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Public awareness and self-efficacy of cardiopulmonary resuscitation in communities and outcomes of out-of-hospital cardiac arrest: A multi-level analysis☆

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ABSTRACT

Background: This study aims to test the association between capacity of cardiopulmonary resuscitation (CPR) at community level and survival after out-of-hospital cardiac arrest (OHCA).
Methods: Emergency medical service (EMS)-treated OHCAs with cardiac etiology in Korea between 2012 and 2013 were analyzed, excluding cases witnessed by EMS providers. Exposure variables were five indexes of community CPR capacity: awareness of CPR (CPR-Awareness), any training experience of CPR (CPR-Any-Training), recent CPR training within the last 2 years (CPR-Recent-Training), CPR training with a manikin (CPR-Manikin-Training), and CPR self-efficacy (CPR-Self-Efficacy). All measures of capacity were calculated as aggregated values for each county level using the national Korean Community Health Survey database of 228,921 responders sampled representatively from 253 counties in 2012. Endpoints were bystander CPR (BCPR) and survival to discharge. We calculated adjusted odds ratios (AORs) per 10% increment in community CPR capacity using multi-level logistic regression models, adjusting for potential confounders at individual levels.
Results: Of 29,052 eligible OHCAs, 11,079 (38.1%) received BCPR. Patients were more likely to receive BCPR in communities with higher proportions of residents with CPR-Awareness, CPR-Any-Training, CPR-Recent-Training, CPR-Manikin-Training, and CPR-Self-Efficacy (all $p < 0.01$). AORs for BCPR were 1.06 (1.03–1.10) per 10% increment in CPR-Awareness, 1.10 (1.04–1.15) for CPR-Any-Training, and 1.08 (1.03–1.13) for CPR-Self-Efficacy. For survival to discharge, AORs (95% CIs) were 1.34 (1.23–1.47) per 10% increment in CPR-Awareness, 1.36 (1.20–1.54) for CPR-Any-Training, and 1.29 (1.15–1.45) for CPR-Self-Efficacy.
Conclusion: Higher CPR capacity at community level was associated with higher bystander CPR and survival to discharge rates after OHCA.

Introduction

Out-of-hospital cardiac arrest (OHCA) is a significant global public health problem with poor survival outcomes.[1,2] Bystander cardiopulmonary resuscitation (CPR) is one of the crucial community factors that initiate the chain of survival for OHCAs.[3–5] Despite the efforts in public advocacy, campaign, and disseminated public training programs of CPR, a low rate of bystander CPR provision remains as one of the significant contributors of poor survival outcome in OHCA patients.[4,5]

Performance of bystander CPR depends on the availability of a person near the incident site of arrest who is prepared and competent to attempt CPR. Therefore, neighborhood and bystander factors are associated with the provision of bystander CPR.[6] Previous studies found that community characteristics, such as low income, high proportion of the elderly, and ethnic or racial distribution are

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associated with a lower probability of receiving bystander CPR after OHCA.[6–11] Although some studies have examined the effects of community characteristics on the provision of bystander CPR for OHCAs, these studies were conducted with proxy factors such as socioeconomic status, urbanization level, and race or ethnicity,[5–12] which are not direct measures of public awareness, training experience, or self-efficacy of bystander CPR provision. Public health interventions, such as targeted CPR campaigns and training programs, could be more accurately designed and cost-effectively implemented if we can directly measure the CPR capacity in communities rather than through proxy factors.

We hypothesized that higher awareness, training experience, and self-efficacy for CPR in communities would be strongly associated with a higher likelihood of bystander CPR provision and favorable survival outcomes after OHCA. The aims of this study were to assess how community CPR capacity affects bystander CPR rate and to test the association of community CPR capacity and survival outcomes, independent of individual event characteristics.

