

2021 CAS Annual Meeting

Critical Care Medicine

(Abstract)

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Impact of Community-Based Resuscitation Interventions on Bystander Cardiopulmonary Resuscitation and Survival Rates After Out-of-Hospital Cardiac Arrest: A Systematic Review and Meta-Analysis

Kayla Simmons¹, Sarah McIsaac², Aidan Goertzen¹, Robert Ohle³

1 Department of Undergraduate Medicine, Northern Ontario School of Medicine, Sudbury, Ontario, Canada.

2 Department of Critical Care, Department of Anesthesia, Northern Ontario School of Medicine, Sudbury, Ontario, Canada.

3 Department of Emergency Medicine, Health Sciences North Research Institute, Northern Ontario School of Medicine, Sudbury, Ontario, Canada.

Introduction: Out-of-hospital cardiac arrest (OHCA) is a leading cause of morbidity and mortality worldwide (1, 2). Approximately 350,000 OHCAs occur in the United States and 40,000 in Canada per annum (1, 3). Studies consistently find that early bystander cardiopulmonary resuscitation (B-CPR) enhances survival following OHCA (2). In response, community-based interventions targeting B-CPR rates have been implemented internationally (4, 5). The effects of these interventions are yet to be evaluated and synthesized collectively. Therefore, the objective of this study is to describe the effect of community-based interventions targeting resuscitation training or awareness on temporal B-CPR rates as well as survival following OHCA.

Methods: Ethics approval was not applicable as the study did not involve human or animal research. Medline/PubMed and Embase were searched from inception to July 2020 using a librarian assisted search strategy. Grey literature was hand-searched. Two reviewers independently conducted title and abstract screening, then selected publications for full text review according to predetermined inclusion criteria. Two reviewers completed data extraction and evaluated risk of bias using the Newcastle-Ottawa Scale. Cochrane's Review Manager 5.4 was used to conduct random effects meta-analyses on the primary outcome, B-CPR rates, and secondary outcomes: survival to hospital discharge, 30-day survival, and survival with a favourable neurological outcome following OHCA.

Results: The search identified a total of 2,304 records of which 122 underwent full text review; 12 were included for data extraction and final analyses. Included studies reported a total of 1,081,040 OHCAs across 11 countries. Median age of those experiencing OHCA ranged from 64 to 78 years. The most common interventions included community-based CPR training (n = 9), community-based AED training (n = 9), and dispatcher-assisted CPR (n = 8). The average quality assessment score was 5.5/8 on the Newcastle-Ottawa Scale. All 12 studies reported higher B-CPR rates post-intervention, increasing 19.5% on average. On meta-analysis, there was a significant difference in post-intervention B-CPR rates (n = 280,330; OR 2.63; 95% CI 1.96 to 3.53; $I^2 = 99\%$; Figure 1.1). For secondary outcomes in the post-intervention period, survival following OHCA was significantly increased (n = 73,784; OR 1.68; 95% CI 1.19 to 2.36; $I^2 = 96\%$; Figure 1.2), while survival with favourable neurological outcome was not significantly altered (n = 61,760; OR 1.16; 95% CI 0.79 to 1.71; $I^2 = 96\%$; Figure 1.3).

Discussion: The findings of this systematic review and meta-analysis suggest that globally, community-based interventions targeting resuscitation training or awareness were associated with higher rates of B-CPR and survival following OHCA, while survival with a favourable neurological outcome was not significantly improved. As the provision of B-CPR is associated

with better outcomes following OHCA, additional research is required to elucidate these relationships and identify which community-based interventions are most effective.

