

UDC 61

THE RELATIONSHIP BETWEEN CHARACTERISTIC OF CARDIAC ETIOLOGY OUT-OF-HOSPITAL CARDIAC ARREST PATIENTS AND THE RETURN OF SPONTANEOUS CIRCULATION

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ABSTRACT

This study aimed to explore the relationship between characteristic of cardiac etiology out-of-hospital cardiac arrest patients and the return of spontaneous circulation. This was a retrospective, primary analysis of the Out Hospital Cardiac Arrest (OHCA) registry data between 2015 and 2017. We included OHCA cases which were presumed cardiac etiology, aged 18 years and above and resuscitation only attempted in the hospital. Gender, race, age, location, and prior medical history were assessed as independent variables. We used cross sectional analysis of the OHCA registry data collected from hospitals in the city. Primary outcome was the return of spontaneous circulation. The result was that there was no significant correlation regarding patient characteristic between cardiac etiology OHCA patients and ROSC. Yet, male patient is more likely to ROSC than women.

KEY WORDS

OHCA, patient characteristics, ROSC.

Sudden cardiac arrest is a common occurrence either in hospital or out of hospital. Globally, it is estimated that more than 135 million deaths per year is caused by cardiovascular events. There is various data regarding the incidence rate of cardiac arrest. In United States, the number is estimated to be 350.000 deaths per year, in Japan it is estimated to be 172 deaths per 100.000 people per year, in Thailand it 128 deaths per 100.000 people per year, and in Singapore it is 126 deaths per 100.000 people per year. (Berdowski *et al.* 2009). In Indonesia, according to the 2014 data from WHO, 37% of all deaths is caused by cardiovascular diseases.

Utstein is a register of public health problems that can be utilized as a data source for researches aimed to improve and educate the society for the betterment of health services which contains elements of five chains of survival. One of the researches using this Utstein-based register is Pan Asian Resuscitation Outcomes Study (PAROS). PAROS aims to identify problems causing poor survival rate of out-of-hospital cardiac arrest patients, as a comparison between countries or communities. Data is collected from registry documents established under Utstein's guidelines with some variations to suit Asian countries (Ong *et al.* 2012).

In the United States, there have been plenty of studies on the characteristics of cardiac arrest patients, including age, sex, socioeconomic background, race, and history of past diseases that affect the occurrence of cardiac arrests (Rea *et al.* 2004).

In Indonesia, there had been several researches conducted using PAROS database. From earlier studies, it can be concluded that in Indonesia, especially Malang, patients commonly received little to no help prior to arrival at the hospital. No patient was given basic life support in both private vehicles and ambulances, no effort to use AED for early defibrillation, and very minimal effort to call the ambulance in out-of-hospital cardiac arrest cases (14%) (Supriadi *et al.* 2015). Survival of cardiac arrest patients will then depend on the next line, which is the alertness and the readiness of the Emergency Department (ED) to commence resuscitation immediately on patient's arrival (Hadimuljono *et al.* 2015).

Another research on patient's resuscitation in the ED studied about the quality of CPR (Ferry *et al.* 2016), and the result was that 6-10 minutes (27,5%) is the longest time after cardiac arrest that is associated with the best result and has significant correlation with return of spontaneous circulation in the hospital (Delsi *et al.* 2016). From the earlier studies, there is still no solid data on the characteristics of patients that experience out of hospital cardiac arrest especially from cardiac causes – either age, residence, sex, race, or risk factors that can affect the occurrence of cardiac arrest – and their correlation with the patient's return of spontaneous circulation. This study is also aimed to begin a collection of epidemiologic data on out of hospital cardiac arrest cases as an effort to prevent its occurrence. It is also in conjunction with Safe Community Program in Indonesia. Safe Community Program is a movement aimed to ensure the health, safety, and welfare of the community wherever they are and involves active participation from various professional organizations and the community itself. (Departemen Kesehatan RI, 2016).

