



# Association between public cardiopulmonary resuscitation education and the willingness to perform bystander cardiopulmonary resuscitation: a metropolitan citywide survey

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**Objective** Bystander cardiopulmonary resuscitation (CPR) is an important factor associated with improved survival rates and neurologic prognoses in cases of out-of-hospital cardiac arrest. We assessed how factors related to CPR education including timing of education, period from the most recent education session, and content, affected CPR willingness.

**Methods** In February 2012, trained interviewers conducted an interview survey of 1,000 Daegu citizens through an organized questionnaire. The subjects were aged  $\geq 19$  years and were selected by quota sampling. Their social and demographic characteristics, as well as CPR and factors related to CPR education, were investigated. Chi-square tests and multivariate logistic regression analyses were used to evaluate how education-related factors affected the willingness to perform CPR.

**Results** Of total 1,000 cases, 48.0% were male. The multivariate analyses revealed several factors significantly associated with CPR willingness: didactic plus practice group (adjusted odds ratio [AOR], 3.38; 95% confidence interval [CI], 2.3 to 5.0), group with more than four CPR education sessions (AOR, 7.68; 95% CI, 3.21 to 18.35), interval of less than 6 months from the last CPR education (AOR, 4.47; 95% CI 1.29 to 15.52), and education with automated external defibrillator (AOR, 5.98; 95% CI 2.30 to 15.53).

**Conclusion** The following were associated with increased willingness to perform CPR: practice sessions and automated electrical defibrillator training in public CPR education, more frequent CPR training, and shorter time period from the most recent CPR education sessions.

**Keywords** Heart arrest; Cardiopulmonary resuscitation; Education



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## Capsule Summary

### What is already known

*Bystander cardiopulmonary resuscitation (CPR) is critical in improving the survival rate of out of hospital cardiac arrest, and CPR training is important in improving bystander CPR rates.*

### What is new in the current study

*Training practice, including automated external defibrillator training, frequent reeducation, and short interval from last training are important factors associated with the willingness to perform bystander CPR.*

## INTRODUCTION

In 2010, the prevalence of sudden cardiac arrest (SCA) was 46.8 per 100,000 people in Korea; the survival to hospital discharge rate was 3.0%, which was lower than that in major developed countries.<sup>1</sup> Bystander cardiopulmonary resuscitation (CPR) is a crucial factor necessary to increase survival rates. Hasselqvist-Ax et al.<sup>2</sup> reported a 30-day survival rate of 10.5% when CPR was performed before the arrival of emergency medical services (EMS), compared to 4.0% when CPR was not performed before EMS arrival. However, in Korea, bystander CPR was performed in 2.1% of SCA cases between 2006 and 2010,<sup>1</sup> which is lower than the bystander CPR rate of 32.0% reported in a global meta-analysis by Sasson et al.<sup>3</sup>

Public CPR education is imperative to increase the rate of bystander CPR. Sipsma et al.<sup>4</sup> reported that willingness to perform CPR was greater when individuals had received CPR education within the last 5 years or more than 3 times. This finding reveals the association between the willingness to perform CPR and the timing and frequency of CPR education, respectively. Furthermore, Wik et al.<sup>5</sup> noted that bystander CPR was associated with a shorter arrest-CPR interval and improved hospital discharge rates, compared to no good bystander CPR or no bystander CPR. Therefore, it is important not only to improve bystander CPR rates but also for bystanders to deliver high-quality CPR. In research targeting emergency medical technicians, Brown et al.<sup>6</sup> found that delivering high-quality CPR, including adequate compression depth and speed, was related to the degree of knowledge regarding CPR protocols. Knowledge of psychomotor skills, such as CPR, declines over time: previous studies have shown that knowledge diminishes after approximately 6 to 12 months.<sup>7-10</sup> Therefore, in order to increase bystander CPR rates and provide high-quality CPR, it is important to implement a strategy for the retention of CPR knowledge and skills. It is necessary to set a target for public CPR that is effective within individual communities. To achieve these targets, it is important to identify the causes of variation in willingness to perform

CPR, according to the details of bystander CPR education. Studies have reported that receiving CPR education positively affects bystander willingness to perform CPR;<sup>6</sup> however, there is little research on how the specific elements of bystander CPR education affect the willingness of bystanders to perform CPR.

