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Clinical paper

Sex difference in the association between type of bystander CPR and clinical outcomes in patients with out of hospital cardiac arrest

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Abstract

Background: A recent study suggested that women with out-of-hospital cardiac arrest have a smaller survival benefit with bystander cardiopulmonary resuscitation than men. We evaluated whether this weaker association between bystander cardiopulmonary resuscitation and survival in women is related to dispatcher-assisted vs unassisted bystander cardiopulmonary resuscitation.

Methods: In a national registry in the Republic of Korea, we identified adult patients with out-of-hospital cardiac arrest during 2013–2018. The main exposure was type of bystander cardiopulmonary resuscitation (categorized as none, dispatcher-assisted, and unassisted). The primary outcome was favourable neurological survival. Multivariable logistic regression evaluated for an interaction between sex and type of bystander cardiopulmonary resuscitation.

Results: Of 93,245 patients with out-of-hospital cardiac arrest, there were 31,578 (33.9%) women and 61,667 (66.1%) men. Overall, both types of bystander cardiopulmonary resuscitation were associated with favourable neurological survival (unassisted: adjusted OR, 1.81 [95% CI: 1.66–1.98]; dispatcher-assisted: adjusted OR, 1.44 [95% CI: 1.33–1.56]). When unassisted cardiopulmonary resuscitation was administered, the association between bystander cardiopulmonary resuscitation and favourable neurological survival was similar between women and men: adjusted ORs of 1.59 (95% CI: 1.30–1.95) in women and 1.88 (95% CI: 1.71–2.08) in men; interaction p = 0.65). In contrast, when dispatcher-assisted cardiopulmonary resuscitation was administered, the association differed by sex: adjusted ORs of 1.08 (95% CI: 0.90–1.92) in women and 1.55 (95% CI: 1.42–1.69) in men; interaction p < 0.0002).

Conclusions: Dispatcher-assisted cardiopulmonary resuscitation was associated with favourable neurological survival in men but not in women whereas unassisted bystander cardiopulmonary resuscitation was associated with favourable neurological survival in women and men.

Keywords: Out-of-hospital cardiac arrest, Bystander cardiopulmonary resuscitation, Patient's sex

Introduction

Bystander cardiopulmonary resuscitation (CPR) is a central component in the Chain of Survival for out-of-hospital cardiac arrest (OHCA).[1] As a result, ongoing efforts to improve OHCA survival have focused on increasing the rate of bystander CPR.[2–5] Dispatcher-assisted (DA) CPR through trained dispatchers is one community intervention to improve rates of bystander CPR when laypersons activate an emergency response.[6] By providing live instructions, dispatchers can coach laypersons to initiate potentially life-saving CPR even if they have not been trained in Basic Life Support. A recent systematic review found that a DA-CPR program increased the odds of bystander CPR by threefold (pooled odds ratio (OR): 3.10 [95% CI: 2.25–4.25]) and survival to discharge with favorable neurological status (pooled OR: 1.70 (95% CI: 1.21–2.37).[7] However, a recent study reported that DA-CPR may be less compliant than unassisted bystander CPR, with a lower compression fraction (52% vs 69%, P < 0.05) and compression rate (87 vs 101 per minute, P < 0.05).[8]

Additionally, several studies have reported that, compared with men, women with OHCA are less likely to receive less bystander CPR in public places.[9–10] One potential opportunity to address any sex disparity in bystander CPR is through broad implementation of

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https://doi.org/10.1016/j.resplu.2022.100342
Received 25 September 2022; Received in revised form 6 December 2022; Accepted 9 December 2022

DA-CPR. Yet, a recent study suggested that, while DA-CPR was likely to attenuate any sex disparities in bystander CPR rates, the impact on survival outcomes is less clear as DA-CPR may not be as effective as unassisted CPR, which is typically initiated by individuals already trained in Basic Life Support.[11] To date, however, it remains unknown whether DA-CPR is performed more frequently in women as compared to men and whether DA-CPR is associated with similar survival benefit as compared with unassisted CPR and whether DA-CPR is associated with similar survival benefit between women and men.

Accordingly, we examined whether the association between bystander CPR (TA vs unassisted) and favorable neurologic survival differed based on patient' sex.