The purpose of this study is to identify basic epidemiologic data as a starting base for further studies on out of hospital cardiac arrests in Indonesia. Furthermore, by identifying the characteristics of people in high risk of cardiac arrest, the patients' profile and the factors that influence return of spontaneous circulation can also be identified and can be used to help prevent the occurrence of cardiac arrest in high-risk group, considering the limitation of prehospital service in cases of out of hospital cardiac arrest.

METHODS OF RESEARCH

This is an analytic observational study with cross sectional approach to examine the correlation between age, residence, sex, race, and previous disease history with return of spontaneous circulation in cases of cardiac arrest caused by cardiac diseases. The study was conducted in ED facilities of several hospitals in Malang area, which were Saiful Anwar Hospital ED and Panti Waluyo Hospital ED from July 2015 to December 2017.

The samples included all out of hospital cardiac arrest patients aged above 18 years old which were brought to all hospitals in Malang area that participated in the research, out of hospital cardiac arrest patients which were brought to the ED and returned to spontaneous circulation or died after in-hospital resuscitation, out of hospital cardiac arrest patients which were brought to the ED with history of typical cardiac chest pain accompanied with nausea vomiting and diaphoresis or whose 12-leads ECG result showed acute myocardial infarction once they returned to spontaneous circulation or whose 12-leads ECG in ambulances showed acute myocardial infarction in cases of patients brought in by ambulances, and out of hospital cardiac arrest patients which arrived at the ED in less than 15 minutes after cardiac arrest.

RESULTS AND DISCUSSION

There were 285 samples gathered from July 2015 to December 2017 and 165 samples were included in the study. Most of the patients that experienced out of hospital cardiac arrest were male (119 people; 72,1%), belonged in the age group of 56-65 years old (57 people; 34,5%), had more than one past diseases (77 people; 46,7%), had history of hypertension (90 people; 54,5%), were Malay race (137 people; 83%), and lived in Malang city (117 people; 71%).

From the gathered data on correlation between age and return of spontaneous circulation, since age is of numerical data scale, normality test Kolmogorov-Smirnov was done. The result of normality test is that the data was normally distributed ($p>0.05$), so parametric test was used (Independent T-test).

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Table 1 – General Characteristics

No.	Characteristic	Number of patients	Percentage (%)	Means (± SD)
1.	Age			
	• 18 – 25	0	0	59 ± 10 years
	• 26 – 35	3	1.8	
	• 36 – 45	18	11	
	• 46 – 55	37	22.4	
	• 56 – 65	57	34.5	
	• >66	50	30.3	
2.	Sex			
	• Male	119	72,1	
	• Female	46	27,9	
3.	Residence			
	• Malang City	117	71	
	• Malang Regency	48	29	
4.	Race			
	• Malay	137	83	
	• Chinese	23	14	
	• Arab	5	3	
5.	Past Disease History			
	• Heart Disease	71	43	
	• Hypertension	90	54.5	
	• Diabetes	55	33.3	
	• Lung Disease	3	2	
	• Cancer	0	0	
	• Kidney Disease	15	9	
	• Stroke	10	6	
	• No Past Disease	21	12.7	
6.	Number of Past Diseases			
	• No past disease	21	12.8	
	• 1 past disease	67	40.6	
	• >1 past diseases	77	46.7	

Table 2 – Correlation of Patients' Characteristics with Return of Spontaneous Circulation

