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South Korean and Japanese intention to use automated external defibrillators in out-of-hospital cardiac arrest situations

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일반인의 AED 사용에 관한 한·일 비교 연구

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=Abstract =

Purpose : The purpose of the study is to investigate the factors influencing using AED use in South Korea and Japan.

Methods : I conducted a questionnaire survey from February 25 to March 4, 2013, receiving responses from 517 people in Korea and 520 people in Japan. The questionnaire included sociodemographic factors, history of heart disease, AED knowledge, and other variables. A logistic regression analysis was conducted.

Results : Among the 517 Korean respondents, 220 (42.6%) intended to use AEDs. Among the 520 Japanese respondents, 384 (74.4%) had similar intentions. Multiple logistic regression analysis found the following significant predictors of intent to use AEDs: gender (odds ratio [OR] = 0.419), household income (OR = 0.991), and AED knowledge (OR = 2.833) in Korea; and gender (OR = 0.582), age (OR = 0.968), cardiac disease history (OR = 2.099), and AED knowledge (OR = 2.984) in Japan.

Conclusion : It would be helpful to teach AED use to encourage performing public access defibrillation. In addition, it is necessary to design AED education programs based on country-specific factors.

Key words : Out-of-hospital cardiac arrest, Japan, Automated external defibrillator, Korea

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=국문초록=

연구 목적 : 한국에서 일반인의 의한 AED의 사용 사례를 극히 드물다. 병원 전 심정지 상황에서 특히 제세동이 필요한 환자의 소생률을 높이기 위해서는 일반인에 의한 AED 사용이 요구된다. 본 연구의 목적은 AED사용에 영향을 미치는 요인을 분석하는 것이며, 한일 비교를 통해 사회적 특성이 있는지를 확인하는 것이다.

연구 방법 : 2013년 2월 25일부터 3월 4일까지 설문 조사를 실시했다. 한국에서 517명, 일본에서 520명의 데이터를 회수했다. 설문지를 통해 파악한 사회인구학적 요인과 AED에 관한 지식 요인이 AED사용의도에 영향을 미치는지를 알기 위해 로지스틱 회귀분석을 실시했다.

연구 결과 : 한국의 517 명의 응답자 중 220명, 42.6%만이, 그리고 일본의 520명의 응답자 중 387 명, 74.4%가 AED를 사용해 환자를 도우려는 의사를 가지고 있었다. 한국과 일본 모두 성별은 유의한 요인이었다(한국 odd ratio[OR] = 0.419, 일본 OR = 0.582). 양국 모두에서 여성은 남성에 비해 AED를 사용해 환자를 도우려고 하지 않았다. AED에 관한 지식은 양국 모두에서 가장 큰 영향을 끼치는 요인이었다. 국가 간의 차가 있었던 요인은 우선 연령이었다. 연령 요인이 한국에서는 유의하지 않았지만 일본에서는 젊을수록 AED 사용의사가 높았다(OR = 0.968). 또한 일본에서는 심장병력이 유의한 요인(OR=2.099)이었다.

결 론: 본 연구는 AED사용의도에 가장 큰 영향을 끼치는 요인이 AED에 관한 지식임을 밝혔다. 따라서, 병원 전 심정지 상황에서 제세동을 장려하기 위해서는 AED 설치와 함께 사회적 요인을 반영한 교육 프로그램이 필요하다.

국문중심단어 : 병원 전 심정지, 일본, 자동제세동기, 한국

I . Introduction

1. The need for research

When arrhythmia due to ventricular fibrillation occurs, defibrillation is an effective method of treatment [1]. Early defibrillation significantly influences the patient survival rate. Therefore, when out-of-hospital cardiac arrest (OHCA) by ventricular fibrillation occurs, immediate use of automated external defibrillators (AEDs) is necessary for patient survival. Using automated external defibrillators for defibrillation as soon as possible is indispensable for survival to hospital admission and survival to hospital discharge without negative sequelae. About 5,826 automated external defibrillator units have been disseminated

and installed throughout South Korea [2]. However, according to a recent report, only 33 of these units (not including those in ambulances, airports, and hospitals) were used between 2008 and 2012 in various multiuse facilities across South Korea, such as museums, train stations, bus terminals, exhibition halls, libraries, and theaters [3]. In Japan, a neighboring country, 383,247 AEDs were sold [4], and 1433 Public Access Defibrillations (PADs) were performed in 2011 [5]. PAD refers to when a layperson administers defibrillation using an AED in OHCA situations. Even considering the population of the two countries, the number of AED and PAD cases is very small in South Korea.