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	Pre-Inter	vention	Post-Inter	vention		Odds Ratio		Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	Year	M-H, Random, 95% CI
1.1.1 Intervention Duration: 1 - 4.9 Ye	ears							
Ristagno et al., 2014; Italy	25	93	22	123	6.6%	1.69 (0.88, 3.23)	2014	+
Dahan et al., 2014; France	280	904	503	2186	9.5%	1.50 [1.26, 1.78]	2014	+
Mauri et al., 2010; Switzerland	61	342	38	349	8.1%	1.78 [1.15, 2.75]	2010	
Subtotal (95% CI)		1339		2658	24.2%	1.54 [1.32, 1.80]		◆
Total events	366		563					
Heterogeneity: Tau ² = 0.00; Chi ² = 0.5	i7, df = 2 (P	= 0.75); l²	= 0%					
Test for overall effect: Z = 5.47 (P < 0.	00001)							
1.1.2 Intervention Duration: 5 - 9.9 Ye	ears							
Blewer et al., 2020: Singapore	1456	2390	79	423	9.1%	6 79 (5 24, 8 79)	2020	
Ro et al., 2019: South Korea	11379	17506	5625	15936	9.8%	3.40 [3.25, 3.56]	2019	•
van Diepen et al., 2017; US	7003	16103	2825	6762	9.8%	1.07 [1.01, 1.14]	2017	
lwami et al., 2015; Japan	53767	113432	30690	88956	9.8%	1.71 [1.68, 1.74]	2015	•
Wissenberg et al., 2013; Denmark	849	1906	247	1262	9.5%	3.30 [2.80, 3.90]	2013	
Subtotal (95% CI)		151337		113339	48.0%	2.65 [1.73, 4.05]		•
Total events	74454		39466					
Heterogeneity: Tau ² = 0.23; Chi ² = 12	65.25, df = 4	4 (P < 0.00	1001); I ² = 1	00%				
Test for overall effect: Z = 4.49 (P < 0.	00001)							
1.1.3 Intervention Duration: 10 - 14.9	Years							
Lai et al., 2015; Singapore	678	3025	478	2428	9.6%	1.18 [1.03, 1.34]	2015	-
Franek et al., 2015; Czech Republic	373	457	52	395	8.5%	29.29 [20.12, 42.64]	2015	
Hollenberg et al., 2008; Sweden	1371	2741	809	2611	9.7%	2.23 [1.99, 2.49]	2010	+
Subtotal (95% CI)		6223		5434	27.8%	4.16 [1.43, 12.10]		
Total events	2422		1339					
Heterogeneity: Tau ² = 0.88; Chi ² = 262:58, df = 2 (P < 0.00001); l ² = 99%								
Test for overall effect: Z = 2.61 (P = 0.	009)							
Total (95% CI)		158899		121431	100.0%	2.63 [1.96, 3.53]		▲
Total events	77242		41368					
Heterogeneity: Tau ² = 0.23; Chi ² = 15	34.94, df = 1	10 (P < 0.0	10001); I ^z = 1	99%			t.	
Test for overall effect: Z = 6.43 (P < 0.	00001)						0.0	Eavours Post-Intervention Eavours Pre-Intervention
Test for subgroup differences: Chi ² = 8.29, df = 2 (P = 0.02), l ² = 75.9%								

	Post-Interv	ention	Pre-Interv	ervention Odds Ratio				Odds Ratio		
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year	M-H, Random, 95% Cl		
2.1.1 Change in Survival to Hospita	l Discharge									
Blewer et al., 2020; Singapore	129	2390	10	423	10.8%	2.36 [1.23, 4.52]	2020			
Ro et al., 2019; South Korea	1943	17506	1594	15936	17.5%	1.12 [1.05, 1.20]	2019	+		
van Diepen et al., 2017; US	1689	16103	924	6762	17.5%	0.74 [0.68, 0.81]	2017	+		
Lai et al., 2015; Singapore	97	3025	38	2428	14.5%	2.08 [1.43, 3.04]	2015	_		
Mauri et al., 2010; Switzerland Subtotal (95% CI)	21	342 39366	7	349 25898	8.2% 68.5%	3.20 [1.34, 7.62] 1.41 [0.99, 2.01]	2010	→		
Total events	3879		2573							
Heterogeneity: Tau ² = 0.12; Chi ² = 8	5.06. df = 4 (P	< 0.0000	1): I ² = 95%	,						
Test for overall effect: Z = 1.92 (P = 0).05)		.,,							
2.1.2 Change in 30-day Survival										
Wissenberg et al., 2013; Denmark	206	1906	44	1262	15.1%	3.35 [2.40, 4.68]	2013			
Hollenberg et al., 2008; Sweden	200	2741	125	2611	16.4%	1.57 [1.24, 1.97]	2010			
Subtotal (95% CI)		4647		3873	31.5%	2.27 [1.07, 4.81]				
Total events	406		169							
Heterogeneity: Tau ² = 0.27; Chi ² = 1 Test for overall effect: Z = 2.14 (P = 0	3.71, df = 1 (P).03)	= 0.0002	!); I² = 93%							
Total (95% CI)		44013		29771	100.0%	1.68 [1.19, 2.36]		◆		
Total events	4285		2742							
Heterogeneity: Tau ² = 0.17; Chi ² = 1	50.10, df = 6 (F	P < 0.000	101); I ² = 96	%			-			
Test for overall effect: Z = 2.98 (P = 0	0.003)						0.1	Eavours Post-Intervention Eavours Pre-Intervention		
Test for subgroup differences: Chi ² = 1.25, df = 1 (P = 0.26), l ² = 20.0%										

	Post-Interv	ention/	Pre-Interv	vention		Odds Ratio		Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	Year	M-H, Random, 95% CI
Ro et al., 2019; South Korea	1243	17506	861	15936	37.6%	1.34 [1.22, 1.46]	2019	
van Diepen et al., 2017; US	1426	16103	701	6762	37.5%	0.84 [0.76, 0.92]	2017	
Lai et al., 2015; Singapore	53	3025	28	2428	24.9%	1.53 [0.96, 2.42]	2015	
Total (95% CI)		36634		25126	100.0%	1.16 [0.79, 1.71]		
Total events	2722		1590					
Heterogeneity: Tau ² = 0.10; Cł	hi² = 50.88, d1	f= 2 (P < I						
Test for overall effect: Z = 0.76	(P = 0.45)							Favours Post-Intervention Favours Pre-Intervention

Figure 1. Forest plots illustrating the results of meta-analyses comparing the association between community-based interventions targeting resuscitation training or awareness and (1.1) rates of bystander cardiopulmonary resuscitation, (1.2) survival following OHCA (survival to hospital discharge and 30-day survival), and (1.3) survival with favourable neurological outcome