Variables	ROSC		No ROSC		Total		P	Ratio	
	n	%	N	%	n	%			
Age	38	22,1	127	76,9	165	100	.666		
Sex	Male	32	26,8	87	72,2	119	100	.058	1:2,7
	Female	6	13	40	87	46	100		1:6,67
Residence	Malang City	26	22,2	91	81,8	117	100	.689	1:3,5
	Malang Regency	12	25	36	75	48	100		1:3
Race	Malay – Chinese	38	23,7	122	76,3	160	100	.192	
	Malay - Arab	35	35	107	75,3	142	100	.333	
Past Disease History	Heart Disease	14	19,7	57	80,3	71	100	.684	1:4
	Hypertension	25	27,7	65	72,3	90	100	.712	1:2,6
	Diabetes	14	26	40	74	54	100	.850	1:2,8
	Kidney Disease	4	26,7	11	73,3	15	100	1.000	1:2,75
	Stroke	2	20	8	80	10	100	1.000	1:4
Number of Past Diseases	Lung Disease	0	0	4	100	4	100	.549	1:4
	1 Past Disease	13		55		68	100	0,349	1:3,4
	>1 Past Diseases	20		56		76	100	0,816	1:2,8
	No Past Disease	5		16		21	100	0.640	1:4,3

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parametric test was used (Independent T-test). The result of parametric test is that the data had homogenous variation (Levene's Test) ($p > 0.05$), so in order to find the significance, we examine assumed equal variances, which yielded not significant result ($p = 0.666$).

There is no significant correlation between the patients whose residence is in Malang City and the patients whose residence is in Malang Regency with return of spontaneous circulation since the occurrence of cardiac arrest until arrival in the ED in less than 15 minutes ($p = 0.689$). From the table, it was also found out that there is no big difference in the ratio of return of spontaneous circulation after out-of-hospital cardiac arrest between patients who live in Malang City (1:3,5) and Malang Regency (1:3). There is also no significant correlation between sexes and return of spontaneous circulation ($p = 0.058$). This study also shows that males are more likely to experience out of hospital cardiac arrest compared to females (119 to 46) and males are also more likely to return to spontaneous circulation (32 to 6). The ratio of male patients who experienced out of hospital cardiac arrest and return to spontaneous circulation is also higher than females, which is 1:2.7.

From the statistical test, there is no significant correlation between Malay-Chinese race and return of spontaneous circulation ($p = 0.192$). There is also no significant correlation between Malay-Arab race and return of spontaneous circulation using Fisher exact test ($p = 0.333$).

There is also no statistically significant correlation between any of past diseases the patients have with return of spontaneous circulation from cardiac arrest caused by cardiac disease ($p > 0.005$). The ratio of patients that return to spontaneous circulation between the ones with past diseases and the ones without also do not differ significantly. The ratio is 1:4 for patients with cardiac disease, 1:2,6 for patients with hypertension, 1:2,8 for patients with diabetes, 1:2,75 for patients with kidney disease, 1:4 for patients with stroke, 1:4 for patients with lung disease, and 1:3,2 for patients with no history of past diseases.

Statistical analysis of return of spontaneous circulation in cardiac arrest patients between patients without past diseases and patients with one or more past diseases do not show significant difference with $p > 0.05$. The ratio of patients that return to spontaneous circulation also does not show much difference between patients with no past disease (1:3,2), patients with one past disease (1:4,3), and patients with more than one past diseases (1:2,8).

DISCUSSION OF RESULTS

Age does not show any correlation with return of spontaneous circulation in patients with out of hospital cardiac arrest. According to earlier studies, there is a theory that age plays a role in return of spontaneous circulation in patients with out of hospital cardiac arrest (Goto *et al*, 2012). There is also a theory stating that the younger the patients, the higher the possibility of return of spontaneous circulation, but in this study, the average age of patients who didn't return to spontaneous circulation is younger than the patients who did (Goto *et al*, 2012). In a study by Su *et al* (2009), the average age of patients who return to spontaneous circulation is > 65 years old, but the result is not statistically significant because only 40% of the samples returned to spontaneous circulation (40 out of 97 samples). Just like in our study, age is not statistically significant possibly because of the distribution of the samples between patients who return and do not return to spontaneous circulation, the number of patients who do not return to spontaneous circulation is much more than the patients who do (23%).

