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The Impact of Dispatcher Assistance in the Rates and Efficacy of Bystander CPR: A Meta-analysis

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Abstract

Objective: To perform a meta-analysis of observational studies addressing whether Dispatcher Assisted Cardiopulmonary Resuscitation (DACPR), compared with independent Bystander Cardiopulmonary Resuscitation (BCPR), increases the rates of BCPR, and whether they alter survival outcomes in out-of-hospital cardiac arrests (OHCA).

Methods: Relevant published articles from PubMed and Cochrane databases were studied. The baseline information and outcome data (BCPR rates, survival to hospital discharge, 1-month survival) were extracted from the out-of-hospital cardiac arrest subgroup. Meta-analyses were performed by using STATA 11.0 software.

Results: Eight studies involving 29,989 patients were eligible. Overall meta-analysis showed that DACPR was associated with statistically improved rates of BCPR (Odds Ratio [OR], 4.136 [95% confidence interval, 3.741-4.531]), and survival to discharge/ 1-month survival (OR, 1.185 [95% confidence interval, 1.089-1.281]) when compared with no BCPR and Odds Ratio [OR], 1.124 [95% confidence interval, 0.9792-1.456] when compared to independent BCPR.

Conclusion: This study found that DACPR resulted in greater survival rate as compared to independent BCPR and no BCPR in OHCAs. Considering that DACPR also resulted in significantly higher rates of BCPR, DACPR should be a standard protocol for EMS systems worldwide.

Keywords: Cardiopulmonary resuscitation; Dispatcher assisted cardiopulmonary resuscitation; Bystander cardiopulmonary resuscitation; Out-of-hospital cardiac arrest, Telephone cardiopulmonary resuscitation

List of Abbreviations

CPR: Cardiopulmonary Resuscitation; DACPR: Dispatcher Assisted Cardiopulmonary Resuscitation; BCPR: Bystander Cardiopulmonary Resuscitation; OHCA: Out-of-hospital cardiac arrest

Introduction

Out-of-hospital cardiac arrest (OHCA) is an often-overlooked area of public health. The chain of survival for OHCAs starts from Cardiopulmonary Resuscitation (CPR) in the field. The role of bystanders in initiating this chain of survival cannot be stressed enough. Bystander cardiopulmonary resuscitation (BCPR), the CPR performed by non-medical personnel at the site of cardiac arrest (CA) in out-of-hospital setting, has been shown to improve survival after OHCA by shortening the time from collapse to initial chest compression [1,2]. Dispatcher-assisted CPR (DACPR) has been implemented as a strategy to increase the rate of BCPR as well as to improve the survival rate among the OHCA victims [3]. Low rates of BCPR and subsequent survival still persist, and the BCPR and survival rates have differences among various regions [4] and communities [5]. The concept of BCPR as well as the idea of DACPR still seeks recognition in Emergency Medical Service (EMS) systems worldwide.

Dispatcher assistance in CPR instructions for OHCAs in not a novel concept. The provision of CPR instructions by the Emergency Medical Services (EMS) dispatcher was first conceived in 1970s [6]. Dispatcher assisted CPR (DACPR) was found to be effective in getting previously untrained persons to initiate CPR [7,8] and also in increasing rates of bystander CPR [8-10] in early stages of its implementation. Dispatchers were able to identify cardiac arrest as well as the necessity to initiate CPR in 50-83% of the cases [11-13] and this has been shown to be directly related to positive mortality outcomes [14,15]. We sought to assess the impact of dispatcher assistance in the rates, as well as efficacy of bystander CPR so as to identify its value for emerging EMS systems contemplating the need of training dispatchers for assistance in CPR.

Survival rates for OHCAs have varied across regions. Regional registries like Pan-Asian Resuscitation Out-comes Registry (PAROS) [16] in Asia, and the Resuscitation Outcomes Consortium (ROC) [17] registry in North America have given us an in-depth perspective into the magnitude of difference in survival for OHCAs. North America and Europe have a well-established EMS system as well as greater awareness among in the general public in addition to knowledge among communities regarding cardiac arrest and cardio-pulmonary resuscitation (CPR). As a result, they have a higher incidence of treated OHCAs i.e., patient surviving till initiation of treatment as compared to Asia. A 2010 systematic review [18] found that the percentage of

Ventricular Fibrillation and survival to discharge rates in Asia were lower (11% and 2% respectively) than those in Europe (35% and 9% respectively), North America (28% and 6% respectively), or Australia (40% and 11% respectively) (P<0.001, P<0.001). A recent more inclusive study of OHCA outcomes in Asia, the PAROS [16] study, found that the overall survival to hospital discharge varied from 0.5% to 8.5% in the 7 Asian countries included in the study. This finding emphasizes the need for further development of EMS in Asia.