This study aimed to determine how bystander CPR willingness is affected by factors related to CPR education, such as the methodology and number of bystander CPR education sessions, the time period from the last education session, and whether automated electrical defibrillator (AED) training was included.

## METHODS

### Study design and subjects

The study population was selected among adults aged 19 years or above living in Daegu metropolitan city. In 2012, the population of Daegu metropolitan city was 2,528,000, with an incidence rate of SCA of 40.2 per 100,000. In the same period, the bystander CPR and survival-to-discharge rates were 12.1% and 4.7%, respectively.<sup>11</sup> According to the official report, 3,705 people received public CPR education in 2012.<sup>12</sup> In February 2012, 1,000 citizens were selected by quota sampling on the basis of distribution among districts or counties, age, and sex. From February 3 to 14, a face-to-face interview survey was administered to the target study population by trained interviewers using a structured questionnaire. The interviewers visited each participant door-to-door in order to conduct the survey.

### Questionnaire and variables

The questionnaire items included social and population factors, factors related to CPR, and factors related to CPR education. The social and population factors included age, sex, education level (middle school graduate or under, high school graduate, and college graduate or higher), average monthly income (< 1 million [M] South Korean won [KRW], 1 M to less than 2 M KRW, 2 M to less than 3 M KRW, 3 M to less than 4 M KRW, 4 M to less than

5 M KRW, or > 5 M KRW), and legal obligation under EMS laws to receive CPR education (yes or no). The factors related to CPR included CPR recognition, AED recognition, confidence in performing CPR, and willingness to perform CPR. All factors were measured using a five-point score (1, not at all; 5, very likely). Results were dichotomized into two categories for analysis:  $\leq 3$  points and  $\geq 4$  points. The factors related to CPR education included prior experience (yes or no), frequency (1 time, 2 times, 3 times, or  $\geq 4$  times), period from the last CPR education session (< 6 months, 6 months to 1 year, 1 to 2 years, 2 to 5 years, or  $\geq 5$  years), type of CPR education (didactic only or didactic with practice), and inclusion of AED training (yes or no).

### Statistical analysis

Subjects were divided into groups according to their willingness to perform CPR. Chi-square tests were used for comparisons be-

tween groups based on social and population factors and factors related to CPR education. To investigate how factors related to CPR education affected CPR willingness, multivariate logistic regression analysis was performed using CPR education-related factors as independent variables and CPR willingness as an endpoint. Age, sex, education level, monthly income, and legal obligation to receive education were used as confounders. Statistical analysis was performed using IBM SPSS Statistics ver. 22.0 (IBM Corp., Armonk, NY, USA) and statistical significance was defined as  $P < 0.05$ .

## RESULTS

A total of 1,000 participants took part in the survey. Of these, 480 (48%) respondents were male and 520 (52%) were female. By age, respondents in their 40 s were most common. Most partici-

