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Clinical paper

Bystander-initiated CPR in an Asian metropolitan: Does the socioeconomic status matter?☆

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ABSTRACT

Objectives: To determine the association of neighborhood socioeconomic status (SES) with bystander-initiated cardiopulmonary resuscitation (CPR) and patient outcomes of out of hospital cardiac arrests (OHCAs) in an Asian metropolitan area.
Methods: We performed a retrospective study in a prospectively collected cohort from the Utstein registry of adult non-traumatic OHCAs in Taipei, Taiwan. Average real estate value was assessed as the first proxy of SES. Twelve administrative districts in Taipei City were categorized into low versus high SES areas to test the association. The primary outcome was bystander-initiated CPR, and the secondary outcome was patient survival status. Factors associated with bystander-initiated CPR were adjusted for in multivariate analysis. The mean household income was assessed as the second proxy of SES to validate the association.
Results: From January 1, 2008 to December 30, 2009, 3573 OHCAs received prehospital resuscitation in the community. Among these, 617 (17.3%) cases received bystander CPR. The proportion of bystander CPR in low-SES vs. high-SES areas was 14.5% vs. 19.6% ($p < 0.01$). Odds ratio of receiving bystander-initiated CPR in low-SES areas was 0.72 (95% confidence interval: [0.60–0.88]) after adjusting for age, gender, witnessed status, public collapse, and OHCA unrecognized by the online dispatcher. Survival to discharge rate was significantly lower in low-SES areas vs. high-SES areas (4.3% vs. 6.8%; $p < 0.01$). All results above remained consistent in the analyses by mean household income.
Conclusions: Patients who experienced an OHCA in low-SES areas were less likely to receive bystander-initiated CPR, and demonstrated worse survival outcomes.

1. Introduction

Bystander-initiated cardiopulmonary resuscitation (CPR) is a vital link in the community chain-of-survival for out-of-hospital cardiac arrest (OHCA).[1,2] For every 30 patients receiving bystander CPR, one additional life will be saved.[1] However, the bystander CPR rate for OHCA patients remains unsatisfactory worldwide. The rate ranged from 10% to 65% in the United States,[3,4] and were even lower among many Asian countries from 1.5% to 36.7%.[5–9] Major barriers to laypersons' willingness to perform bystander CPR include the fear of injuring the patient by incorrect or poor CPR performance, the physical inability of the bystander to perform CPR, legal liability, and the risk of infectious disease transmission.[10–12]

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Previous studies have indicated that there are individual-level factors that influence the rate of bystander CPR, but the neighborhood in which the arrest occurs may also affect the rate of bystander CPR. The neighborhood factors associated with bystander CPR rates include location of collapse (public vs. private), the racial composition or educational level of residents, and socioeconomic status (SES).[13–16] Sasson et al. examined the correlations between bystander CPR rates and neighborhood features, and identified higher OHCA rates and lesser provision of bystander CPR in communities with lower income, lower education level, and higher percentage of black residents.[14,17,18] Recently, a large cohort study also showed lower bystander-initiated CPR in low-income black neighborhoods than those in high-income white neighborhoods.[3] Identifying areas with lower rates of bystander-initiated CPR in a community could facilitate efficient delivery of CPR training courses based on local needs, and increase the overall bystander CPR rate for OHCAs. Therefore, communities are advised to conduct a surveillance to identify areas with lower rates of bystander CPR to evaluate for neighborhood effect.[2]

Currently the association of SES with bystander-initiated CPR has only been reported in North America. Compared to North America, Asian communities have a lower rate of bystander-initiated CPR, a less complex racial composition, and a lesser disparity between rich and poor. Whether the association between SES and bystander-initiated CPR exists universally has not been examined previously.

Using the Utstein-based registered data from an Asian metropolitan area, we conducted a study to evaluate the association between SES and bystander-initiated CPR, and to examine whether the difference of bystander CPR rate influences patient outcomes.