One of the main differences in the EMS systems in most of the Asian countries and the west is the greater incidence of bystander initiated CPR and the availability of dispatcher assistance for bystanders. This can be invaluable in cases like cardiac arrest where the prompt initiation of CPR might be the difference between life and death. The experts and researchers almost unanimously agree that bystander CPR (BCPR) drastically increases the chances of survival in out-of-hospital settings [19-21]. This is true even for lay-person initiated CPR, as even though the CPR might not be as effective as when delivered by a trained person, they were able to successfully carry out cardiac compressions in 92.1% in a recent study [22]. BCPR has been found to increase survival rates when compared to no- BCPR [23], although survival rates were not as high as when CPR was administered by trained healthcare professionals. Long term studies have found that increase in rates of BCPR, [24] and its effect in the survival outcome is undeniable.

Materials and Methods

This meta-analysis is based on published articles in related topic from January 1980 to February 2017.

Search parameters

The terms 'dispatcher', 'out of hospital', cardiac arrest', 'cardiopulmonary resuscitation', 'bystander', and 'CPR' were used to search the PubMed database. The Cochrane database of systematic reviews was searched using the terms "cardiopulmonary resuscitation" and "dispatcher". The search was limited to publications in English and in humans. Further search using the terms 'Asia', 'Africa', 'Australia', 'Middle East' was done to ensure coverage of all the regions. Names of some of the countries where dispatcher assistance for CPR is provided, i.e., 'United States', 'Canada', as well as the PAROS nations 'Singapore', 'South Korea', 'Malaysia', 'Thailand', 'Singapore', 'UAE', 'Taiwan' and 'Japan' were also specified in the search parameters to prevent omission of articles. 'China' was used as a keyword to identify native Chinese studies (Figure 1).

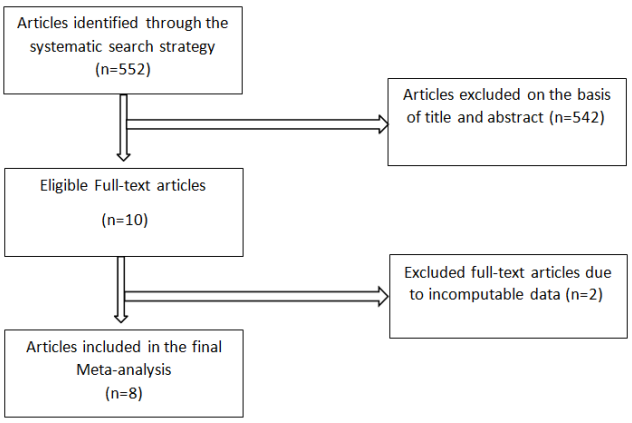

Figure 1: Selection process for articles included in the meta-analysis.

Article selection

Initially, abstracts of the collected articles were studied. A total of 552 articles reporting OHCA cases with pre-hospital intervention were further analysed. Articles with no information on the size of the study population or with inconsistencies were excluded from further consideration. Studies that were subgroup reports and reviews were excluded. 10 articles were identified as relevant to our research. Finally, articles with comparative study of DACPR and independent BCPR with parameters being of either rate or survival or both were selected for this study, resulting in inclusion of data from 8 original articles for the purpose of this analysis.

Study population

Studies of both paediatric and adult population were included. No differentiation was done regarding age, gender or ethnicity of the study population for selection of research papers.

Outcome measures

For evaluating the effect of dispatcher assistance on rates of CPR by bystanders, the primary outcome was initiation of CPR by the bystander in out-of-hospital setting.

For the effect of dispatcher assistance on survival of the patient, the primary outcomes of the study were:

- Survival till discharge from the hospital.
- 1 month survival, irrespective of the neurological outcome.

We originally intended to include survival till discharge from the hospital as the only primary outcome but the paucity of data and lack of uniformity of outcome parameters in published articles compelled us to add other survival outcomes as the primary outcome. Survival till hospital discharge has been taken as the survival indicator wherever available, while 1 month survival has been taken as the survival indicator in the rest.

Statistical analysis

All statistical analyses of this Meta were performed using STATA 11.0 software (Stata- Corp, College Station, TX, USA). Odds ratios (ORs) and 95% confidence intervals (95%CI) were calculated for each study by comparing dispatcher assisted and independent bystander group. Heterogeneity tests were measured using the Q-test and I2 statistics, the pooled ORs were calculated using the fixed-effect model when the P>0.10 or/and I2 value was less than 50%, otherwise a random-effect was used which indicated existence of heterogeneity. Subgroup analyses were also performed by ethnicity because potential heterogeneity between various studies existed. The sensitivity analysis was enforced by sequential omission of individual studies. Forest plots were performed to evaluate specific study results. Begg's rank regression and Egger's weighted regression were used to estimate potential publication bias. In the present analysis, P value less than 0.05 was considered to be statistically significant.