**Table 1.** General characteristics of respondents and their willingness to perform CPR

		Total (n = 1,000)	Willingness to perform CPR	P-value
Sex	Male	480	324 (67.5)	<0.001
	Female	520	249 (47.9)	
Age (yr)	20s	178	115 (64.6)	<0.001
	30s	203	124 (61.1)	
	40s	233	145 (62.2)	
	50s	189	113 (59.8)	
	60s and above	197	76 (38.6)	
CPR recognition ('Do you know what CPR is?')	Yes	893	541 (60.6)	<0.001
	No	104	32 (30.8)	
	Unknown	3		
CPR procedure recognition ('Do you know how to perform CPR?')	Yes	349	276 (79.1)	<0.001
	No	651	297 (45.6)	
Prior experience with CPR training	Yes	362	268 (74.0)	<0.001
	No	630	305 (47.8)	
	Unknown	8		
Confidence in performing CPR	Yes	85	81 (95.3)	<0.001
	No	914	492 (53.8)	
Legally obligated by EMS law	Yes	130	87 (66.9)	0.017
	No	870	486 (55.9)	
Education level	Middle school graduate or under	135	46 (34.1)	<0.001
	High school graduate	292	162 (55.5)	
	College graduate or higher	560	357 (68.9)	
	Unknown	13		
Monthly income (KRW)	Less than 1 M	153	74 (48.4)	0.141
	1 M-less than 2 M	202	116 (57.4)	
	2 M-less than 3 M	238	149 (62.6)	
	3 M-less than 4 M	213	125 (58.7)	
	4 M-less than 5 M	98	54 (55.1)	
	5 M or more	53	32 (60.4)	
	Unknown	43		

Values are presented as number or number (%).

CPR, cardiopulmonary resuscitation; EMS, emergency medical service; KRW, Korean won; M, million.

pants were educated through college or higher. A total of 57.3% of respondents reported a willingness to perform bystander CPR. The rate of willingness to perform CPR on family members or friends was 55.3% compared to 32.2% on strangers. Of the 480 male respondents, 67.5% reported a willingness to perform bystander CPR. The rate was 47.9% among the 520 female respondents, indicating that male respondents were more willing to perform CPR.

The rates of willingness to perform CPR decreased with age as follows: 64.6% amongst respondents aged 20 to 29 years, 59.8% for respondents aged 50 to 59 years, and 38.6% for respondents aged 60 years or above. The rates of willingness to perform CPR according to grade of education were 34.1% of 135 middle school graduates or respondents with a lower level of education, 55.5% of 292 high school graduates, and 68.9% of 560 college graduates or respondents with a higher level of education. These findings indicate that increased willingness to perform CPR was associated with higher levels of education. Monthly income had no significant impact on CPR willingness. Among respondents legally obligated to perform CPR under Korean EMS laws, 66.9% of 130 respondents reported their willingness.

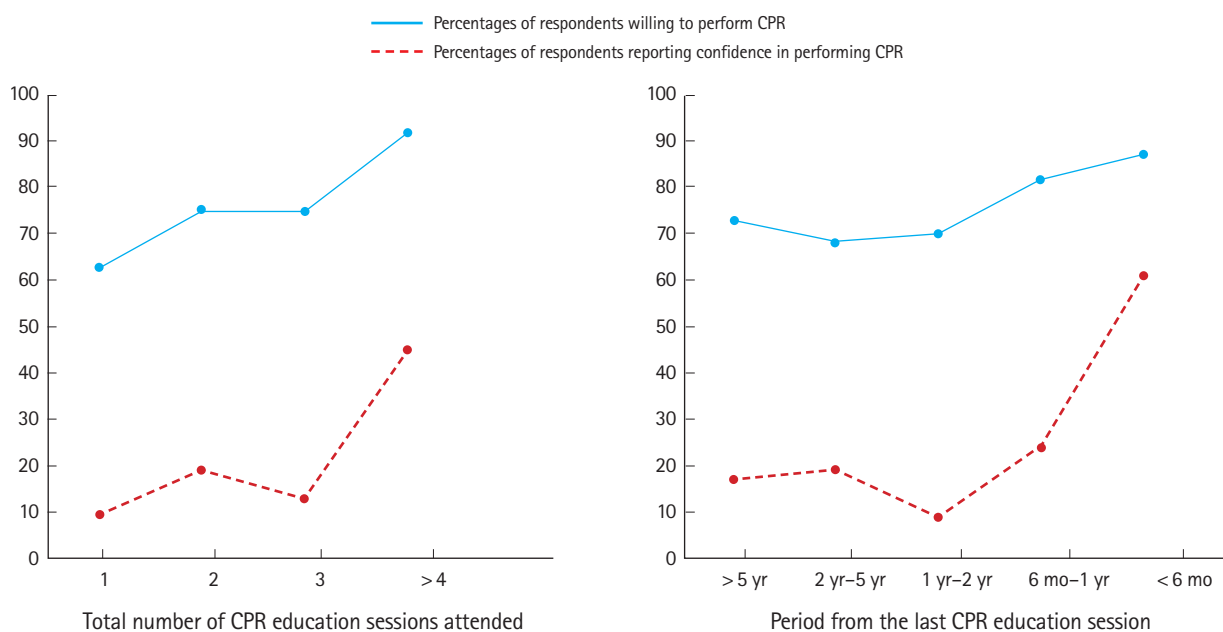
Regarding questions about their recognition of CPR and CPR procedures, 893 and 349 respondents, respectively, answered affirmatively. The rates of willingness were 60.6% in the group recognizing CPR and 79.1% in the group recognizing CPR procedures.