Methods

Study design and study population

This retrospective cohort study used data from the national OHCA registry of the Republic of Korea. The Republic of Korea has a public emergency medical services (EMS) system, including a dispatch system with a national DA-CPR instruction protocol.[12] The nationwide OHCA registry obtains data on patients with OHCA from dispatch centres, EMS agencies, and receiving hospitals using standardized Utstein definitions.[13] A quality management committee regularly reviews the records for completeness and accuracy. Details of the registry and data quality management processes have been previously described.[14] This study was approved by Myongji hospital's institutional review board, which waived the requirement for informed consent because the study involved de-identified data (IRB number 2021-11-019).

For this study, we identified adult patients 18 years of age or older with a cardiac aetiology for OHCA and who received resuscitation treatment from EMS personnel between January 1, 2013, and December 31, 2018 in the Republic of Korea. Patients with an EMS-witnessed OHCA were excluded, as we were interested in bystander CPR. Furthermore, OHCAs occurring in nursing homes or healthcare facilities were excluded. Finally, patients with missing data on sex, initiation type of bystander CPR, and clinical outcomes were excluded.

Independent variable and study outcomes

The primary exposure variable was bystander CPR status, which was classified into three categories: no bystander CPR, unassisted bystander CPR, and DA-CPR. DA-CPR was defined as CPR administered by a layperson with documentation of DA-CPR provided by the dispatch centre, whereas unassisted CPR was defined as bystander CPR without a record of DA-CPR provided by the dispatch centre. Bystanders included laypersons and family members who are not part of the official response to OHCA within the EMS system. Patient sex was examined both as a separate independent variable to assess whether there were sex disparities in survival outcomes for OHCA in the Republic of Korea as well as an effect modifier to determine whether the association between bystander CPR type and favourable neurological survival differed by patient sex.

The primary outcome was favourable neurological survival, which was defined as survival to discharge with a cerebral performance category (CPC) score of 1 or 2 (i.e., without severe neurological disability).[15] We also evaluated survival to hospital discharge, regardless of the neurological status, as the secondary outcome.

Statistical analysis

Baseline characteristics of patients with OHCA according to bystander CPR type are presented as medians with interquartile range (IQR) for continuous variables and counts (with percentage distributions) for categorical variables. Given the large sample size, a standardized difference of $\geq$0.10 was used to denote a significant and clinically meaningful difference.[16]

We first assessed the independent associations of bystander CPR status and patient sex with the primary outcome of favourable neurological survival by constructing a multivariable model using logistic regression. In addition to bystander CPR status and sex, these models also included patient age (categorised as <55, 55–64, 65–75, 75–84, >85-years-old), type of medical insurance (medical aid vs non-medical aid) as proxy measure of socioeconomic status,[17] urbanisation level (metropolitan vs urban vs rural area),[18] witnessed status of OHCA, location type of OHCA (public vs private vs other), calendar season (spring, summer, autumn, winter), day and time of arrest (weekday vs weekend arrest and office hour [8:00 am to 17:59 pm] vs non-office hour [18:00 pm to 7:59 am]), initial presenting OHCA rhythm (shockable vs non-shockable), and type of caller (family vs non-family). We also included in the model calendar year of cardiac arrest to control for any temporal trends. After assessing the independent associations of bystander CPR type and sex with survival, we then examined whether the association between bystander CPR status and outcomes differed according to patient sex by including an interaction term with bystander CPR type in the model. Similar analyses were performed for the secondary outcome of overall rates of survival to hospital discharge.

For each analysis, the null hypothesis was evaluated at a two-sided significance level of 0.05 and 95% confidence intervals (CIs) were calculated using robust standard errors. All statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA).

Results

A total of 117,856 EMS-treated adult OHCA cases of presumed cardiac aetiology were identified during the study period. We excluded 10,621 OHCAs witnessed by an EMS provider, 10,860 OHCAs in a nursing home or a healthcare facility. This yielded 89,541 patients who were eligible to have bystander CPR from a layperson. We then excluded 2510 cases with missing information on bystander CPR status. There were no missing data on patient sex or survival outcome. The final cohort comprised 86,941 patients (Fig. 1).

