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Clinical paper

Recognition of out-of-hospital cardiac arrest during emergency calls and public awareness of cardiopulmonary resuscitation in communities: A multilevel analysis☆

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ABSTRACT

Background: For an effective dispatcher-assisted cardiopulmonary resuscitation (CPR) program, recognition of out-of-hospital cardiac arrest (OHCA) by a dispatcher is the first step in initiating bystander CPR. This study evaluated whether CPR awareness in the community is associated with recognition of arrest, dispatcher-provided CPR instructions, and bystander CPR.

Methods: All emergency medical services (EMS)-treated adult OHCAs with cardiac etiology were enrolled between 2013 and 2015, excluding cases witnessed by EMS providers. Exposure was CPR awareness in the community where the OHCA occurred. Endpoints were recognition of arrest, dispatcher-provided CPR instructions, and bystander CPR. Multilevel logistic regression analysis was performed to calculate adjusted odds ratios (AORs) per 10% increment in community CPR awareness adjusting for potential confounders.

Results: Of 44,185 eligible OHCAs, 20,255 (45.8%) cases were recognized by a dispatcher, 17,858 (40.4%) received dispatcher-provided CPR instructions, and 22,255 (50.4%) received bystander CPR (39.8% with dispatcher assistance and 10.6% without dispatcher assistance). Compared with OHCAs that occurred in the communities with low awareness, dispatchers were more likely to provide CPR instructions to the caller, and bystanders were more likely to perform CPR for OHCAs that occurred in the communities with high CPR awareness. AORs (95% CIs) per 10% increment in public awareness of CPR in the community were 1.05 (1.01–1.10) for recognition of arrest, 1.11 (1.06–1.16) for dispatcher-provided CPR instructions, and 1.07 (1.03–1.11) for bystander CPR.

Conclusions: Public CPR awareness of the communities where OHCAs occurred was associated with recognition of arrest during an emergency call, dispatcher-provided CPR instructions, and bystander CPR.

Introduction

Out-of-hospital cardiac arrest (OHCA) is a major public health burden because of its high morbidity and low survival rates [1,2]. Dispatcher-provided cardiopulmonary resuscitation (CPR) instructions during an emergency call is one of the crucial community interventions to increase bystander CPR and enhance survival outcomes after OHCAs [3,4]. Recognition of cardiac arrest by a dispatcher is the first step of initiating bystander CPR with dispatcher assistance. The dispatcher should recognize the cardiac arrest very early in the emergency call and be assertive in providing CPR instructions in communication with a caller. Variance of dispatchers' recognition of cardiac arrest and provision of the instructions may lead to disparities in effective implementation of the dispatcher-assisted CPR program and bystander CPR rates among communities [4–6].

Public awareness of CPR and education level in a community affects bystander CPR rate and survival outcomes after OHCAs [7–9]. The laypersons who are aware of CPR or have had CPR training are more likely to have self-efficacy in performing CPR and to provide bystander CPR on patients in an arrest situation [7,10]. The caller's CPR

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awareness determines whether he/she is capable to deliver accurate information about the patients to the dispatcher, understand and follow the dispatcher-provided CPR instructions, and be willing to initiate chest compression [7–9,11]. The capacity for CPR in the neighborhood is associated with the bystander CPR rate; however, there is limited evidence for the associations between public awareness of CPR in a community and recognition of cardiac arrest during an emergency call and dispatcher-provided CPR instructions.

We hypothesized that a dispatcher would be more likely to recognize cardiac arrest by communicating with an EMS caller in a community of higher public awareness of CPR and provide the caller with CPR instructions. This would lead the bystander to provide CPR to the OHCA patient in a community of higher public awareness. This study aimed to evaluate the association between the public awareness of CPR in a community and the recognition of arrest during an emergency call, the dispatcher-provided CPR instructions, and the bystander performing CPR. Furthermore, this study investigated why a dispatcher might recognize a cardiac arrest but not provide CPR instructions to the caller.

Methods

Study design, setting, and data collection

This is a cross-sectional study using the nationwide OHCA registry database in Korea and the Korean Community Health Survey (CHS) database.