A total of 362 respondents had attended CPR education ses-

sions at least once; of these, 74.0% were willing to perform CPR, compared to 47.8% in the non-educated group (Table 1).

Of these 362 respondents, 229 indicated that they had also undergone practical education sessions. The rate of CPR willingness (79.9%) in the didactic plus practice group was significantly higher than that in the didactic only group (63.9%). The CPR willingness rates, according to the total number of CPR education sessions attended, were 62.5% for the group attending one session, 74.8% for the group attending 2 sessions, 74.5% for the group attending 3 sessions, and 91.5% for the group attending 4 or more sessions. The willingness to perform CPR, according to the time interval between the last CPR session and the study period, was 72.6% with an interval of 5 years or more, 68.1% with an interval between 2 and 5 years, and 70.0% with an interval between 1 and 2 years. Of note, willingness rates were 81.6% and 87% for intervals between 6 months and 1 year, and intervals under 6 months, respectively. These findings indicate that more respondents were willing to perform CPR if the interval was under 1 year than those who received CPR education more than 1 year earlier. Moreover, as respondents attended CPR education more frequently or more recently, they tended to be more confident in performing CPR (Fig. 1).

Only 13.8% of respondents reported that AED training was included in the CPR education sessions that they had attended. However, the willingness to perform CPR was 90.0% in the AED-trained group, which indicates a greater willingness compared to subjects who did not receive AED training (Table 2).



**Fig. 1.** Trends in the percentages of participants willing to perform cardiopulmonary resuscitation (CPR) and percentages of confidence in performing CPR according to CPR education characteristics.

**Table 2.** CPR training and willingness to perform CPR

		Total (n = 362)	Willingness to perform CPR	P-value
Type of CPR education	Didactic only	133	85 (63.9)	< 0.001
	Didactic plus practice	229	183 (79.9)	
Total no. of CPR education sessions attended	1	112	70 (62.5)	< 0.001
	2	119	89 (74.8)	
	3	47	35 (74.5)	
	4 Or more	71	65 (91.5)	
	Unknown	13		
Period from the last CPR education session	6 Months or shorter	23	20 (87.0)	0.183
	6 Months to 1 year	76	62 (81.6)	
	1 To 2 years	70	49 (70.0)	
	2 To 5 years	69	47 (68.1)	
	5 Years or longer	113	82 (72.6)	
AED training included in CPR education	Yes	50	45 (90.0)	0.006
	No	277	198 (71.5)	
	Unknown	35		

Values are presented as number or number (%).

CPR, cardiopulmonary resuscitation; AED, automated external defibrillator.

