**0.019-0.138**
	Emergency doctor	399 (80.8%)	**0.011**	**0.347**	**0.154-0.786**
	Emergency nurse	308 (77.0%)	**0.012**	**0.337**	**0.145-0.784**
	Medical emergency assistant	20 (54.1%)	Reference		
Working years			0.225	0.974	0.934-1.016
Professional title	Junior	582 (81.6%)	**0.006**	**0.436**	**0.240-0.792**
	Intermediate	248 (80.3%)	0.092	0.543	0.266-1.106
	Senior	58 (87.9%)	0.122	0.421	0.141-

				1.261
Others	72 (72.7%)	Reference		
Dispatcher's workload		**0.000**	**1.002**	**1.001-1.003**
Dispatcher recognised CA		0.203	0.977	0.942-1.013
Doctor's workload		0.266	0.982	0.950-1.014
Doctor recognised CA		0.330	0.984	0.953-1.016

EMS, emergency medical service; CA, cardiac arrest.

Table 5

Implementation of T-CPR

		Total
For patients with unconsciousness, determine the frequency of CA over the phone	occasionally	213 (22.2%)
	sometimes	205 (21.4%)
	often	190 (19.8%)
	always	188 (19.6%)
	Never	164 (17.1%)
Frequency of T-CPR when recognised to be CA by telephone	occasionally	236 (29.6%)
	sometimes	167 (21%)
	often	162 (20.4%)
	always	149 (18.7%)
	Never	82 (10.3%)
Most recommended bystander treatment	Chest compression + artificial respiration	310 (43.4%)
	Simple chest compressions	216 (30.3%)
	Chest compression + artificial respiration + AED	140 (19.6%)
	Chest compression + AED	40 (5.6%)
	Pure artificial respiration	8 (1.1%)
Percentage of onlookers who started CPR with telephone guidance	5%	202 (28.3%)
	50% and above	153 (21.4%)
	10%	124 (17.4%)

	20%	56 (7.8%)
	0%	50 (7%)
	30%	43 (6%)
	15%	22 (3.1%)
	40%	21 (2.9%)
	25%	20 (2.8%)
	45%	13 (1.8%)
	35%	10 (1.4%)
Percentage of bystanders who continue to implement CPR to the arrival of first responders	5%	222 (31.1%)
	50% and above	131 (18.3%)
	10%	92 (12.9%)
	0%	75 (10.5%)
	20%	57 (8%)
	30%	41 (5.7%)
	15%	34 (4.8%)
	25%	20 (2.8%)
	40%	19 (2.7%)
	35%	13 (1.8%)
	45%	10 (1.4%)

Figures

Figure 1

Distribution of questionnaires in provinces that participated in the survey. The map in Fig.1 is made from the website, http://c.dituhui.com/apps. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.