



Clinical paper

Characteristics of bystander cardiopulmonary resuscitation for paediatric out-of-hospital cardiac arrests: A national observational study from 2012 to 2014[☆]

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ARTICLE INFO

Article history:

Received 26 August 2016

Received in revised form 20 October 2016

Accepted 6 November 2016

Keywords:

Child

Out-of-hospital cardiac arrest

Cardiopulmonary resuscitation

Family

Community

ABSTRACT

Objectives: This study evaluated the associations between the provision of bystander cardiopulmonary resuscitation (BCPR) and both the relationship of bystanders with paediatric out-of-hospital cardiac arrest (OHCA) victims and the community educational level.

Methods: This observational study was conducted using the Korean national OHCA registry of paediatric OHCA (<19 years old) between 2012 and 2014. The main factor was the relationship between the bystander and the OHCA victim. The primary endpoint was the provision of BCPR. The association between BCPR provision and community educational level was also examined. Multivariable logistic regression and interaction analyses were performed to determine whether community educational level affected BCPR provision.

Results: Among the 1477 enrolled patients, 725 (49.1%) received BCPR. Family members provided BCPR in 458 (57.4%) cases. The adjusted odds ratios and corresponding 95% confidence intervals (AORs, 95% CIs) for the provision of BCPR by family members or first responders compared with strangers were 1.75 (1.31–2.34) and 8.90 (5.00–15.84). The AORs for BCPR provision in communities with the middle and lowest educational levels compared with the highest were 0.70 (0.53–0.92) and 1.11 (0.79–1.55). The interaction analysis showed that the AORs of family members or first responders providing BCPR compared with strangers were 1.32 (0.79–2.19) and 5.90 (1.98–17.63), 1.98 (1.31–2.98) and 10.88 (4.20–28.16), and 1.87 (1.18–2.96) and 9.89 (3.88–25.21) in communities with the lowest, middle and highest educational levels, respectively.

Conclusion: In paediatric OHCA cases, family members were more likely than strangers to perform BCPR except in communities with the lowest educational level.

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Abbreviations: OHCA, out-of-hospital cardiac arrest; BCPR, bystander cardiopulmonary resuscitation; EMS, emergency medical services; CPR, cardiopulmonary resuscitation; BLS, basic life support; SES, socioeconomic status; CDC, Centres for Disease Control and Prevention; EMTs, emergency medical technicians; ED, emergency department; CPC, Cerebral Performance Category; AORs, adjusted odds ratios; CIs, confidence intervals.

[☆] A Spanish translated version of the abstract of this article appears as Appendix in the final online version at <http://dx.doi.org/10.1016/j.resuscitation.2016.11.007>.

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<http://dx.doi.org/10.1016/j.resuscitation.2016.11.007>

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Introduction

Paediatric out-of-hospital cardiac arrest (OHCA) is a devastating event that is experienced by more than 1339 Korean children from 2006 to 2007.¹ Bystander cardiopulmonary resuscitation (BCPR) before the arrival of emergency medical services (EMS) is a critical factor for improving the neurological outcome and the survival rate in adult and paediatric victims of OHCA.^{2–4}

There have been some previous studies to find bystander factors associated with the provision of BCPR to OHCA victims, such as their relationship with the victim and educational level. Unfortunately, the results of previous studies investigating bystander-related factors associated with the provision of BCPR to OHCA victims have been varied and somewhat conflicting. According to some studies, strangers rather than family members are more likely to perform BCPR for adults or OHCA victims of all ages.^{5–8} In contrast,

some questionnaire-based studies showed that the participants had more willingness to provide cardiopulmonary resuscitation (CPR) or full basic life support (BLS) if victims were family members or relatives of the bystander.^{9,10} Some similar studies have indicated that the participants were more willing to perform CPR if the OHCA victim was a child or a family member.^{11–13}

The rate of BCPR and the survival outcomes of OHCA in communities are known to be affected by various components, such as socioeconomic status (SES) and the community racial composition.^{14–16} The educational level of a community is a closely related with the SES of the population.¹⁷ A recent study using a nation-wide OHCA database of adult patients in Korea found that OHCA victims in communities with a higher proportion of highly educated residents were more likely to receive BCPR.¹⁸ Similarly, another recent study showed that parents with a low educational level were less likely to perform BCPR.¹⁹

The aim of this study was to evaluate the association between the provision of BCPR and the relationship of bystanders with paediatric OHCA victims, as well as the effect of the educational level of the communities in which paediatric OHCA occurred.