Methods

Study setting

The Korea emergency medical services (EMS) system, which is single-tiered and government-based, provides a basic-to-intermediate level of ambulance services from sixteen provincial headquarters of the national fire department and serves a population of approximately 50 million. EMS CPR protocol encourages providers to perform at least three cycles of CPR in the field and transport patients to an emergency department (ED) with on-going CPR in an ambulance. EMS providers are not allowed to stop CPR unless the patients are restored in the field or during transportation to ED, and declaration of death can only be made at the hospital ED.[13]

CPR training programs were developed in the early 2000s and has been spreading since by the Korea Centers for Disease Control and Prevention (CDC) in collaboration with many academic societies. The recent guideline for layperson CPR was released in 2011, which outlines 1-h layperson training on hands-only compression CPR, 1. 5 to 2 h of first responder training on chest compression with rescue ventilation CPR, and advanced cardiovascular life support training for professional providers. The EMS division of the Ministry of Health and Welfare financially supports the 16 provincial government for conducting CPR campaigns and training. The Ministry also collects information on the number of persons trained annually in each province; in recent years, the total number of CPR trainee was 186,589 in 2010, 159,455 in 2011, and 223,952 in 2012. Enforcement of the EMS Act requires mandatory training of all first responders such as firefighters, police officers, nursing teachers, safeguarding officers, and transportation employees. CPR training is provided by hospitals, non-governmental organizations, academic and scientific societies, fire departments, and branches of the Red Cross. Each provincial government has its own program and criteria which are regulated under the national standards for training sites and training instructors as recommend by the Korea CDC.[14]

Study design and data source

This is a cross-sectional study using the nationwide OHCA registry database in Korea and the Korean Community Health Survey database. The nationwide OHCA registry was first constructed in 2006 using EMS run sheets for basic ambulance operation information, EMS cardiac arrest registry for Utstein factors, and the national OHCA registry for hospital care and survival outcomes which was reviewed and abstracted from hospital medical records by the Korea CDC. EMS providers recorded EMS run sheets and EMS cardiac arrest registry for every OHCA case after transporting the patients to ED. The Korea CDC medical record reviewers then visited and collected information on hospital care and outcomes from about 700 hospitals. Detailed information about this registry, including data collection process, EMS characteristics, and OHCA protocols, has been reported previously.[12,15,16]

Community CPR capacity factors were explored using the 2012 Korean Community Health Survey (CHS) conducted by the Korea CDC between September and November 2012. The Korean CHS is a nationwide, community-based, cross-sectional household-level survey which began in 2008 and has been annually conducted since by 253 county health authorities. The survey consists of about 247 questionnaire items and gathers reliable health-related information on targeted acute and chronic diseases, health care utilization, health behavior, quality of life, socio-environmental factors, and basic information on responders.

A total of 228,921 participants responded to the Korean CHS in 2012. Respondents were members of representatively selected households in 253 counties which were sampled using probability proportional to size and systematic sampling method. Respondents were recruited by each county health authority and were adults of 19 years of age and older in the selected households. An average of 920 adults in each county participated in the survey. All surveys were administered by trained interviewers using structured survey forms in a face-to-face interview manner along with a strong quality management program and survey protocol.[17]

Study population

All EMS-treated OHCAs with presumed cardiac etiology from January 2012 to December 2013 were enrolled in the study, excluding cases that were witnessed by EMS providers.

Main outcomes

The primary endpoint was bystander CPR as recorded by EMS providers at the scene. A bystander was defined as someone who was present at the scene but is not part of the EMS response team. The secondary endpoint was survival to hospital discharge as indicated by medical records review of the Korea CDC.

Variables and measurements

The 2012 Korean CHS included four questions to measure community CPR capacity: (1) Are you familiar with CPR? (CPR-Awareness); (2) Have you participated in a CPR class with on-site group training for 40 min or longer? (CPR-Any-Training); (3) If you have ever joined a CPR class, did you take the class within the last 2 years? (CPR-Recent-Training); (4) If your class was within the last 2 years, did your CPR class include hands-on practice with a manikin? (CPR-Manikin-Training); and (5) If you were to witness a cardiac arrest patient, would you be capable of providing CPR to the person in need? (CPR-Self-Efficacy). These five capacity factors were used as exposure variables at county level. We calculated the proportions of the abovementioned five factors by county on the basis of multistage sampling weights of 228,921 participants in 253 counties. The proportions were used to represent CPR capacity in each county and were classified by quartiles of counties.

County addresses of arrest incident locations were obtained from the national OHCA registry, sorted by county name, and were matched to the Korean CHS data. For unknown county information in which the arrest location was not recorded ($n = 27$, 0.1%), we used the county address of ambulance station which initially responded to the call. Finally, the national OHCA registry was merged with the Korean CHS data of 253 counties. Proportions of