According to Zheng *et al*. (2001), the majority of patients who have cardiac arrest are men compared with women, and patients who survive are more women than men because the heart structure of women is more normal than men. But there are exceptions in the elderly, it turns out the possibility of patients for cardiac arrest and survival rate, women than men have the same possibility.

From the results of this study also found that the ratio for ROSC in cardiac cardiac arrest patients outside the hospital there is a large difference between men and women (1: 2,7 compared to 1: 6,7). This is described in a study conducted by Rea *et al* (2010) that men

are more likely ROSCnya due to the influence of places where the occurrence of cardiac arrest more witnessed by people around (public places) compared with women. Another influential factor was the hormonal effect in the study that the ROSC rate in women was higher than in men in the age group of 15-45 years, but decreased after the age of 45 years. In the study of fewer women the ROSC was due to the majority of patients who had cardiac arrest outside of the disease aged > 45 years

In a study by Reiner *et al* (2011), place of residence can determine the patient's social status and access to health services. In this study, the patient's place of residence is represented by Malang city and Malang Regency, who come to the ED in less than 15 minutes since witnessed cardiac arrest. But from the acquired result, there is no significant difference between patients that live in Malang City compared to Malang Regency.

This is possibly because even though patients in the city have easier access to nearby hospital or other health facilities, the families usually do not immediately take them to the nearest facilities or call the ambulance (Supriadi *et al*, 2015), and thus the patients do not get early first aid like calling for help or immediate CPR and AED. This causes failure to initiate chain of survival optimally as recommended by American Heart Association, which leads to no significant difference between patients who live in Malang City and Malang Regency. This is in accordance with a study conducted by Bottiger *et al* (1999) which states that patients who live in city area have higher possibility of ROSC and also higher survival rate if early CPR is done in the ambulance followed by advanced life support in the ED. Another related study by Kuo *et al* (2014) finds ROSC rate only 1,4% in cardiac arrest patients outside of Taiwan City, caused by low number of witnessed rate and bystander CPR, and lengthy response time since the event of cardiac arrest.

From our study, we also find that there is no significant correlation between race and return of spontaneous circulation in out of hospital cardiac arrest patients. The most dominant race in our study was Malay (83%), followed by Chinese (14%) and Arab (5%). This is in accordance with the geographical location of Malang in which the majority of its citizens is Javanese. According to Fender, Henrikson & Tereshchenko (2014) race has a role in return of spontaneous circulation due to genetics related to the genes present in each race. In a study by McNally *et al* (2011), Asian (11,4%) is found to be the second most often race to have out of hospital cardiac arrest, after Indian-American (11,9%). Other than that, according to Wilde *et al* (2011) race affects ROSC and survival rate in which black people has lower survival rate from out of hospital cardiac arrest compared to white people, possibly because of racism issue that is still prevalent in United States. Because of that, black people suffer longer time to bystander CPR and Emergency Medical Service (EMS) call. However, this never happens in Malang, because the majority of patients comes to the ED not by ambulance, but by private vehicle or public transportation (Supriadi *et al*, 2015), so they do not get early CPR. In Malang, this result is caused more by the unbalanced proportion of the races, and inability to evaluate the correlation in Arab race because the number is so low and none of them returns to spontaneous circulation (5 people).

From this research we also find no significant correlation between history of past diseases with return of spontaneous circulation from out of hospital cardiac arrest. According to Gorges *et al* (2003), people with previous history of cardiac disease have higher possibility of sudden cardiac arrest with higher difficulties to have ROSC, because of the existing anatomical and physiological heart dysfunction showed by decrease in Left Ventricular Ejection Fraction (LVEF) < 50%.

Hypertension also has no significant correlation with ROSC in cardiac arrest. This is possibly because in patients with chronic hypertension, the structures and functions of the heart and vessels have decreased compared to its normal state, so it is difficult to achieve ROSC (Hayashi *et al*, 2015). More than half of them (54%) experienced cardiac arrest, in accordance with a study by Bener *et al* (2006) that more than 40% of the out of hospital cardiac arrest patients have hypertension as one of their risk factors. Another study by Oh *et al* (2017) states that patients with history of hypertension is more unlikely to achieve ROSC and that there is no significant correlation with ROSC in out of hospital cardiac arrest patients.