Quantitative analysis of the medical and economic effects of AED use is necessary in

order to spread AED use [6]. Cost benefit analysis or cost effectiveness analysis can demonstrate that the AED dissemination policy is effective and efficient. Other countries have also completed such nationwide studies [7–10]. In addition, studies at the city level have demonstrated the effects of AED use [11–14]. However, Korean AED usage has been so limited that no data is even available. Therefore, it is necessary to assess who are the most likely AED users in OHCA situations. To promote PAD, it is necessary to analyze the variables that affect people's intent to use AEDs or to perform PAD.

Various studies on how to increase survival rate through AED use are underway in Europe and the United States. It would be possible to reference these studies to increase AED use in Korea. However, Japan, which has a similar social structure, would provide a better model for South Korea. A 2004 policy promulgated by Japan's Ministry of Health, Labour and Welfare [15] permits AED use by laypersons. Thereafter, AED spread at a faster rate and recently more than 1,000 cases of PAD were performed annually. A comparative analysis regarding intent to use AEDs is useful to understand the differences between South Korea and Japan and to clarify specifically Korean characteristics of AED use and intent.

In both Korea and Japan, fewer than 10 years have passed since laypersons were permitted to use AEDs in public situations; thus, it is unsurprising that no previous studies have examined the factors that affect intention to use AEDs. However, there is some literature on

what affects a similar procedure, cardiopulmonary resuscitation (CPR). An important factor affecting the intention to perform CPR is knowledge of CPR [16–21]. In addition, Leem [16] and Roh et al [19] showed that religious factors and having served in the military affect the intention to perform CPR, respectively. Given the findings of these studies, I wanted to determine whether there are similar factors that influence intention to use AEDs. My previous research, which found that a number of social factors influence AED installation in the home [22], suggest that this is the case: If there are social factors that affect AED installation, it is likely that similar social factors affect intention to use AEDs.

2. Purpose of research

The purpose of this study is to describe what factors affect respondents' intention to use an AED to save a life in an OHCA situation. In addition, I aimed to clarify specifically Korean characteristics of intent to use AEDs through comparison with a similar survey in Japan, in order to develop policy recommendations for using AEDs in OHCA situations in South Korea in the future. The following hypotheses were tested:

- 1) Social and demographic factors such as gender, age, household income, and disease history affect intention to use AEDs.
- 2) Knowledge of AEDs positively affects intention to use AEDs.
- 3) Factors affecting intention to use AEDs differ between South Korea and Japan.

As mentioned above, some social factors

affect intention to perform CPR [16,19], which is a similar procedure to PAD; thus, I think that some of the same social factors that affect intention to perform CPR will affect intention to use AED in OHCA. As such, the second hypothesis proposes that PAD and AED utilization will be affected by prior knowledge of AEDs, in the same way that knowledge of CPR was the most significant factor affecting its performance [16–21]. The most significant factor affecting CPR performance was knowledge of CPR. I considered PAD and AED utilization to be similarly influenced by previous knowledge. Finally, Ahn et al [23] showed a gender disparity in prehospital care in South Korea suggesting that males have a better survival rate than females from OCHA to admission. However, an American study [24] suggested the opposite. My third hypothesis, then, was that if countries differed with regard to factors affecting prehospital care, they might also differ with regard to factors affecting AED use.

II. Methods

1. Research design

This study describes the factors affecting intention to use AEDs in OHCA situations in Korea and Japan using a questionnaire survey. In this study, I employed the following to maintain the ethical soundness of the design: First, information received from respondents for analysis in this study was only used after

explaining to the respondents the purpose of the research. Second, respondents' identities were blinded using a coding procedure.

2. Research target

I surveyed the members of one research company in South Korea (Macromill Embrain; Seoul, Korea) and another in Japan (Macromill; Tokyo, Japan). An e-mail containing the questionnaire (entitled: "A general survey on health") was sent to recruit subjects. In South Korea, 5,459 people were sent the questionnaire via e-mail and data from 517 people were included in the final analysis. In Japan, 2,706 people were sent the questionnaire and data from 520 people were included in the final analysis.