Overall, 58.1% of patients with OHCA received bystander CPR, with 41.1% receiving DA-CPR and 17.0% receiving unassisted bystander CPR. There were 29,612 (34.1%) women and 57,329 (65.9%) men. Table 1 compares patient characteristics according to patients' sex. Overall, there were differences in bystander CPR type by sex; 42.2% DA-CPR and 17.9% unassisted CPR in women and 34.2% DA-CPR and 15.2% unassisted CPR in men (standardized difference = 0.10). However, the overall rate of bystander CPR (DA and unassisted combined) were similar between women and men (59.4 vs 57.4%; standardized difference of 0.04). Women were older than men, more likely to have their OHCA at home, and more likely to have an initial non-shockable arrest rhythm. Women were less likely than men to survive to hospital discharge (4.7% vs 9.8%; standardized difference of 0.20) and have favourable neurological survival (2.6% vs 6.6%; standardized difference of 0.19).

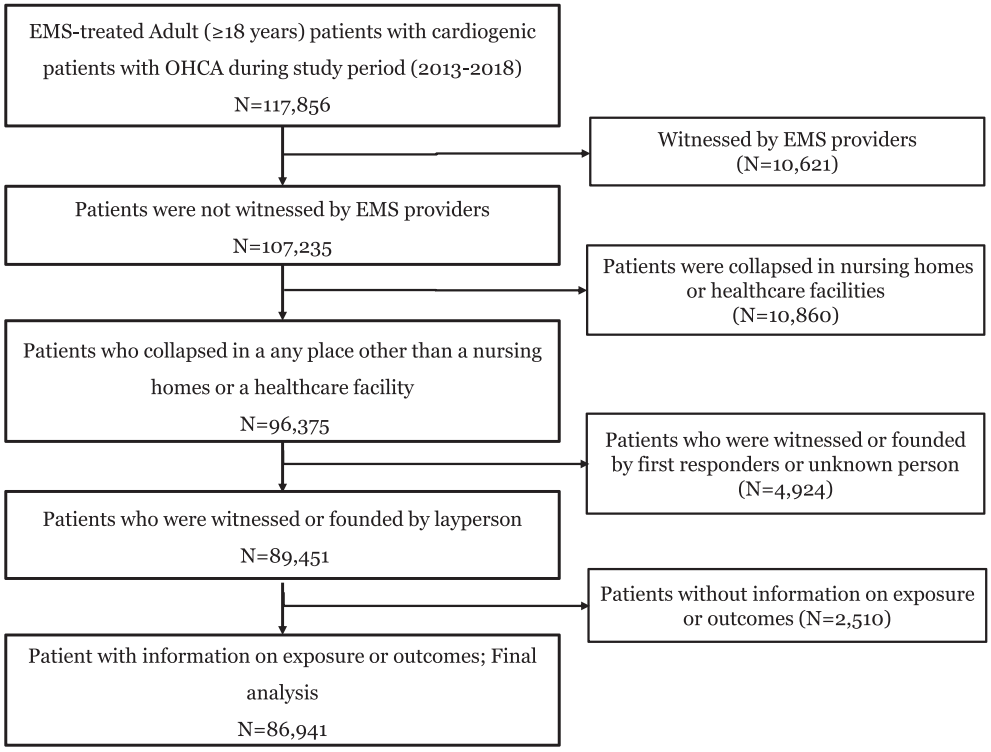

Fig. 1 – Definition of the Study Cohort.

Table 2 compares patient characteristics and OHCA outcomes by the type of bystander CPR provided. Bystander CPR (DA or unassisted) was more likely to occur for witnessed OHCAs, and unassisted bystander CPR was more likely to occur for OHCAs in public locations. Unadjusted rates of favourable neurological survival were highest in those with unassisted bystander CPR (9.5%), followed by DA-CPR (5.5%) and no bystander CPR (3.1%). A similar pattern was seen for unadjusted rates of survival to discharge (see Table 2).

After multivariable adjustment, both types of bystander CPR were associated with higher survival, as compared to patients with no bystander CPR. Patients with TA-CPR had 44% higher odds of favourable neurological survival (adjusted OR, 1.44 [95% CI: 1.33–1.56]) whereas those with unassisted CPR had 81% higher odds of favourable neurological survival (adjusted OR, 1.81 [95% CI, 1.66–1.98]) (Table 3). For survival to discharge, TA-CPR was associated with 14% higher odds of survival and unassisted bystander CPR was associated with 41% higher odds of survival. Additionally, female sex was associated with lower likelihood of favourable neurological survival (adjusted OR, 0.67 [95% CI, 0.61–0.72] and survival to discharge (adjusted OR, 0.75 [95% CI, 0.70–0.80]) (Table 3).