Results

We found 10 studies in total were done eligible for initial evaluation, three from North America (1 from Canada and 2 from The United States), one from Europe (Finland), and six from Asia (3 from South Korea, 2 from Japan and 1 from Singapore). There were no studies from Africa and South America as there is no provision of dispatcher assistance for CPR in any of the countries in these regions.

The characteristics of the relevant studies with their interventions, population, and outcome measures are presented in Table 1.

Rate of dispatcher instructions

Studies have shown a varied range of application of dispatcher instructions in different geographical settings. The instructions for CPR with both compressions and ventilations have been found to have been delivered in 25.7-75.9% of cases. [9,15,25,26] One of the earlier assessments of the potential causes for lack of BCPR was done by Culley et al. [8] They found that the most frequent causes for not delivering DACPR were that instructions were refused in 12% of the cases, that EMS personnel arrived before BCPR could be initiated in 11% of the cases and that the dispatcher did not offer instructions in 9% of the cases. Vaillancourt et al. [9] reported that 43.8% of cases of true cardiac arrests were successfully identified by dispatchers. Among those, CPR instructions were not initiated in 26 out of 108 cases (24.1%). They identified in progress CPR and difficulty for the dispatcher to determinate the situation as the most frequent cause for not providing instructions. Lewis et al. [33] performed a retrospective cohort study of out-of-hospital cardiac arrests occurring between January 1, 2011 and December 31, 2011 in which they sought to identify the factors that hampered the identification of cardiac arrest by 9-1-1 emergency dispatchers and delayed or prevented the provision of DACPR chest compressions. From their review of dispatch recordings for 476 OHCAs, they found that the dispatcher correctly identified CA in 80% of reviewed cases and 92% of cases in which they were able to assess patient consciousness and breathing. Similar high rates of recognition of CA and eventual DACPR have been reported by Kusima et al. [15] (Table 2).

Article	Country	Study Population	End Point
Mickey SE [25]	USA	Paediatric and Adult	Hospital Discharge
Thomas DR [26]	USA	Adult	Hospital Discharge
Markku K [15]	Finland	Patients with VF	Hospital Discharge
Christian V [9]	Canada	Adult	Hospital Discharge
Manabu A [27]	Japan	Paediatric	1 month survival
Kyoung JS [28]	South Korea	Adult	Hospital Discharge
Yoshikazu G [29]	Japan	Paediatric	1 month survival
Young SR [30]	South Korea	Paediatric	Hospital Discharge
Sumitro H [31]	Singapore	Paediatric and Adult	1 month survival
Young SR [32]	South Korea	Paediatric and Adult	Hospital Discharge
Note: VF: Ventricular Fibrillation			

Table 1: Characteristics of selected studies.

	Ethnicity	Number of studies	OR (95% CI)	P	Heterogeneity test		P_{Begg}	P_{egger}	Effect model
Survival					P	I2(%)			
Dispatcher assisted#	Caucasians	1	1.890(1.420-2.010)	<0.001	—	—	—	—	—
	Asians	4	1.125(1.023-1.227)	<0.001	0.003	78.8	1.000	0.772	Random
	Total	5	1.185(1.089-1.281)	<0.001	<0.001	85	0.734	0.478	Random
Independent bystander#	Caucasians	1	1.450(1.190-1.710)	<0.001	—	—	—	—	—
	Asians	4	1.139(1.017-1.260)	<0.001	0.029	66.8	1.000	—	Random
	Total	5	1.194(1.084-1.304)	<0.001	0.009	70.5	1.000	0.605	Random
Dispatcher assisted*	Caucasians	1	0.620(0.070-1.170)	0.027	—	—	—	—	—
	Asians	2	1.413(0.996-1.829)	<0.001	0.72	0	1.000	—	Fixed
	Total	3	1.124(0.9792-1.456)	<0.001	0.074	61.6	1.000	0.491	Random

CPR Rate									
Dispatcher assisted*	Caucasians	1	9.700(8.300-11.100)	<0.001	—	—	—	—	—
	Asians	3	3.655(3.244-4.067)	<0.001	<0.001	97.8	0.296	0.298	Random
	Total	4	4.136(3.741-4.531)	<0.001	<0.001	98.1	0.089	0.104	Random

#: No bystander is reference group; *: Independent bystander is reference group; OR: odds ratios, CI: confidence interval; CPR: Cardiopulmonary resuscitation; P_{Begg}: P value for Begg's test; P_{Egger}: P value for Egger's test

Table 2: The main results of the meta-analysis.

The papers by Mickey SE [25] and Markku K [15] were excluded from the final meta-analysis due to incomputable nature of the data.