Methods

This study was approved by the institutional review board of the relevant institution and by the Korea Centres for Disease Control and Prevention (CDC). Informed consent was waived because the database was used without identifying or private information.

Study design and data collection

This was a cross-sectional study using the national OHCA registry database that was constructed by the national fire department and the Korea CDC and has been in use since 2006.^{18,20,21}

The national OHCA database is a retrospective observational registry that was constructed from EMS run sheets that recorded the following information: (1) all primary data provided by EMS providers; (2) Utstein information from the EMS cardiac arrest registry; and (3) retrospective medical record data regarding hospital resuscitation, post-resuscitation and outcomes that are collected by trained medical record reviewers. The Data Quality Management Control team comprises emergency medicine physicians, epidemiologist, statistical experts, cardiologists, medical record review experts, and the data management team of the Korea CDC and is responsible for the quality control of all these data, which is maintained via a regular monthly programme.^{20,21} The educational levels in the communities used in this study were based on information from the 2010 Korea National Census database.¹⁸

Study setting

Korea consists of 251 counties that have an average area of approximately 400 km².¹⁸ In 2014, among a total population of approximately 50 million in Korea, 479,304 students entered primary school, 632,983 graduated high school, 663,485 entered a university or college, and 127,757 entered postgraduate school.

The Korean EMS is a single-tiered, government-operated and tax-based system that provides a BLS ambulance system. Emergency medical technicians (EMTs) provide CPR to paediatric and adult OHCA patients at the scene. EMTs follow the EMS CPR protocol and transport all victims to an emergency department (ED). EMTs cannot declare death at the scene. The details of EMT actions in Korea have been described elsewhere.^{20,21}

A CPR training programme following the 2010 American Heart Association Guidelines was developed in Korea and supplied by the Korea CDC in collaboration with many associated institutes and societies. The Korean government supplied financial support for

a CPR campaign and for training. As a result, many organizations associated with the CPR training programme are able to provide CPR training to Korean individuals.¹⁸ Additionally, all elementary and middle schools have had CPR training programmes as part of the curriculum since 2014 in accordance with the School Health Act. Furthermore, according to the EMS Act of Korea, since 2012, first responders, such as teachers, policemen, lifeguards in sports facilities, and crew in aircrafts, trains, and ships, must learn BCPR and have a duty to provide BCPR to OHCA victims at the scene.

Study population

This study included all EMS-treated OHCA victims younger than 19 years old, regardless of OHCA cause, whose OHCA was witnessed by laypersons in a community between January 2012 and December 2014. Patients whose experienced OHCA was witnessed by EMS providers or occurred at a primary care clinic or long-term care facility were excluded.

Main outcomes

The primary endpoint was the provision of BCPR on the scene when the EMS arrived. The secondary and third endpoints were the rate of survival and good neurological recovery at the time of hospital discharge.

Variables and measurements

The main factor of interest was the relationship between the bystander providing BCPR and the OHCA victim. EMS providers obtained and recorded the relationship of bystander with OHCA patient, and we categorized this relation into one of the following groups: family member, first responder, or stranger. When categorizing the educational level of communities in which OHCA occurred, we defined a highly educated resident as one with a high school degree or higher.^{18,22} Community educational level was classified as follows according to the proportion of highly educated residents: the lowest (<72%), the middle (72%–76.9%), and the highest (>77%) educational levels. Age- and gender-standardized proportions of highly educated residents in all 251 counties were calculated by using the 2010 National Census population as a standard population. The 2010 National Census contains data regarding resident status by education level in each county of Korea.

We obtained individual characteristics of OHCA victims from the national OHCA registry. The following information was collected in this study regarding the victims: the event date, age, gender, witnessed status, location of arrest (public, private, or other), relationship of the bystander (family, first responder, or stranger) with the OHCA victim, urbanization level (metropolitan area or not), dispatcher-provided CPR instructions, primary electrocardiogram on scene (shockable or non-shockable rhythm), EMS response time interval from call to ambulance arrival on scene, and ED level (levels 1, 2, or 3).^{18,20,21} The educational level of each county was matched to individual data by county name of the incident location.

A good neurological status was defined as having a Cerebral Performance Category (CPC) score of 1 (good performance, no neurological disability) or 2 (moderate disability, can work).²⁰ The CPC score was determined by the medical record reviewers based on the discharge summary abstracts, which were usually documented by inpatient care doctors.^{20,21}

Statistical analysis

Enrolled patients were divided into 3 groups according to the OHCA victim relationship and the proportion of highly educated residents in their community. The reference group consisted

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