The association between type of bystander CPR and survival outcomes differed by whether the victim was a man or woman. For the primary outcome of favourable neurological survival, unassisted bystander CPR benefitted men and women equally (adjusted ORs of 1.58 [95% CI: 1.30–1.59] in women and 1.88 [95% CI: 1.71–2.08] in men [interaction p = 0.65]) whereas DA-CPR was associated with benefit only in men (adjusted ORs of 1.08 [95% CI: 0.90–1.29] in women and 1.55 [95% CI: 1.42–1.69] in men [interaction p-value < 0.0002]). Similarly, for the outcome of survival to discharge, unassisted bystander CPR benefitted both men and women (interaction p-value of 0.31) whereas DA-CPR benefitted only men (interaction p-value 0.0005; Table 4).

Discussion

We leveraged data from a national OHCA registry from the Republic of Korea to examine the association of bystander CPR and survival outcomes by patients' sex. There were several main findings. First, the majority of patients with OHCA received bystander CPR, with two-thirds of those treated receiving DA-CPR. Second, there were no major differences in bystander CPR treatment rates by sex. However, women were less likely to receive unassisted bystander CPR and more likely to receive DA-CPR. Additionally, women were less likely to survive an OHCA than men, even after adjusting for patient and cardiac arrest characteristics. Third, although both unassisted and dispatcher assisted bystander CPR were associated with a higher likelihood of favourable neurological survival, the benefit of DA-CPR was observed only in men whereas unassisted bystander CPR was associated with improved survival outcomes in both women and men. Collectively, these findings provide important insights into differing outcomes for OHCA by patients' sex in a non-Western nation.

One potential explanation of sex differences in OHCA survival in our study could have been due to sex differences in rates of bystander CPR. However, overall rates of bystander CPR (unassisted and DA-CPR) were similar between men and women, and our model evaluating for sex differences in survival outcomes adjusted for the provision of bystander CPR. Notably, when DA-CPR (which accounted for two-thirds of bystander CPR) was provided, there was no discernible survival benefit for women. Previous studies have

Table 1 – Characteristics of patients according to patient's sex.