Influence on BCPR rates

Four of the eligible 8 studies compared the rate of administration of CPR by bystanders in independent BCPR and DACPR groups. They were conducted in Canada, South Korea, Japan and Singapore. Eisenberg et al. [25] conducted the first study of its kind, and demonstrated increasing trend of BCPR rates after the implementation of the 9-1-1 telephone dispatch system in USA. They demonstrated an increase of BCPR from 86 out of 191 (45%) cardiac arrest cases before the implementation of the program to 143 out of 255 (56%) cardiac arrest cases after the program. Vaillancourt et al. [9] performed a before- after observational study enrolling out-of-hospital adult CA patients in Ottawa between July 1, 2003, and December 31, 2004. Their study included 529 CA patients, and the BCPR rate among the 295 CA cases included in the nine-month period where dispatcher instructions were not provided was 16.7%, while the BCPR rate among the 234 CA cases included in the nine-month intervention period where dispatcher assistance was provided was 26.4% (an absolute increase of 9.7%; 95% CI=8.5% - 11.3%; and p=0.006). This was a statistically significant finding. A population-based, observational study in Japan assessing the impact of telephone dispatcher assistance on the outcomes of paediatric out-of-hospital cardiac arrest [27] included 1,780 paediatric out-of-hospital cardiac arrest patients with witnessed collapse. They found a significant increase in both chest compression (adjusted OR 6.04; 95% CI 4.72-7.72) and mouth-to mouth ventilation (adjusted OR 3.10; 95% CI 2.44-3.95) and concluded that the provision of telephone dispatcher assistance significantly increases BCPR among witnessed paediatric out-of-hospital cardiac arrests. A large before-and-after intervention trial conducted in South Korea with 8,494 OHCAs of presumed cardiac etiology [28] done to determine the effects of DACPR on the outcomes of OHCA found that the BCPR rates increased from 190 out of 2,856 (6.7%) OHCAs in the control period (2010) to 334 out of 2689 (12.4%) in the intervention period (2011). Interestingly, they also found fluctuations in rates, (12–18%) for BCPR, in the latter 6 months, attributable to the recommendation and implementation of Compression Only CPR (COCPR) instructions in out of hospital settings. They hypothesized that DACPR using COCPR is associated with increased rate of BCPR, but emphasized that the protocol requires a continuous quality management process. Another study from a nationwide Utstein-style Japanese database (2008–2010) by Goto et al. [29] tried to assess the impact of DACPR on neurological outcomes in children with records of 5,009 children (age <18) with OHCAs. Although BCPR rate was not a primary outcome measure for this study, they nonetheless found that DACPR rates increased from 679 out of 2287 when dispatcher assistance was not offered (29.6%), to 2019 out of 2019 (100%) when dispatcher assistance was offered. This possibly highlights the fact that bystanders, most likely, are willing to initiate CPR if appropriate instructions and assistance is provided. The solitary study of its kind in Singapore, a before–after interventional trial of DACPR for OHCAs [31] collected data from a total of 2,968 cases before the intervention (April 2010 - December 2011), during the run-in period (January 2012 - June 2012) and after the intervention (July 2012 - February 2013). They found that BCPR rates increased almost 2-fold, from 22.4% before the provision of dispatcher assistance, to 42.1% in the intervention period (p<0.001) with odds ratio of 2.52 (95% CI of 2.09-3.04). They also concluded that while BCPR from a trained bystander had the best outcomes for OHCA, provision of DACPR could improve outcomes when an untrained bystander is present, or when there is reluctance to start CPR.

All of these observational studies found that there was significant difference in rate of BCPR between the DACPR group and the independent BCPR group. The overall meta- analysis showed that DACPR was associated with statistically increased rate of BCPR when compared with both independent BCPR and no BCPR group (Odds Ratio [OR], 4.136 [95% confidence interval, 3.741-4.531]).

Influence on survival

Eisenberg et al. [25], first conducted a prospective study over a 20-month period from May 6, 1981 to December 31, 1982 in King County, Washington, USA after initiating a program of telephone CPR instructions provided by emergency dispatchers so as to increase the percentage of BCPR for OHCAs. In the control period, there was one survivor among 17 cases (6%) while in the intervention period, i.e., after implementation of the DACPR provision, there were 12 survivors among 58 cases (21%). Their study demonstrated that the program to provide telephone CPR instructions can not only increase the percentage of bystander-initiated CPR for cardiac arrest, but also highlighted the fact that the program appeared to be safe and may have been responsible for saving lives. Rea et al. [26] population-based cohort of EMS-attended adult cardiac arrests in the same location spanned over a 17-year period with 7,265 cases of OHCAs. They used no BCPR as the reference group, and the multivariate adjusted odds ratio of survival was 1.45 (95% CI, 1.21, 1.73) for DACPR and 1.69 (95% CI, 1.42, 2.01) for independent BCPR without dispatcher assistance. There was a clear survival advantage in OHCAs after the implementation of DACPR provision. A retrospective cohort study conducted in Helsinki Emergency Medical Services [15] included 373 consecutive cases with out-of-hospital bystander witnessed VF of cardiac origin between 1 January 1997 and 31 December 2002. Telephone CPR instructions were given for a total of 123 cases (35.5%). Survival to discharge was their primary outcome, which was 43.1%

(53/123) when CPR instructions were given by the dispatcher and 31.7% (72/223) when they were not given (p=0.0453). Furthermore, survival to discharge was found to be 37.2% (110/296) if CA was identified by the dispatcher and 28.6% (22/77) if the dispatcher did not recognize the CA (p=0.1550). Another before-after observational study enrolling adult OHCA patients where resuscitation was attempted by bystanders was done in Ottawa, Canada [9], however, found a decreasing trend for survival rate, from 4.8% in the control period (no DACPR) to 3.0% in the intervention period (DACPR). Although, they rightly pointed out that their study was not powered to measure the effect of DACPR instructions on survival for OHCA victims.