Supplemental investigation examined the reason for response rate differences. Of the 5,459 people e-mailed in Korea, 4,507 mails reached the recipient. Among the 4,507 received e-mails, only 1,290 people opened the e-mail. Of those 1,290, 773 people participated in the survey. Data from 177 people were either incomplete or clearly inaccurate.

The survey in Japan was different. First, I aimed at a final number of 500 respondents. To obtain that amount, the survey e-mail was sent to 2,706 people. The survey was over as soon as 520 samples were received. Therefore, I cannot know what percentage of the 2,706 recipients refused the survey, since I only used the first 520 returned. However, it can be assumed that many people responded to the survey because of the offered compensation

(points or money) for their response.

3. Research tool

The Korean questionnaire was developed for this research. It consisted of 44 questions, including ten questions related to social factors and 34 questions related to CPR and AED performance, ambulance usage, and other details (Cronbach's $\alpha = .872$). This questionnaire has been used for research on Korean CPR performance [16]. The Japanese questionnaire consisted of 22 items, including nine on social factors (Cronbach's $\alpha = .796$).

Again, I performed a supplemental investigation. First, I used two grants from Waseda University. One was a grant for special research projects and the other was a faculty research fund grant. It was practically impossible to combine the two grants. Therefore, I used each grant separately for the survey in each country. Second, the research companies charged the same price for different numbers of questions; Macromill Embrain (Seoul, South Korea) permitted more questions, thereby providing richer information. Third, the present study is only a part of a larger research project involving a general survey about health and emergency services. Therefore, only some of the questions from each country were used for this study.

The main dependent variable, intention to use AED, was assessed by the question, "If you witnessed a person having a heart attack, would you look for an AED and perform defibrillation on that person?" Respondents

could choose either "yes" or "no". The main independent variables included social demographic factors, such as age, gender, and household income. Additional variables included disease history (cardiac history for self and family, and history of lifestyle diseases such as diabetes, hypertension, and arteriosclerosis). Finally, AED knowledge was assessed using 7-point Likert-type scales (1 = disagree or negative to 7 = agree or positive) in Korea and 5-point Likert-type scales in Japan.

4. Data collection

Data collection took place between February 25 and March 4, 2013 in South Korea and between February 28 and March 2, 2013 in Japan.

5. Data analysis

To assess the impact of these independent variables on intention to use AEDs, I performed a binary logistic regression analysis. Logistic regression analysis can measure to what extent independent variables affect a binary, discrete dependent variable (as that used in our study), and has several advantages: odds ratios can be calculated easily through regression coefficients; both nominal and categorical variables can be used as explanatory variables; and it is free from the constraints of a multivariate normal distribution. All analysis was performed using SPSS Statistics ver. 20 (IBM Corporation, U.S.A.).

III. Results

1. General characteristics

I ensured that the proportions of men, women, and age groups between Korea and Japan were roughly similar to prevent selection bias. Education level was roughly the same in Korea and Japan but marital status differed slightly. Annual household income also differed: Japanese household income was about 10 million won higher than Korean income. Differences can also be seen in disease history. The rate of Japanese participants with cardiac history was 26.7%, but 14.9% in South Korea. In the case of lifestyle diseases, 62.3% of Koreans reported them but only 46.3% of

Japanese did so (Table 1).

2. Response ratio for intent to use AEDs by social factors

In OHCA situations, the percentage of people who said they would use the AED was about 75% in Japan, but only about 42% (or less than half) in Korea. Differences in age were seen in both countries. In Korea, the percentage of positive answers was higher among people in their 50s (47.6%) and 60s (51.9%), but in Japan, it was higher among people in the 20s (81.7%) and 30s (83.7). In both countries, the proportion of positive responses increased with education level. Japanese persons with history of cardiac

Table 1. General characteristics

Variables		Korea N (%) [*]	Japan N (%)
Total		517 (100)	520 (100)
Gender	Male	262 (50.7)	260 (50.0)
	Female	255 (49.3)	260 (50.0)
Age	19~29	104 (20.1)	104 (20.0)
	30~39	104 (20.1)	104 (20.0)
	40~49	100 (19.3)	104 (20.0)
	50~59	105 (20.3)	104 (20.0)
	60≤	104 (20.1)	104 (20.0)
	Mean ±SD	43.40 ±13.70	44.40 ±14.60
Household income [†]	Mean ±SD	52.53 ±32.63	61.81 ±96.87
Marital status	No	176 (34.0)	211 (40.6)
	Yes	341 (66.0)	309 (59.4)
Education	Under high school	147 (28.4)	163 (31.3)
	College/university	324 (62.7)	318 (61.2)
	Above master	46 (8.9)	39 (7.5)
History of cardiac disease	Existence	77 (14.9)	139 (26.7)
	None	440 (85.1)	381 (73.3)
History of lifestyle diseases [‡]	Existence	322 (62.3)	241 (46.3)
	None	195 (37.7)	279 (53.7)

* Percentage was rounded to the decimal two points.