Another disease is diabetes mellitus, but it also has no significant correlation with return of spontaneous circulation in out of hospital cardiac arrest patients. This is in accordance with a study by Jouven *et al* (2005) that diabetes only increases the risk of out of hospital cardiac arrest but doesn't have any significant correlation with ROSC in patients who experience out of hospital cardiac arrest. Similarly, a study by Parry *et al* (2017) states that patients with history of diabetes have lower ROSC and survival rate compared to the normal population.

Patients with history of kidney disease also doesn't have significant correlation with ROSC in out of hospital cardiac arrest patients. This is probably because patients with kidney disease already have chronic condition, in which the vessels of the heart and body are atherosclerotic, and the left ventricle is enlarged, so that the patients who fall into cardiac arrest are unlikely to return to spontaneous circulation (Go *et al*, 2004). Stroke also doesn't have significant correlation with ROSC in out of hospital cardiac arrest patients, because stroke as a cerebrovascular disease is unlikely to be a single disease entity and is often accompanied by other diseases like hypertension and diabetes mellitus. 60% of them also have history of coronary artery disease, so that out of hospital cardiac arrest patients with history of stroke are unlikely to return to spontaneous circulation (Bener *et al*, 2006).

History of lung disease does not have any significant correlation with ROSC in out of hospital cardiac arrest patients. In a study by Song *et al* (2017), patients with chronic obstructive pulmonary disease have extremely decreased pulmonary function compared to normal people and patients with this history have lower survival rate when they experienced cardiac arrest. In this study, there is no patient with lung disease who returns to spontaneous circulation probably because the patients have diseases other the lung disease and with age > 55 years old, the lung disease is possibly already chronic.

The number of past disease also doesn't show any correlation with ROSC in out of hospital cardiac arrest patients. According to a study by Rehmani *et al* (2007) number of disease influence the likeliness of ROSC in out of hospital cardiac arrest patients. Patients with one past disease have higher possibility to gain ROSC than patients with two or more diseases.

CONCLUSION

From the data analysis and discussion on correlations between variables in this study, we found that from 165 samples, only 38 patients achieve ROSC (23%) while 127 patients (77%) do not. We also found that there is no patient's characteristic that correlate with the likeliness of of ROSC in patients with out of hospital cardiac arrest, but the ratio of males who achieve ROSC is higher than females.

REFERENCES

1. Andersen, LW, Bivens, MJ, Giberson, T, Giberson, B, Mottley, JL, Gautam, S, Saliccioli, JD, Cocchi, MN, McNally, B & Donnino, MW 2015, 'The relationship between age and outcome in out-of-hospital cardiac arrest patients', *Resuscitation*, vol. 94, pp. 49-54.
2. Bener, AI, Kamran, S, B. Elouzi, E & Hamad, A 2006, 'Association between stroke and acute myocardial infarction and its related risk factors: hypertension and diabetes', *Anatol J Cardiol*, vol. 6, no. 1, pp. 24-7.
3. Berdowski, J, Beekhuis, F, Zwinderman, AH, Tijssen, JGP & Koster, RW 2009, 'Importance of the first link description and recognition of an out-of-hospital cardiac arrest in an emergency call', *Circulation*, vol. 119, no. 15, pp. 2096-102.
4. Berg, RA, Hemphill, R, Abella, BS, Aufderheide, TP, Cave, DM, Hazinski, MF, Lerner, EB, Rea, TD, Sayre, MR & Swor, RA 2010, 'Part 5: Adult basic life support 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care', *Circulation*, vol. 122, no. 18 suppl 3, pp. S685-S705.