Akahane et al. [27] did a paediatric centric population based, observational study in Japan with 1,780 paediatric OHCA patients over a four-year period from January 2005 to December 2008. Telephone dispatcher assistance was offered in 505 cases. Dispatcher assistance was not only associated with a significant increase in the rates of BCPR, but there was significant improvement in 1-month survival (OR 1.46; 95% CI 1.05–2.03) in the DACPR group. Although, there was a smaller effect on the improvement in favourable neurologic outcome (category 1: good cerebral performance or 2: moderate cerebral disability of the Cerebral Performance Category at 1 month) (OR 1.15; 95% CI 0.70–1.88). Song et al. [28] before and after intervention trial based in the capital city of South Korea was done from 2009 to 2011 to determine the effects of DACPR on outcomes of OHCA. They used multivariate logistic analysis to compare between intervention group (2011) and historical control group (2009 to 2010). The survival to discharge rates were found to be 7.1% in 2009, 7.1% in 2010, and 9.4% in 2011 (p=0.001). The adjusted ORs (95% CI) for survival to discharge were 1.12 (0.89 to 1.41) in 2010 and 1.33 (1.07 to 1.66) in 2011 compared to 2009. There was a gain in neurological outcomes in 2.1% in 2009, 2.0% in 2010, and 3.6% in 2011 (p<0.001). They concluded that the DACPR protocol was associated with a significant increase in survival and neurologic outcome after OHCA. A prospective nationwide population based cohort study based in Japan, by Goto et al. [29] in children with OHCA, found that the prevalence of dispatcher CPR instruction for children with OHCAs possibly influences and improves the overall 1-month survival rate. Compared to the no BCPR group, both independent BCPR (Adjusted OR 1.62; 95% CI 1.23 to 2.11) group and DACPR group (Adjusted OR 1.63; 95% CI 1.32 to 2.02) had higher survival rates. Ro et al. [30] performed a cross-sectional study using a nationwide, prospective registry of OHCAs in South Korea with all emergency medical services (EMS) treated paediatric OHCAs enrolled between 2012 and 2014. Out of a total of 1529 patients, 32.8% had bystander CPR with dispatcher assistance, 17.3% without dispatcher assistance, and 54.6% cases did not receive BCPR. Both the BCPR groups were more likely to have higher rate of survival to discharge (8.8% and 12.1%) compared to no BCPR (3.9%). The adjusted OR (95% CI) for survival to discharge were 1.77 (1.04 to 3.00) in BCPR with dispatcher assistance and 2.86 (1.61 to 5.08) in without dispatcher assistance group compared with the no BCPR group. They concluded that BCPR, regardless of provision of dispatcher assistance, was associated with increased survival outcomes after OHCA in the paediatric population. Harjanto et al. [31] study evaluating the effects of a comprehensive DACPR training program on BCPR rates and the outcomes of OHCA in Singapore was done during three 9 month periods, from April 2010 to February 2013. In this period, the overall survival rate was 3.9% (116 out of 2,968 OHCAs). They found a significant increase in Return of spontaneous circulation (ROSC) from 26.5% to 31.2% (p=0.02) with OR of 1.26 (95% CI: 1.04-1.53) after the intervention. There was a trend of significantly higher 30-day survival rate for BCPR as compared to DACPR (p value=0.044, OR=0.30 [95%CI: 0.04-2.18]) and without BCPR (p value=0.001, OR=2.07 [95%CI: 1.41-3.02]). They attributed this occurrence of low survival in DACPR cases to failure in locating the audio recording or incomplete or damaged audio files. They hypothesized that the reported DACPR rate is likely to be an underestimation of the true DACPR rate. The largest study on the effect of DACPR program on survival of OHCAs conducted by Ro et al. [32] in South Korea studied the effect of a nationwide DACPR program on OHCA outcomes by arrest location. BCPR with or without dispatcher assistance was more likely to result in higher survival as well as good neurologic recovery (4.8% and 5.2%, respectively) compared with no BCPR (2.1%). They found that while the provision of BCPR increased the odds of survival in OHCAs, there was no statistically significant difference in survival to hospital discharge between the groups with dispatcher assistance (adjusted OR 1.03 [95% CI 0.92 to 1.15]) and the group without it (OR 1.08 [95% CI 0.94to 1.23]).