	Total N = 86941		Patient's sex				Standardized difference
			Female N = 29612		Male N = 57329		
	n	(%)	n	(%)	n	(%)	
Bystander CPR							0.04
No	36,445	41.9	12,022	40.6	24,423	42.6	
Yes	50,496	58.1	17,590	59.4	32,906	57.4	
Type of bystander CPR							0.10
No	36,445	41.9	12,022	40.6	24,423	42.6	
Unassisted	14,752	17.0	4500	15.2	10,252	17.9	
Dispatcher-assisted	35,744	41.1	13,090	44.2	22,654	39.5	
Age group (year)							0.54
<55	17,312	19.9	4043	13.7	13,269	23.1	
56 ~ 65	15,196	17.5	3324	11.2	11,872	20.7	
66 ~ 75	18,833	21.7	5612	19.0	13,221	23.1	
76 ~ 85	24,972	28.7	10,278	34.7	14,694	25.6	
> 85	10,628	12.2	6355	21.5	4273	7.5	
Medical insurance type							0.11
Non-medical aid	80,135	92.2	26,679	90.1	53,456	93.2	
Medical aid	6806	7.8	2933	9.9	3873	6.8	
Urbanization level of location							0.02
Metropolitan	49,925	57.4	16,942	57.2	32,983	57.5	
Urban	25,591	29.4	8840	29.9	16,751	29.2	
Rural	11,425	13.1	3830	12.9	7595	13.2	
Location type							0.33
Public	17,157	19.7	3442	11.6	13,715	23.9	
Private	69,076	79.5	26,022	87.9	43,054	75.1	
Other	708	0.8	148	0.5	560	1.0	
Witnessed status							0.04
N0	47,522	54.7	16,587	56.0	30,935	54.0	
Yes	39,419	45.3	13,025	44.0	26,394	46.0	
Type of caller							0.25
Family	21,387	24.6	5291	17.9	16,096	28.1	
Non-family	64,745	74.5	24,068	81.3	40,677	71.0	
Unknown	809	0.9	253	0.9	556	1.0	
Year of OHCA							0.02
2013	10,820	12.4	3609	12.2	7211	12.6	
2014	13,732	15.8	4741	16.0	8991	15.7	
2015	15,152	17.4	5174	17.5	9978	17.4	
2016	15,432	17.7	5270	17.8	10,162	17.7	
2017	15,449	17.8	5165	17.4	10,284	17.9	
2018	16,356	18.8	5653	19.1	10,703	18.7	
Season							0.04
Spring	21,850	25.1	7472	25.2	14,378	25.1	
Summer	18,916	21.8	6209	21.0	12,707	22.2	
Fall	21,643	24.9	7321	24.7	14,322	25.0	
Winter	24,532	28.2	8610	29.1	15,922	27.8	
Day of week							0.003
Weekday	61,379	70.6	20,934	70.7	40,445	70.5	
Weekend	25,562	29.4	8678	29.3	16,884	29.5	
Time of OHCA							0.02
Non-office time	48,051	55.3	16,151	54.5	31,900	55.6	
Office time (8am ~ 5 pm)	38,890	44.7	13,461	45.5	25,429	44.4	
Initial ECG rhythm							0.26
Non-shockable	77,445	89.1	27,843	94.0	49,602	86.5	
Shockable	9496	10.9	1769	6.0	7727	13.5	
Survival to discharge							0.20
No	79,943	92.0	28,223	95.3	51,720	90.2	
Yes	6998	8.0	1389	4.7	5609	9.8	
Favorable neurological survival							0.19
No	82,360	94.7	28,843	97.4	53,517	93.4	
Yes	4581	5.3	769	2.6	3812	6.6	

CPR; cardiopulmonary resuscitation, OHCA; out of hospital cardiac arrest, ECG; electrocardiography.

Table 2 – Characteristics of patients according to type of bystander CPR initiated.

	Total N = 86941		Bystander CPR type						Standardized difference	
			No CPR N = 36445		Unassisted CPR N = 14752		DA-CPR N = 35744		No vs Unassisted	No vs DA-
	n	(%)	n	(%)	n	(%)	n	(%)		
Patient's sex									0.08	0.05
Female	29,612	34.1	12,022	33.0	4500	30.5	13,090	36.6		
Male	57,329	65.9	24,423	67.0	10,252	69.5	22,654	63.4		
Age group (year)									0.23	0.10
<55	17,312	19.9	6536	17.9	3569	24.2	7207	20.2		
56 ~ 65	15,196	17.5	5890	16.2	2965	20.1	6341	17.7		
66 ~ 75	18,833	21.7	8393	23.0	3249	22.0	7191	20.1		
76 ~ 85	24,972	28.7	11,125	30.5	3637	24.7	10,210	28.6		
> 85	10,628	12.2	4501	12.4	1332	9.0	4795	13.4		
Medical insurance type									0.12	0.08
Non-medical aid	80,135	92.2	33,080	90.8	13,856	93.9	33,199	92.9		
Medical aid	6806	7.8	3365	9.2	896	6.1	2545	7.1		
Urbanization level of location									0.11	0.02
Metropolitan	49,925	57.4	21,336	58.5	7829	53.1	20,760	58.1		
Urban	25,591	29.4	10,325	28.3	4832	32.8	10,434	29.2		
Rural	11,425	13.1	4784	13.1	2091	14.2	4550	12.7		
Location type									0.41	0.08
Public	17,157	19.7	6538	17.9	5181	35.1	5438	15.2		
Private	69,076	79.5	29,607	81.2	9362	63.5	30,107	84.2		
Other	708	0.8	300	0.8	209	1.4	199	0.6		
Witnessed status									0.42	0.18
N0	47,522	54.7	22,505	61.8	6080	41.2	18,937	53.0		
Yes	39,419	45.3	13,940	38.2	8672	58.8	16,807	47.0		
Type of caller									0.33	0.12
Family	21,387	24.6	8858	24.3	5573	37.8	6956	19.5		
Non-family	64,745	74.5	27,310	74.9	8841	59.9	28,594	80.0		
Unknown	809	0.9	277	0.8	338	2.3	194	0.5		
Year of OHCA									0.06	0.32
2013	10,820	12.4	5824	16.0	2348	15.9	2648	7.4		
2014	13,732	15.8	6361	17.5	2413	16.4	4958	13.9		
2015	15,152	17.4	6318	17.3	2757	18.7	6077	17.0		
2016	15,432	17.7	5957	16.3	2506	17.0	6969	19.5		
2017	15,449	17.8	5771	15.8	2443	16.6	7235	20.2		
2018	16,356	18.8	6214	17.1	2285	15.5	7857	22.0		
Season									0.03	0.02
Spring	21,850	25.1	9247	25.4	3678	24.9	8925	25.0		
Summer	18,916	21.8	7894	21.7	3398	23.0	7624	21.3		
Fall	21,643	24.9	8994	24.7	3585	24.3	9064	25.4		
Winter	24,532	28.2	10,310	28.3	4091	27.7	10,131	28.3		
Day of week									0.04	0.02
Weekday	61,379	70.6	26,007	71.4	10,263	69.6	25,109	70.2		
Weekend	25,562	29.4	10,438	28.6	4489	30.4	10,635	29.8		
Time of OHCA									0.07	0.05
Non-office hour	48,051	55.3	19,972	54.8	7546	51.2	20,533	57.4		
Office hour	38,890	44.7	16,473	45.2	7206	48.8	15,211	42.6		
Initial ECG rhythm									0.31	0.10
Non-shockable	64,975	74.7	28,725	78.8	9603	65.1	26,647	74.5		
Shockable	21,966	25.3	7720	21.2	5149	34.9	9097	25.5		
Survival to discharge									0.25	0.08
No	79,943	92.0	34,288	94.1	12,784	86.7	32,871	92.0		
Yes	6998	8.0	2157	5.9	1968	13.3	2873	8.0		
Favorable neurological survival									0.28	0.12
No	82,360	94.7	35,297	96.9	13,292	90.1	33,771	94.5		
Yes	4581	5.3	1148	3.1	1460	9.9	1973	5.5		