5. Bobrow, BJ, Zuercher, M, Ewy, GA, Clark, L, Chikani, V, Donahue, D, Sanders, AB, Hilwig, RW, Berg, RA & Kern, KB 2008, 'Gasping during cardiac arrest in humans is frequent and associated with improved survival', *Circulation*, vol. 118, no. 24, pp. 2550-4.
6. Bottiger, BW, Grabner, C, Bauer, H, Bode, C, Weber, T, Motsch, J & Martin, E 1999, 'Long term outcome after out-of-hospital cardiac arrest with physician staffed emergency medical services: the Utstein style applied to a midsized urban/suburban area', *Heart*, vol. 82, no. 6, pp. 674-9.
7. Cebula, GM, Osadnik, S, Wysocki, M, Dyrda, M, Chmura, K, Nowakowski, M & Andres, J 2016, 'Comparison of the early effects of out-of-hospital resuscitation in selected urban and rural areas in Poland. A preliminary report from the Polish Cardiac Arrest Registry by the Polish Resuscitation Council', *Kardiologia Polska (Polish Heart Journal)*, vol. 74, no. 4, pp. 356-61.
8. Delsi, E, Dradjat, RS, Haedar, A & Setijowati, N 2016, 'Faktor yang Mempengaruhi Lama Bertahannya Pasien Henti Jantung di Luar Rumah Sakit Setelah Kembalinya Sirkulasi Spontan di IGD Kota Malang'.
9. Fender, EA, Henrikson, CA & Tereshchenko, L 2014, 'Racial differences in sudden cardiac death', *Journal of electrocardiology*, vol. 47, no. 6, pp. 815-8.
10. Ferry, J, Dradjat, RS, Haedar, A & Setijowati, N 2016, 'Pencapaian RJP Kualitas Tinggi dan Hubungannya Dengan Kembali ke Sirkulasi Spontan pada Henti Jantung Luar Rumah Sakit'.
11. Friis-Møller, N, Weber, R, Reiss, P, Thiébaud, R, Kirk, O, Monforte, AdA, Pradier, C, Morfeldt, L, Mateu, S & Law, M 2003, 'Cardiovascular disease risk factors in HIV patients—association with antiretroviral therapy. Results from the DAD study', *Aids*, vol. 17, no. 8, pp. 1179-93.
12. Go, AS, Chertow, GM, Fan, D, McCulloch, CE & Hsu, C-y 2004, 'Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization', *New England Journal of Medicine*, vol. 351, no. 13, pp. 1296-305.
13. Gorgels, APM, Gijssbers, C, de Vreede-Swagemakers, J, Lousberg, A & Wellens, HJJ 2003, 'Out-of-hospital cardiac arrest—the relevance of heart failure. The Maastricht Circulatory Arrest Registry', *European heart journal*, vol. 24, no. 13, pp. 1204-9.
14. Goto, Y, Maeda, T & Goto, Y 2014, 'Impact of dispatcher-assisted bystander cardiopulmonary resuscitation on neurological outcomes in children with out-of-hospital cardiac arrests: a prospective, nationwide, population-based cohort study', *Journal of the American Heart Association*, vol. 3, no. 3, p. e000499.
15. Hadimuljono, E, Haedar, A, Dradjat, RS & Setijowati, N 2015, 'Hubungan Antara Penanganan Jalan Napas dengan Kembalinya Sirkulasi Spontan pada Penderita Henti Jantung'.
16. Haedar, A, Dradjat, RS & Setijowati, N 2011, 'Out-Hospital Cardiac Arrest (OHCA) Study Registry'.
17. Hasyim, et al. 2009. Penanganan bencana berbasis masyarakat, dlunduh dari :<http://mpbi.org/content/prbbk/2009>.
18. Hayashi, M, Shimizu, W & Albert, CM 2015, 'The spectrum of epidemiology underlying sudden cardiac death', *Circulation research*, vol. 116, no. 12, pp. 1887-906.
19. Idris, AH, Berg, RA, Bierens, J, Bossaert, L, Branche, CM, Gabrielli, A, Graves, SA, Handley, AJ, Hoelle, R & Morley, PT 2003, 'Recommended guidelines for uniform reporting of data from drowning the "Utstein style"', *Circulation*, vol. 108, no. 20, pp. 2565-74.
20. Jouven, X, Lemaître, RN, Rea, TD, Sotoodehnia, N, Empana, J-P & Siscovick, DS 2005, 'Diabetes, glucose level, and risk of sudden cardiac death', *European heart journal*, vol. 26, no. 20, pp. 2142-7.
21. Karlsson, V, Dankiewicz, J, Nielsen, N, Kern, KB, Mooney, MR, Riker, RR, Rubertsson, S, Seder, DB, Stamat, P & Sunde, K 2015, 'Association of gender to outcome after out-of-hospital cardiac arrest—a report from the International Cardiac Arrest Registry', *Critical Care*, vol. 19, no. 1, p. 182.