2. Methods

2.1. EMS setting in Taipei and Utstein-based dataset

Taipei City has a population of 2.65 million in the area of 272 km^2. The metropolis is covered by fire-based, two-tiered emergency medical service (EMS) system including 39 basic life support (BLS) teams with early defibrillation capability and 4 advanced life support (ALS) teams capable and authorized to perform tracheal intubation and intravenous injections of adrenaline (epinephrine) and atropine.[19,20]

The Utstein-based data of Taipei EMS has been developed and modified for a quality assurance process for OHCAs since early 2000. The registry data contains the dispatch records, modes and timeliness of pre-hospital care, patients' demographics (age, sex), arrest characteristics (witnessed status, bystander CPR, initial recorded rhythm), automated external defibrillator records, and patient outcomes from the EMS receiving hospitals, including return of spontaneous circulation (ROSC), survival to hospital admission, survival to hospital discharge, and neurologic functional status by cerebral performance category (CPC) at discharge.

2.2. Study design, study population and data collection

We conducted a retrospective study in a prospective cohort of the Utstein-based registry of Taipei EMS OHCAs. This study was designed as a descriptive analysis between SES of the twelve administrative districts in Taipei and likelihood of receiving bystander-initiated CPR. Because the record of "bystander-initiated CPR" was not required until mid-2007, data for this study was selected thereafter. The study protocol has been approved by the Institutional Review Board of the National Taiwan University Hospital.

Patients with OHCA from January 1, 2008 to December 31, 2009 registered in the Utstein-based system were enrolled. Patients without transport to hospital due to obvious death or an existing do-not-attempt-resuscitate (DNAR) orders, or OHCA with traumatic cause, or pediatric cases (<18 years old) were excluded. Data on each OHCA are collected from a combination of forms of run sheets filled out by EMS personnel who responded to the call, hospital records, and defibrillator downloads.

2.3. Measures of exposure and outcomes

2.3.1. Exposure: surrogate for socioeconomic status

We intended to study how the SES of the area affects the provision of CPR in prehospital setting. In health research, SES is viewed as a composite condition of a person according to educational attainment, mean income, occupation, wealth and so on.[21] However, all the information above is not collected as a part of the cardiac arrest registry. Accurate measurement of SES is difficult in EMS research field. Therefore, literature of SES and EMS research employ surrogate measures for neighborhood SES.[3,13,14,16,22]

In this study, community SES is assessed by the average price of real estate in 2008 and 2009 among the 12 administrative districts in Taipei City, similar in the study by Vaillancourt et al.[13] Historically, significant disparity exists between publicly announced land value by government and current assessed residential property value by market in Taiwan. As registry of the real selling price of property was implemented by Department of Land Administration only after 2012 exact price of real estate property in 2008 and 2009 was not available. Therefore, we estimated the price of real estate during the study period by averaging announced property values from two major real estate agencies in Taiwan.

2.3.2. Outcomes rates of bystander-initiated CPR and cardiac arrest survival

We defined two outcomes of interest: the provision of bystander CPR and survival of patients with OHCA. The primary outcome was the rate of bystander CPR as obtained from the web-based Utstein-based registry system in Taipei during the study period. Bystander CPR on EMS arrival was recorded by EMS personnel on ambulance run sheet for every OHCA. Secondary outcomes were the survival status of patients, including sustained ROSC (longer than 2 h), survival to hospital discharge, and favorable neurological outcome of survivors defined by cerebral performance category (CPC) scale 1 and 2.

2.4. Validation by a second proxy of SES: the mean household income

To verify the association of bystander CPR and community SES as defined by average real estate price, the analyses were repeated using a second proxy of SES, the mean household income in 2008 and 2009 among the 12 administrative districts in Taipei City. The values of mean household income, annually reported by Department of Budget, Accounting and Statistics, Taipei City Government through cluster sampling of Taipei citizens, represented the finical status at home-level in the area, and has been commonly used as a proxy of neighborhood effect in previous studies.[3,16]

2.5. Statistical analysis

Mean and standard deviation (S.D.) were calculated as summaries of the continuous variables. For categorical variables, number and percentage were computed. Unpaired Student's *t*-tests were used for comparisons of continuous variables, and binominal variables were analyzed with Chi-square or Fisher's exact tests, as