In Korea, the emergency medical services (EMS) system is exclusively operated by the National Emergency Management Agency (the national fire department). EMS providers are not allowed to stop administering CPR for OHCA patients unless the patient regains a pulse in the field or during transport to an emergency department (ED). Since October 2011, the national fire department has decided to implement a dispatcher-assisted CPR program at all 16 provincial fire departments [14,15]. The program was based on the 2010 American Heart Association (AHA) guidelines [12], which included two simplified key questions for detecting OHCA (altered mental status and abnormal breathing) and structured dialogue for providing CPR instructions [4,13]. All 16 provincial dispatch centers set up a program for detecting OHCA, instructing bystanders in CPR via telephone, and reporting the process. Training programs for dispatchers were implemented, and more than 90% of dispatchers completed the course in 2011. An electronic dispatcher CPR registry was developed and implemented in all dispatch centers and was used for quality assurance of the program. The detailed protocol and process of quality control of dispatcher-assisted CPR are described in previous studies [4,14].

The nationwide OHCA registry, which captures all emergency medical services (EMS)-assessed OHCAs, was constructed in 2006 using EMS run sheet, EMS cardiac arrest registry for Utstein factors, dispatcher CPR registry, and the medical record review for hospital care and outcomes [4,7,14].

The Korean CHS is a nationwide, community-based household-level survey by Korea Centers for Disease Control and Prevention (CDC) in existence since 2008. It has been conducted by 254 county health authorities to gather health-related information including health care utilization, health-related knowledge, and health behavior of the responders [7,10]. A total of 228,721 participants responded to the survey of 168 items in 2014 (0.63% of approximately 36.4 million population of aged ≥19). The Korean CHS surveyed information on the public awareness of CPR, experience of CPR training, and self-efficacy to provide CPR to participants in each community.

Study population

All EMS-treated OHCA patients with presumed cardiac etiology who were aged 18 or older between January 2013 and December 2015 were included. Cases that were witnessed by EMS personnel or had incidents at a primary care clinic or long-term care facility were excluded.

Main outcomes

The primary endpoint was recognition of cardiac arrest by a dispatcher during the emergency call, and the secondary endpoint was the dispatcher-provided CPR instructions. Information on recognition of cardiac arrest and dispatcher-provided CPR instructions were confirmed with the dispatcher CPR registry, which the dispatcher recorded during the emergency call. Recognition of arrest was defined as cases when the dispatcher recorded 'altered mental status' and 'abnormal breathing' to the initial two simplified key questions for detecting OHCA. The dispatcher-provided CPR instructions was defined as cases when the dispatcher initiated providing CPR instruction based on the dispatcher CPR registry, regardless of initial recognition of cardiac arrest using the two simplified questions. The tertiary outcome was provision of bystander CPR regardless of dispatcher-provided CPR instructions. Information on bystander CPR was confirmed with the EMS cardiac arrest registry, which was identified at the scene by an EMS provider.

Variables and measurements

The main exposure of interest was the public awareness of CPR in the community using a question of the 2014 Korean CHS: Are you familiar with CPR? The proportion of people who answered yes to the CPR awareness question was calculated by county based on multistage sampling weights of 228,721 respondents in 254 counties. The proportions were used to estimate the community CPR awareness level in each county and classified by quartile of counties: the lowest (Q1), lower (Q2), higher (Q3), and highest (Q4) communities [7].

We collected demographic factors of the arrest patients, including date of arrest, address of arrest locations, age, gender, and past medical history (diabetes mellitus, hypertension, heart disease, and stroke), and community-EMS factors, including witnessed status, location of arrest (public vs. private), bystanders' use of automated external defibrillator (AED), primary electrocardiogram at the scene, prehospital defibrillation, EMS response time (interval from call to EMS arrival at the scene), and return of spontaneous circulation at arrival in the ED. Addresses of the arrest incident location of individual patients were sorted by county and matched with the Korean CHS data calculated above. The quartile-grouped CPR awareness level of each county was merged with individual patients' information by county name. We hereafter refer to these counties as communities.

We also used the dispatcher CPR registry to collect the reasons for occasions when the dispatcher recognized the cardiac arrest but did not provide CPR instructions to the caller. We classified the reasons into patients' factors, callers' factors, and other factors and then divided the patients' and callers' factors into modifiable, non-modifiable, and other factors [15].

Statistical analysis

Descriptive analysis was conducted to investigate the distribution of categorical variables (counts and proportion) and continuous variables (medians and inter-quartiles).

To determine the associations of individual factors (level 1) and community factors (level 2) with the study outcomes, we used generalized linear mixed models for multilevel logistic regression analysis. The adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) of the exposure variable on study outcomes were calculated after controlling for potential confounders (age, gender, bystander witnessed, and location of arrest). The exposure variable was analyzed both as quartiles and as a continuous variable; for quartiles, AORs on study outcomes were calculated with the lowest (Q1) CPR awareness