CPR; cardiopulmonary resuscitation, OHCA; out of hospital cardiac arrest, ECG; electrocardiography; DA, dispatcher-assisted.

suggested barriers to providing bystander CPR to female patients with OHCA, including uncertainty of cardiac arrest, concern about sexual harassment,[19] and potential physical harm.[20] It is possible these cultural and societal norms affected the quality of CPR in Korean women when DA-CPR was performed, as these individuals were likely less confident or knowledgeable about CPR than those who ini-

Table 3 – Multivariable model for survival outcomes.

	Favorable neurological survival			Survival to discharge		
	Adjusted OR	(95% CI)		Adjusted OR	(95% CI)	
Type of bystander CPR						
No	reference			reference		
Unassisted	1.44	1.33	1.56	1.41	1.32	1.52
Dispatcher-assisted	1.81	1.66	1.98	1.15	1.08	1.23
Patient's sex						
Male	reference			reference		
Female	0.67	0.61	0.72	0.75	0.70	0.80
Age group (years old)						
<55	3.20	2.92	3.51	2.47	2.301	2.65
55 ~ 64	2.13	1.93	2.34	1.75	1.62	1.90
65 ~ 74	reference			reference		
75 ~ 84	0.31	0.27	0.36	0.43	0.39	0.48
>85	0.13	0.09	0.18	0.21	0.18	0.25
Medical insurance type						
Non-medical aid	reference			reference		
Medical aid	0.50	0.42	0.58	0.68	0.60	0.76
Urbanization level of location						
Metropolitan	2.73	2.40	3.11	2.85	2.56	3.16
Urban	1.73	1.50	1.98	1.76	1.57	1.97
Rural	reference			reference		
Location type						
Private	reference			reference		
Public	2.38	2.15	2.62	2.13	1.96	2.30
Other	2.20	1.68	2.86	1.80	1.43	2.27
Witnessed status						
N0	reference			reference		
Yes	4.33	4.01	4.67	3.70	3.49	3.93
Type of caller						
Non-Family	reference			reference		
Family	0.81	0.73	0.89	0.77	0.71	0.84
Unknown	1.77	1.38	2.27	1.396	1.118	1.744
Year of OHCA						
2013	reference			reference		
2014	1.29	1.11	1.49	1.03	0.92	1.15
2015	1.84	1.60	2.11	1.45	1.30	1.62
2016	2.20	1.92	2.52	1.76	1.58	1.95
2017	2.78	2.43	3.18	2.16	1.95	2.40
2018	2.89	2.53	3.30	2.16	1.95	2.40
Season						
Spring	reference			reference		
Summer	1.10	1.00	1.20	1.10	1.02	1.19
Fall	1.02	0.93	1.11	1.03	0.96	1.11
Winter	0.86	0.79	0.94	0.92	0.85	0.99
Day of week						
Weekday	reference			reference		
Weekend	1.07	1.00	1.14	1.03	0.99	1.12
Time of OHCA						
Non-office hour	reference			reference		
Office hour	0.85	0.79	0.91	0.87	0.82	0.91