22. Kuo, C-W, See, L-C, Tu, H-T & Chen, J-C 2014, 'Adult out-of-hospital cardiac arrest based on chain of survival in Taoyuan County, northern Taiwan', *Journal of Emergency Medicine*, vol. 46, no. 6, pp. 782-90.
23. McNally, B, Robb, R, Mehta, M, Vellano, K, Valderrama, AL, Yoon, PW, Sasson, C, Crouch, A, Perez, AB & Merritt, R 2010, 'Out-of-hospital cardiac arrest surveillance—cardiac arrest registry to enhance survival (CARES), United States, October 1, 2005—December 31, 2010', *Morbidity and Mortality Weekly Report: Surveillance Summaries*, vol. 60, no. 8, pp. 1-19.
24. Oh, SJ, Kim, JJ, Jang, JH, Hwang, IC, Woo, JH, Lim, YS & Yang, HJ 2017, 'Age is related to neurological outcome in patients with out-of-hospital cardiac arrest (OHCA) receiving therapeutic hypothermia (TH)', *The American journal of emergency medicine*.
25. O'Keefe, JH & Bell, DSH 2007, 'Postprandial hyperglycemia/hyperlipidemia (postprandial dysmetabolism) is a cardiovascular risk factor', *The American journal of cardiology*, vol. 100, no. 5, pp. 899-904.
26. Ong, MEH, Shin, SD, Tanaka, H, Ma, MHM, Khruerkarnchana, P, Hisamuddin, N, Atilla, R, Middleton, P, Kajino, K & Leong, BSH 2012, 'Pan Asian Resuscitation Outcomes Study (PAROS): Rationale, Methodology, and Implementation', *Academic Emergency Medicine*, vol. 18, no. 8, pp. 890-7.
27. Parry, M, Danielson, K, Brennenstuhl, S, Drennan, IR & Morrison, LJ 2017, 'The association between diabetes status and survival following an out-of-hospital cardiac arrest: A retrospective cohort study', *Resuscitation*, vol. 113, pp. 21-6.
28. Rea, TD, Cook, AJ, Stiell, IG, Powell, J, Bigham, B, Callaway, CW, Chugh, S, Aufderheide, TP, Morrison, L & Terndrup, TE 2010, 'Predicting survival after out-of-hospital cardiac arrest: role of the Utstein data elements', *Annals of emergency medicine*, vol. 55, no. 3, pp. 249-57.
29. Rea, TD, Pearce, RM, Raghunathan, TE, Lemaitre, RN, Sotoodehnia, N, Jouven, X & Siscovick, DS 2004, 'Incidence of out-of-hospital cardiac arrest', *The American journal of cardiology*, vol. 93, no. 12, pp. 1455-60.
30. Rehmani, R, Baqir, SM & Amanullah, S 2007, 'Return of spontaneous circulation and survival at hospital discharge in patients with out-of-hospital and emergency department cardiac arrests in a tertiary care centre', *Journal of Pakistan Medical Association*, vol. 57, no. 6, p. 278.
31. Reinier, K, Thomas, E, Andrusiek, DL, Aufderheide, TP, Brooks, SC, Callaway, CW, Pepe, PE, Rea, TD, Schmicker, RH & Vaillancourt, C 2011, 'Socioeconomic status and incidence of sudden cardiac arrest', *Canadian medical association journal*, vol. 183, no. 15, pp. 1705-12.
32. Saiful Saanin, 2004. Sistem Penanggulangan Gawat Darurat terpadu, SPGDT Dep.Kes RI, BSB Sumbar.
33. Song, S, Yang, P-S, Kim, T-H, Uhm, J-S, Pak, H-N, Lee, M-H & Joung, B 2017, 'Relation of Chronic Obstructive Pulmonary Disease to Cardiovascular Disease in the General Population', *American Journal of Cardiology*, vol. 120, no. 8, pp. 1399-404.
34. Sotoodehnia, N, Siscovick, DS, Vatta, M, Psaty, BM, Tracy, RP, Towbin, JA, Lemaitre, RN, Rea, TD, Durda, JP & Chang, JM 2006, '2-Adrenergic receptor genetic variants and risk of sudden cardiac death', *Circulation*, vol. 113, no. 15, pp. 1842-8.
35. Suarez, GA, 2005, 'Sudden cardiac death in diabetes mellitus: risk factors in the Rochester diabetic neuropathy study', *Journal of Neurology, Neurosurgery & Psychiatry*, vol. 76, no. 2, pp. 240-5.
36. Su, Y-J & Lai, Y-C 2009, 'Optimal parameters for return of spontaneous circulation in resuscitating out-of-hospital cardiac arrest patients', *International Journal of Gerontology*, vol. 3, no. 2, pp. 96-100.
37. Supriadi, A, Dradjat, RS, Haedar, A & Setijowati, N 2015, 'Faktor-faktor Prarumah Sakit yang Mempengaruhi Kembalinya Sirkulasi Spontan Pada Pasien Henti Jantung di Luar Rumah Sakit'.
38. Travers, AH, Rea, TD, Bobrow, BJ, Edelson, DP, Berg, RA, Sayre, MR, Berg, MD, Chameides, L, O'Connor, RE & Swor, RA 2010, 'Part 4: CPR overview 2010 American

- Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care', *Circulation*, vol. 122, no. 18 suppl 3, pp. S676-S84.
39. Uchmanowicz, I, Bartkiewicz, Wa, Sowizdraniuk, Ja & Rosi czuk, J 2015, 'Factors affecting the occurrence of out-of-hospital sudden cardiac arrest', *Emergency medicine international*, vol. 2015.
 40. Wellens, HJJ, 2014, 'Risk stratification for sudden cardiac death: current status and challenges for the future', *European heart journal*, vol. 35, no. 25, pp. 1642-51.
 41. White RD, Khan AH, Packer DL. Impact of age on long-term survival and quality of life following out-of-hospital cardiac arrest. *Crit Care Med*2004;32:963–7.15
 42. Wilde, ET, Robbins, LS & Pressley, JC 2016, 'Racial differences in out-of-hospital cardiac arrest survival and treatment', *Emerg Med J*, vol. 29, no. 5, pp. 415-9.
 43. Yeung, S-CJ & Escalante, CP 2003, 'Circulatory Oncologic Emergencies'.
 44. Zheng, Z-J, Croft, JB, Giles, WH & Mensah, GA 2001, 'Sudden cardiac death in the United States, 1989 to 1998', *Circulation*, vol. 104, no. 18, pp. 2158-63.
 45. Zipes, DP & Wellens, HJJ 1998, 'Sudden cardiac death', *Circulation*, vol. 98, no. 21, pp. 2334-51.