The pooled meta-analysis found that there was significant difference in survival rate to hospital discharge or 1 month survival in the DACPR group. Overall, there was a statistically significant advantage for the DACPR group when compared to no BCPR group (OR, 1.185 [95% confidence interval, 1.089-1.281], P value<0.001) and similar advantage when compared to independent BCPR group (OR 1.124 [95% confidence interval, 0.9792-1.456], P value <0.001). The funnel plots were not suggestive of any publication bias and the sensitivity analyses using random-effect methods identified results similar to the funnel plot.

Discussion

BCPR is an important modifiable factor to affecting the outcomes in OHCAs. It reflects the involvement of community in the management of this emergency condition. While it is a universally accepted fact that BCPR increases survival, the 'call-first versus CPR-first' debate [34] was popular during the early developmental days of emergency dispatch system. American Heart Association [35] has clearly recommend CPR-first BLS only in paediatric cardiac arrests of presumed non-cardiac etiology, not characterized by sudden collapse. For all other cases of OHCA, AHA has clearly stated that a call first approach gives the arrest victim the greatest survival advantage. Kamikura et al. [36], in their study of 952,288 OHCAs, found that the overall survival rates in immediate Call and CPR, Call-First, and CPR-First groups were 11.5%, 12.4%, and 11.5%, respectively. There was no significant statistical difference (p=0.543) among the groups. They recommended an immediate (1- 2 minutes after collapse) CPR first BLS action, followed by an emergency call without a large (>4 min) delay. Takei et al. [37] went a step further and aimed to find and confirm the benefit of early emergency calls, even before the patient's collapse on survival after OHCAs. They observed that survival rate after OHCAs witnessed by bystanders and EMTs were higher when emergency calls were placed before patient's collapse and concluded that while calls before the patient's collapse efficiently increases the proportion of EMT-witnessed cases and improves survival after witnessed OHCAs, early calls prior to the collapse may possibly worsen the outcome if the patient's condition deteriorates to CA before arrival of the EMTs. A Danish observational study [38] evaluating OHCAs occurring in the capital region of Denmark from January 1, 2013 to December 12, 2013 aimed at evaluating whether time for initiation of BCPR prior to the emergency call versus during the emergency call following DACPR was associated with return of

spontaneous circulation and 30-day survival. They found that BCPR initiated prior to emergency call versus during the emergency call following DA CPR was not associated with ROSC or 30- day survival. The bottom-line remained that BCPR and DACPR had survival advantage, irrespective of when the call was placed.

The outcome measures

All of the 6 studies comparing the influence of dispatcher assistance on the rates of CPR had the same result, an increase in bystander CPR. The implementation of a DACPR instruction program positively effects the pre-hospital management of OHCAs. The first published study of this kind, the widely-touted King County research [25], showed a net increase of 11% (from 45% to 56%) in BCPR rates after the implementation of the telephone CPR program. Their study laid the groundwork for further studies and thus wider implementation of the provision of dispatcher assistance during OHCAs. However, while BCPR was found to increase chances of survival in OHCAs in all the studies, there was no unanimity regarding the effectiveness of the provision of DACPR in increasing survival as compared to DACPR. Seven of the 10 studies showed significant increase in survival to discharge or 1 month survival after the implementation of provision of DACPR, 1 study showed no significant difference in survival advantage for DACPR cases in favor of independent BCPR cases, and 2 studies found that the provision of DACPR negatively impacted survival when compared to independent BCPR.

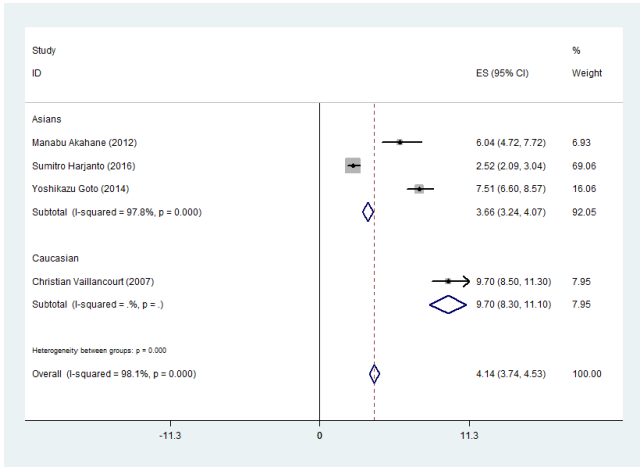

Figure 2: Forest plot of OR for BCPR rate comparing DACPR to independent BCPR. The squares and horizontal lines correspond to the study specific OR and 95% CI. The area of the squares reflects the study-specific weight (inverse of the variance).