**Table 3.** Factors associated with willingness to perform CPR

		Unadjusted OR	95% CI	Adjusted OR <sup>a)</sup>	95% CI
Type of CPR education	Not trained	Reference			
	Didactic only	1.78	1.24–2.52	1.50	0.97–2.33
	Didactic plus practice	2.98	2.88–5.50	3.38	2.26–5.04
Total no. of CPR education sessions attended	Not trained	Reference			
	1	1.67	1.14–2.44	1.51	0.96–2.37
	2	2.97	1.97–4.49	2.15	1.34–3.45
	3	2.92	1.51–5.62	2.17	1.08–4.36
	4 Or more	10.83	4.69–25.00	7.68	3.21–18.35
Period from the last CPR education session	Not trained	Reference			
	5 Years or longer	2.65	1.75–4.00	2.31	1.44–3.69
	2 To 5 years	2.14	1.29–3.55	1.52	0.87–2.65
	1 To 2 years	2.33	1.40–3.90	1.91	1.02–3.20
	6 Months–1 year	4.43	2.48–7.10	3.80	1.91–7.56
	Shorter than 6 months	6.67	1.98–22.44	4.47	1.29–15.52
AED training included in CPR education	Not trained	Reference			
	No	2.51	1.93–3.25	1.90	1.36–2.67
	Yes	9.00	3.57–22.67	5.98	2.30–15.53

CPR, cardiopulmonary resuscitation; OR, odds ratio; CI, confidence interval; AED, automated external defibrillator.

<sup>a)</sup>Adjusted for sex, age, education level, monthly income, and legal obligation under emergency medical service law.

Multivariate analysis was performed to identify how discrepancies in CPR education experience, such as type of CPR education, period from the most recent CPR education session, and frequency of sessions, affect CPR willingness. The adjusted odds ratio (OR) was 3.38 (95% confidence interval [CI], 2.26 to 5.04) for didactic plus practice group. In the group receiving CPR education on 4 or more occasions, the adjusted OR for CPR willingness was 7.68 (95% CI, 3.21 to 18.35). This was higher than the adjusted OR of 2.17 (95% CI, 1.08 to 4.36) for groups receiving CPR

education on 3 occasions or less. The adjusted OR for CPR willingness according to the period from the latest CPR education session was 4.47 (95% CI, 1.29 to 15.52) for intervals shorter than 6 months, 3.80 (95% CI, 1.91 to 7.56) for intervals between 6 months and 1 year, and 1.91 (95% CI, 1.02 to 3.20) for intervals between 1 and 2 years. If AED training was included in CPR education, the adjusted OR for CPR willingness was 5.98 (95% CI, 2.30 to 15.53) (Table 3).

## DISCUSSION

Prompt CPR synchronous to cardiac arrest increases survival rates two to four-fold.<sup>13</sup> Therefore, bystander CPR may be an important factor for improving survival rates in cases of out-of-hospital cardiac arrest. Wissenberg et al.<sup>14</sup> examined the association between increasing bystander CPR rates and improvement in survival rate, reporting that bystander CPR rates in Denmark increased from 21.1% to 44.9% between 2001 and 2010, following implementation of the following strategies: introduction of CPR education as part of elementary education and driver's license testing, widespread distribution of self CPR training kits, and expansion of first-aid education.

Previous studies reported community EMS response intervals of approximately 5 to 8 minutes.<sup>13</sup> According to Ro et al.,<sup>1</sup> the response interval in Korea is comparable, at 6 minutes. Performing bystander CPR before EMS arrival may be important for improving outcome among out-of-hospital cardiac arrest patients in Korea. To achieve this goal, public CPR education has been implemented. Laws regarding emergency care were introduced that implemented CPR training for persons under legal obligation, and the 'good Samaritan law' was legislated in 2008 in an attempt to promote bystander CPR rates.

Hamasu et al.<sup>15</sup> evaluated bystander CPR willingness among college students after basic life support training and reported increases from 58% to 92.7% for family members and from 12.8% to 76.8%, for an unknown person. Cho et al.<sup>16</sup> also reported an increased willingness to perform bystander CPR following basic life support training at 7 Korean university hospitals. The present study also observed an increased CPR willingness among those receiving CPR education, which further increased when the education included CPR practice in addition to the didactic element. Although CPR education is crucial to increase bystander CPR rates, not all recipients exhibited the same degree of CPR willingness. The degree of willingness to perform CPR varied according to the type, frequency, and timing of CPR education. Therefore, in order to maintain an adequate level of bystander CPR willingness, it is imperative to identify the most effective strategy, in terms of educational method, number of required educational sessions, and time interval between educational sessions.