[†] Yearly, million won

[‡] Diabetes, hypertension, arteriosclerosis

[§] Missing data on household income at Japan was replaced by the average value

Table 2. The response ratio for intent to use AEDs* by social factors

“If you witnessed a person having a heart attack, would you look for an AED* and perform defibrillation on that person?”

		Korea			Japan		
		“yes” N (%)	“no” N (%)	Total	“yes” N (%)	“no” N (%)	Total
Total		220 (42.6)	297 (57.5)	517	387 (74.4)	133 (25.6)	520
Gender	Male	138 (52.7)	124 (47.3)	262	208 (80.0)	52 (20.0)	260
	Female	82 (32.2)	173 (67.8)	255	179 (68.9)	81 (31.2)	260
Age	19~29	47 (45.2)	57 (54.8)	104	85 (81.7)	19 (18.3)	104
	30~39	32 (32.7)	70 (67.3)	104	87 (83.7)	17 (16.4)	104
	40~49	35 (35.0)	65 (65.0)	100	72 (69.2)	32 (30.8)	104
	50~59	50 (47.6)	55 (52.4)	105	76 (73.1)	28 (26.9)	104
	60≤	54 (51.9)	50 (48.1)	104	67 (64.4)	37 (35.6)	104
Marriage	No	70 (39.8)	106 (60.2)	176	159 (75.4)	52 (24.6)	211
	Yes	150 (44.0)	191 (56.0)	341	228 (73.8)	81 (26.2)	309
Education	Under high school	56 (38.1)	91 (61.9)	147	117 (71.8)	46 (28.2)	163
	College/university	143 (44.1)	181 (55.9)	324	238 (74.8)	80 (25.2)	318
	Above master's	21 (45.7)	25 (54.3)	46	32 (82.1)	7 (17.9)	39
History of CD†	Existence	39 (50.7)	38 (49.4)	77	120 (86.3)	19 (13.7)	139
	None	181 (41.1)	259 (58.9)	440	267 (70.1)	114 (29.9)	381
History of LD‡	Existence	143 (44.4)	179 (55.6)	322	190 (78.8)	51 (21.2)	241
	None	77 (39.5)	118 (60.5)	195	197 (70.6)	82 (29.4)	279

*AED: Automated external defibrillator
 †CD: Cardiac disease
 ‡LD: Lifestyle diseases(diabetes, hypertension, arteriosclerosis)

Table 3. Multiple logistic regression analysis for Koreans

	B	S.E.	Wald	p	OR
Gender	-0.870	.237	13.495	.000	0.419
Age	0.015	.011	1.873	.171	1.016
Marital status	-0.258	.331	0.608	.435	0.772
Education level	-0.086	.214	0.163	.686	0.917
Household income	-0.009	.004	5.372	.020	0.991
History of cardiac disease	0.038	.340	0.013	.910	1.039
History of lifestyle disease	0.266	.250	1.129	.288	1.305
AED* knowledge	1.041	.093	126.599	.000	2.833
Constant	-2.058	.741	7.718	.005	0.128

*AED: Automated external defibrillator

disease (86.3%) and lifestyle diseases (78.8%) had higher positive responses <Table 2> than did Koreans.

3. Multiple logistic regression analysis on Korean subjects

The results of a logistic regression analysis on intention to use AEDs indicated that, in

Korea, gender($p < .001$, OR=0.419), household income($p = .020$, OR=0.991), and AED knowledge ($p < .001$, OR=2.833) were significantly related to intention to use AEDs. Age, marital status, education, cardiac disease history, and lifestyle disease history were not significantly related to intention use AEDs (Table 3).