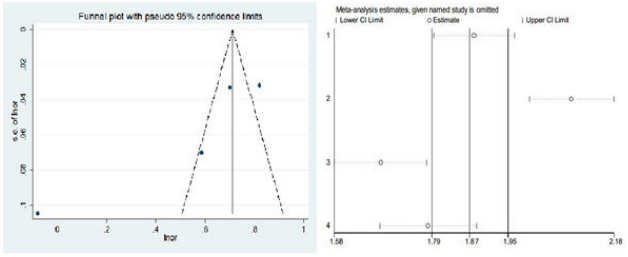

Figure 3: Funnel plot and sensitivity analysis plot comparing rate of BCPR in DACPR versus independent BCPR.

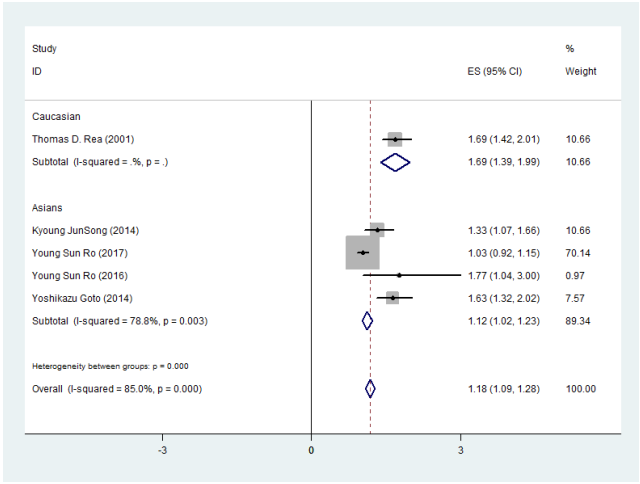

Figure 4: Forest plot of OR for survival comparing DACPR to no BCPR. The squares and horizontal lines correspond to the study specific OR and 95% CI. The area of the squares reflects the study-specific weight (inverse of the variance).

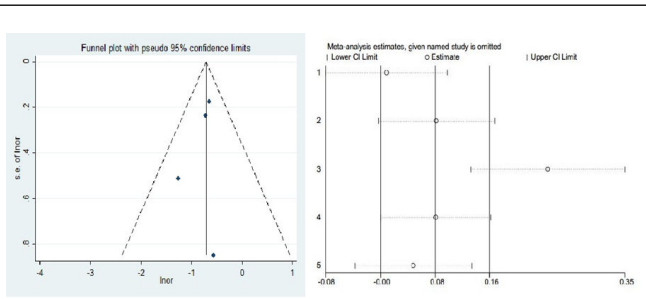

Figure 5: Funnel plot and sensitivity analysis plot comparing survival in DACPR versus no BCPR.

We made subgroups of the studies on the basis of ethnicity of the population, consisting of Asians and Caucasians. This grouping not only gives us the insight into the ethnic variations, but also rives a regional estimation of the effects of DACPR. We found that the rate of BCPR when comparing DACPR to independent BCPR was significantly higher in the DACPR group (Figure 2). This was true for both the Asian and Caucasian population. Overall OR of 4.14 (95% CI

3.74-4.53) is significant enough to enable us to conclude that the provision of dispatcher assistance does, in-fact, increases BCPR rates. Survival in OHCA had a similar increase with the provision of DACPR. When comparing DACPR to no BCPR (Figures 3 and 4), an overall survival advantage in the DACPR was seen [OR 1.18 (95% CI 1.09-1.28)]. As compared to no BCPR, even independent BCPR had survival advantage [OR 1.19 (95% CI 1.08-1.30)]. When comparing survival for DACPR group with independent BCPR group, the survival advantage was similarly significant. We found that the OR was 1.12 (95% CI 0.79- 1.46) (Figures 5 and 6). It is important to note that the provision of DACPR also had positive influence on the neurologic outcome of the survivors. In the Japanese study conducted by Akhane et al. [27] in the paediatric population, a small improvement in favourable neurologic outcome was observed when dispatcher assistance was provided to bystanders performing CPR. Song et al. [28] study also found a significant cerebral outcome advantage for survivors of DACPR as compared to the survivors of independent BCPR. This highlights the possibility that bystanders are able to perform CPR in a more effective and fruitful manner when dispatcher assistance is provided. The implementation of a telephone CPR instruction provision has several positive effects on the pre-hospital treatment of OHCAs. The quality of BCPR as well as the interval from collapse to CPR has been associated with survival in OHCA. The survival advantage for BCPR with dispatcher assistance compared with independent BCPR may be explained by multiple factors. First is the obvious increase in the provision of BCPR when dispatcher assistance is provided. As shown by our study, there is significant increase in the rates of BCPR when dispatcher instructions are provided. There is also the difference in the quality of CPR when dispatchers provide instruction on how to perform CPR, even for someone performing CPR for the first time. Whether the bystander calls first or performs the CPR first, outcomes are similar [38], so DACPR is theoretically as well as practically preferable to independent BCPR (Figures 7-9).