Few studies have evaluated the impact of social and population factors and CPR education on bystander CPR.<sup>6,17-20</sup> Very limited research has focused on the detailed characteristics of CPR education, such as the inclusion of practical sessions and AED training, the timing and frequency of educational sessions, and the effect of these variables on bystander CPR willingness.

In this study, we investigated how the details of the effect of

CPR education, including the type, frequency, and timing of education sessions, as well as the inclusion of AED on subsequent willingness to perform CPR. We found that the willingness was greater when practical sessions and AED training were included, with more frequent education sessions, and with intervals from the most recent CPR education session between 6 months and 1 year.

In a community-based study, Sipsma et al.<sup>4</sup> found that CPR willingness was significantly greater following 3 or more education sessions. In our study, CPR willingness was significantly higher after the participants had received 2 or more education sessions. In particular, willingness was 7 times higher in persons with 4 or more education sessions, compared to those with no previous CPR education.

Reeducation within a certain timeframe following CPR education appears to be necessary, as bystander CPR willingness tends to decrease over time. In a survey of the general Australian population, Johnston et al.<sup>21</sup> reported that people who had received CPR education within the preceding year had a higher willingness to perform bystander CPR. Lee et al.<sup>22</sup> found that CPR education within the preceding 2 years resulted in greater bystander willingness to perform CPR. In our study, the OR differed significantly for a period from most recent CPR education session of 1 year.

CPR knowledge acquired during education sessions diminishes over time. Previous studies involving health care providers report that the knowledge declines after approximately 6 to 12 months.<sup>7-10</sup> Wilson et al.<sup>23</sup> reported a rapid decline in CPR knowledge among bystanders over the first year after CPR education. These findings suggest that, as CPR knowledge diminishes, bystander CPR willingness decreases, an observation that may explain why the OR in our study differed significantly when the period from the most recent CPR education session was 1 year.

The findings of this study indicate that, in order to maintain an adequate level of bystander willingness to perform CPR, it is necessary to repeat CPR education sessions over time. However, this is a challenging goal, in terms of both time and resources. Bobrow et al.<sup>24</sup> noted that educating community members to maintain an effective citizen-rescue force is both numerically and financially impractical, and emphasized the importance of dispatcher-assisted CPR (DA-CPR) to overcome such difficulties. Hasselqvist-Ax et al.<sup>2</sup> suggested that increased bystander CPR rates may be the result of widespread CPR training, expansion of DA-CPR, and more frequent EMS dispatch. Based on the result of this and a number of other studies, it appears that DA-CPR, as well as CPR training, are important factors to improve bystander CPR, along with CPR quality and survival rate. In addition, a number of other studies have also reported improved CPR quality, by-

stander CPR rate, and survival rate with DA-CPR.<sup>25-28</sup>

Therefore, bystander CPR willingness is affected by the frequency of education sessions and the period from the most recent session. We believe that it is essential to establish a community dispatch center system and incorporate DA-CPR in bystander CPR education programs, in order to effectively perform DA-CPR alongside public CPR education.

The current study has a number of limitations. First, the timing and frequency of previous education sessions were identified through a survey; therefore, we cannot exclude the possibility of errors in recall, particularly regarding the point in time when CPR education was received. Second, as the investigation was conducted using a survey, it is difficult to reliably predict whether a respondent will actually perform CPR when witnessing a cardiac arrest.

In summary, it is imperative to include practice sessions and AED education in CPR education. As CPR willingness is greater with a shorter period from the most recent CPR education and with increased reeducation sessions, systematic planning and management of CPR reeducation are required for first-aid responders.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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