4. Multiple logistic regression analysis on Japanese subjects

The results of a logistic regression analysis of intention to use AEDs indicated that, in Japan, gender($p = .028$, OR = 0.582), age($p =$

.001, OR = 0.968), cardiac disease history($p = .020$, OR = 2.099), and AED knowledge ($p < .001$, OR = 2.984) were significantly related to intention to use AEDs. Marital status, education, and lifestyle disease history were not significantly related to intention to use AEDs (Table 4).

5. Korean AED locations

Of the 517 Korean respondents, 205 had never seen AED. Most of those who had seen installed AEDs reported that these had been in hospitals, and thus would not be relevant for

Table 4. Multiple logistic regression analysis for Japanese

	B	S.E.	Wald	p	OR
Gender	-0.541	.247	4.798	.028	0.582
Age	-0.033	.010	11.591	.001	0.968
Marital status	0.313	.277	1.271	.260	1.367
Education level	-0.059	.221	0.071	.790	0.943
Household income	0.005	.003	1.958	.162	1.005
History of cardiac disease	0.741	.318	5.418	.020	2.099
History of lifestyle disease	0.476	.255	3.504	.061	1.610
AED* knowledge	1.093	.117	87.883	.000	2.984
Constant	-0.931	.824	1.276	.259	0.394

*AED: Automated external defibrillator

Table 5. Korean AED* locations

Where did you see that AED* is installed? Please check the following items (multiple responses)			
Locations	Numbers of answers	Locations	Numbers of answers
Hospital	199	Health Club	9
Train	35	Gymnasium	22
Ship	14	School	10
Aircraft	49	Educational institute	0
Apartment	28	Park	8
Row houses	2	Fire station	33
Subway & Rail stations	147	Police station	11
Airport	51	Public office	65
Harbor	2	Other	12
I have never seen an AED*	205		

*AED: Automated external defibrillator

OHCA (Table 5).

IV. Discussion

Whereas 74.4% of Japanese respondents intended to perform PAD using AEDs, only 42.6% of Korean respondents replied similarly (Table 2). This number is even lower than the 57% of Koreans who reported intention to implement CPR in a previous study [16]. Currently, the number of AEDs installed in public places remains small in South Korea. AED installation in public areas and apartments above a certain size has been mandatory since August 5, 2012 in Korea (as per Article 47 of the Emergency Medical Act). However, most Koreans do not yet know what an AED is. As shown in Table 5, about 40% of respondents have never seen an AED, and most respondents who have seen AED have seen them in hospitals. This suggests that observed AEDs are located in a way that PADs are unlikely to be performed in the event of OHCA. Furthermore, quantitatively, there are few AEDs in South Korea, and this is true of other countries such as the United States. For instance, about 1,300 AEDs are installed throughout Los Angeles, which has a population of 3.8 million [11]. In South Korea, which has a population of 50 million, only 5,826 AEDs have been installed in public places [2]. As the data from Japan can attest, the frequency of PADs increases with the number of AED installations. Therefore, to increase PAD activation, it is necessary to increase the number of AED

installed in non-hospital locations. Specifically, it would be desirable to expand installation of AEDs from current public facilities to various multiuse facilities [25]. A rental system method may be helpful if purchase and installation cost-AED price is several million won, becomes a burden [26].

Furthermore, we must act to eliminate the significant gender difference in PAD activation in both Korea and Japan. Logistic regression results show that fewer females report intending to use AEDs than do males. This may deepen the gender disparity in resuscitation as well. Ahn et al. [23] showed that women were less likely than were males to receive defibrillation by AEDs.

In Japan, younger people had higher rates of intention to use AEDs. This is likely related to the timing of the spread of AEDs in Japan. Layperson AED use was permitted in Japan on July 1, 2004 [15]. Education about AED use also began at that time in elementary, middle, and high schools. In addition, AED education was included in the first aid class required to receive a driver's license. Because students who were learning about AEDs then would currently be young adults, this has likely affected intention to use AEDs. The results of the logistic regression analysis showed that AED knowledge is a major factor in intention to use AEDs; thus, it is necessary to teach people, specifically Koreans, about AEDs, to increase the performance of PADs in situations of OHCA. Including AED education in the first aid class for driver's licenses in South Korea would be effective.

V. Conclusion

All of the stated hypotheses were confirmed: social factors influenced the intention to use AEDs; AED knowledge positively influenced the intention to use AEDs; and the factors that affected intention to use AEDs differed between Japan and Korea. In Korea, AED education should focus on improving AED use on women. In Japan, AED education should focus on improving AED use on women and older citizens.

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