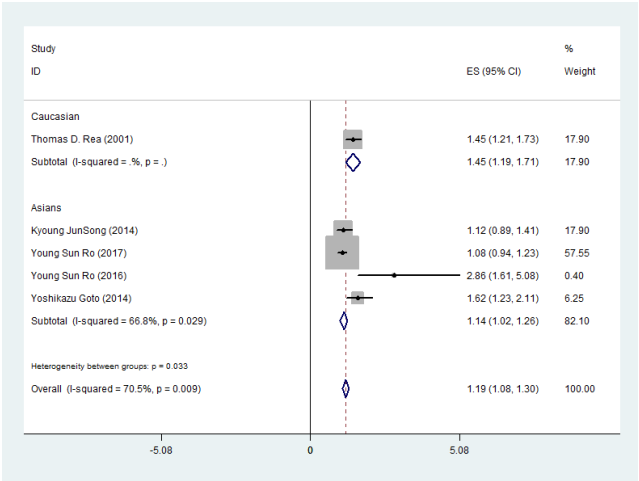

Figure 6: Forest plot of OR for survival comparing independent BCPR to no BCPR. The squares and horizontal lines correspond to the study specific OR and 95% CI. The area of the squares reflects the study-specific weight (inverse of the variance).

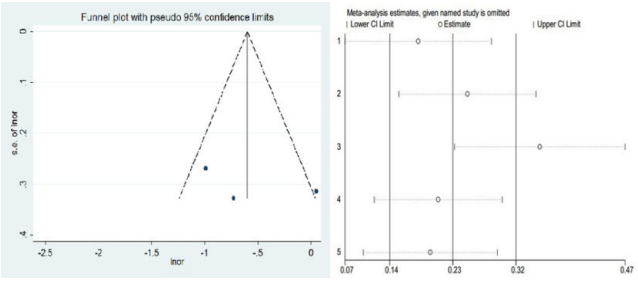

Figure 7: Funnel plot and sensitivity analysis plot comparing survival in independent BCPR versus no BCPR.

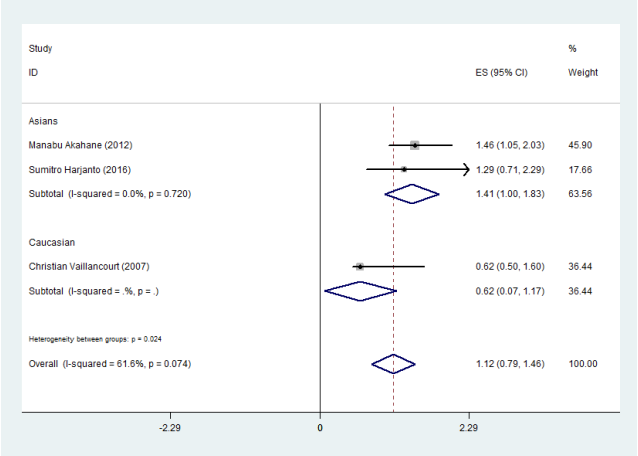

Figure 8: Forest plot of OR for survival comparing DACPR to independent BCPR. The squares and horizontal lines correspond to the study specific OR and 95% CI. The area of the squares reflects the study-specific weight (inverse of the variance).

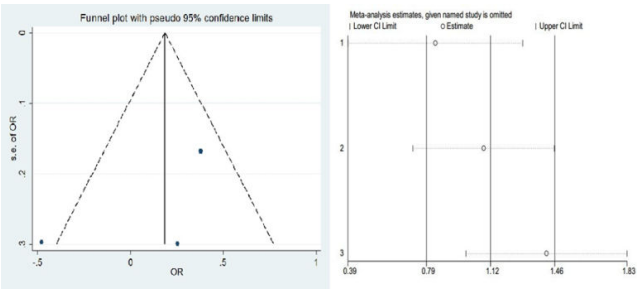

Figure 9: Funnel plot and sensitivity analysis plot comparing survival in DACPR versus independent BCPR.

Conclusion

We performed a comprehensive analysis of the effects of dispatcher assistance on the rates of bystander CPR, and the survival advantage when dispatcher assistance is provided. On the basis of our findings, we can conclude that:

- DACPR results in greater BCPR rate as compared to independent BCPR.
- DACPR results in greater BCPR rate as compared no BCPR.
- DACPR also increases the percentage of survivors of OHCAs when compared to both independent BCPR and no BCPR.

Our findings enable us to recommend that DACPR should be a standard protocol for EMS systems worldwide. Not only does it influence the rates of BCPR and survival, a trend of improving cerebral outcomes in the survivors has been seen. Also, considering the paucity of data in the subject, it has to be emphasized that further studies need to be conducted to come to a definite conclusion regarding the effectiveness of DACPR with respect to BCPR rates as well as survival benefits.

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