Adjusted for sex, age, type of bystander CPR, socioeconomic status, urbanization of location, location of arrest, witnessed status, type of caller, time of arrest (year, season, weekday, daytime).

tiated unassisted CPR, for which there was a survival benefit with bystander CPR regardless of patients' sex. Our study highlights that further research is needed to understand the reasons for a sex disparity in OHCA survival in the Republic of Korea and whether there are sex differences in the quality of CPR administered to women and men when patients receive DA-CPR. Several previous studies suggest that there are delays in initiation of chest compression and low CPR quality with DA-CPR.[21–22] However, it is not clear whether these issues with DA-CPR may be more prominent in women.

This study has several limitations. First, this study was an observational study and there is the possibility of unmeasured confounding. For instance, the extent of sex disparities in OHCA survival

Table 4 – Association between initiation type of bystander CPR and survival outcomes by patients' sex.

	No Bystander CPR		Unassisted Bystander CPR		Dispatcher-assisted Bystander CPR	
	n/N (%)	Adjusted OR (95% CI)	n/N (%)	Adjusted OR (95% CI)	n/N (%)	Adjusted OR (95% CI)
Favorable neurological survival						
Women	234/12022 2.0)	Reference	25/4500 (5.0)	1.59 (1.30–1.95)	310/13090 (2.4)	1.08 (0.90–1.92)
Men	914/24423 (3.7)	Reference	1235/10252 (12.1)	1.88 (1.71–2.08)	1663/22654 (7.3)	1.55 (1.42–1.69)
Interaction P-value	0.65			0.0002		
Survival to discharge						
Women	507/12022 (4.2)	Reference	331/45000(7.4)	1.16 (1.01–1.36)	551/13090 (4.2)	0.89 (0.78–1.02)
Men	650/24423 (6.8)	Reference	1637/10252 (16.0)	1.50 (1.38–1.62)	2322/22654 (10.3)	1.24(1.16–1.33)
Interaction P-value	0.31			0.0005		

Adjusted for sex, age, type of bystander CPR, socioeconomic status, urbanization of location, location of arrest, witnessed status, type of caller, time of arrest (year, season, weekday, daytime), sex*type of bystander CPR.

may be even greater if men in the Republic of Korea have higher rates of comorbidities than age-matched women. Second, information on the bystander's sex and their CPR training experience, as well as the quality of bystander CPR was not available. Future studies that collect this data can provide insights as to the sex differences in survival benefit with DA-CPR. Third, we did not analyse the time interval from call reception to the initiation of chest compression in unassisted and DA-CPR because of considerable missing data in this variable. If women had longer times to first CPR than men with either modality of bystander CPR, this could have attenuated the survival benefit of bystander CPR in women and potentially accounted for some of the sex disparities in OHCA survival in our study. Finally, our findings may not be generalizable to other regions. Additional studies on the association between bystander CPR and sex with survival outcomes in non-Western nations are needed to determine if our OHCA findings may be similar in other non-Western nations.

Conclusion

In the Republic of Korea, women are less likely than men to have favourable neurological survival after OHCA. Although bystander CPR rates were similar between men and women, DA-CPR was associated with favourable neurological survival in men but not in women. The reasons for sex disparities in OHCA survival and a bystander CPR by sex interaction for DA-CPR in Korea deserve further study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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