

DOES BYSTANDER RESUSCITATION TREND INCREASE AFTER CARDIOPULMONARY RESUSCITATION TRAINING?: A SYSTEMATIC REVIEW

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ABSTRAK

Beberapa penelitian telah menggarisbawahi manfaat Resusitasi Jantung Paru (RJP) yang diberikan oleh orang awam terhadap angka keberlangsungan hidup penderita *Out of Hospital Cardiac Arrest* (OHCA). Berbagai pelatihan diberikan kepada orang awam untuk meningkatkan pengetahuan dan keterampilannya dalam melakukan RJP. Namun, masih terdapat perbedaan hasil penelitian tentang apakah pelatihan-pelatihan tersebut dapat meningkatkan angka RJP yang dilakukan oleh orang awam. Penelitian ini bertujuan untuk meninjau secara sistematis penelitian-penelitian yang mengevaluasi efek dari pelatihan RJP untuk orang awam terhadap tren RJP oleh orang awam serta tingkat kelangsungan hidup dari penderita OHCA. Strategi pencarian diterapkan dalam database Proquest, Medline, dan Cochrane. Kriteria inklusi mencakup penelitian dengan desain *Randomized Controlled Trial (RCT)*, quasi-experimen maupun observasional, membahas pelatihan CPR untuk orang awam dan evaluasi angka CPR yang dilakukan oleh orang awam sebagai *outcome* pelatihan serta angka angka keberlangsungan hidup penderita OHCA. Enam penelitian kuantitatif observasional disertakan dalam telaah. Dua penelitian menunjukkan peningkatan tren RJP oleh orang awam setelah diadakan pelatihan, dan dua lainnya menunjukkan penurunan dengan rata-rata tren meningkat 6.69% (95% CI -1.53-14.9). Tiga dari empat penelitian menunjukkan hasil positif dari pelatihan RJP terhadap tingkat kelangsungan hidup OHCA. Satu penelitian membandingkan RJP oleh orang awam yang terlatih dibanding yang tidak terlatih yang tidak menunjukkan perbedaan signifikan ($p=0.5$). Pelatihan RJP untuk orang awam dapat meningkatkan angka RJP pada OHCA. Namun, perlu penelitian lebih lanjut untuk mengetahui apakah pelatihan ini dapat meningkatkan tingkat kelangsungan hidup penderita OHCA. Penting untuk melakukan evaluasi terhadap cakupan dan efek dari pelatihan RJP di tingkat komunitas terhadap tren RJP oleh orang awam.

Kata Kunci: *Out-of-Hospital Cardiac Arrest*, Resusitasi Jantung Paru, Tingkat Kelangsungan Hidup

ABSTRACT

Numbers of studies have reported the benefit of bystander CPR on *Out-of-Hospital Cardiac Arrest (OHCA)*. Training programs are sought to improve the knowledge and skills of lay people in conducting CPR. However, there are still varied results on whether training can increase the actual bystander CPR. This study systematically reviews studies that evaluate the effect of CPR training for laypeople on bystander CPR and the survival rate of OHCA. We applied a search strategy in Proquest, Medline, and Cochrane databases. The inclusion criteria consist of studies with *Randomized Controlled Trial (RCT)*, quasi-experimental, and observational designs, and studies that apply CPR training for laypeople and evaluate the bystander CPR by laypeople and the survival rate. We include six quantitative observational studies for review. Two studies show an increased bystander CPR trend after training, and two studies show a downward trend, with a mean trend increase of 6.69% (95% CI -1.53-14.9). Three out of four studies show an increased survival rate. One study comparing bystander CPR between trained and untrained groups shows no significant difference ($p=0.5$). The CPR training for laypeople could increase the percentage of bystander CPR. Further studies that assess the

bystander CPR by laypeople and analyze its effect on survival is needed. Evaluating community-level CPR training programs is pivotal to determine the coverage and the effect on bystander CPR trend.

Keywords: *Cardiac Pulmonary Resuscitation; Out-of-Hospital Cardiac Arrest; Survival Rate*

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INTRODUCTION

Cardiac arrest is among the diseases that have become the leading cause of death around the globe. The World Health Organization (WHO) reports that 17 million people died due to cardiovascular diseases (CVDs), and 85% of them are heart attack and stroke (World Health Organization, 2017). The survival rate of people who experienced out-of-hospital cardiac arrest is low in most countries in the world (Berdowski, Berg, Tijssen, & Koster, 2010). The early treatment for out-of-hospital cardiac arrest (OHCA) is related to the higher survival rate (Hasselqvist-Ax et al., 2015; McNally et al., 2011). Lay people who make the first contact with the sufferer are a possible rescuer. However, the OHCA events that bystanders witness are not always followed by the delivery of CPR itself. Compared to the witnessed OHCA, the bystander CPR percentage is low (Bobrow et al., 2010). In order to improve the survival rate of OHCA by increasing the number of bystander CPR, community-based CPR training programs have been initiated around the world. One of those steps is community-based CPR training.

A study conducts a systematic review to evaluate resuscitation training programs on the knowledge, skill, and self-efficacy of trained people (Meaney et al., 2010). Despite the improvement of these outcomes, the actual performance of CPR by lay people has yet been sought. The competency and willingness to deliver resuscitation cannot solely determine the actual bystander CPR. There are varied results in existing studies that assess CPR training's effect in increasing the bystander CPR frequency and survival rate of OHCA. Thus, this study aims to systematically review the studies that evaluate the effect of CPR training for laypeople on bystander CPR and the survival rate of OHCA.

METHOD

Search Strategy and Selection Criteria

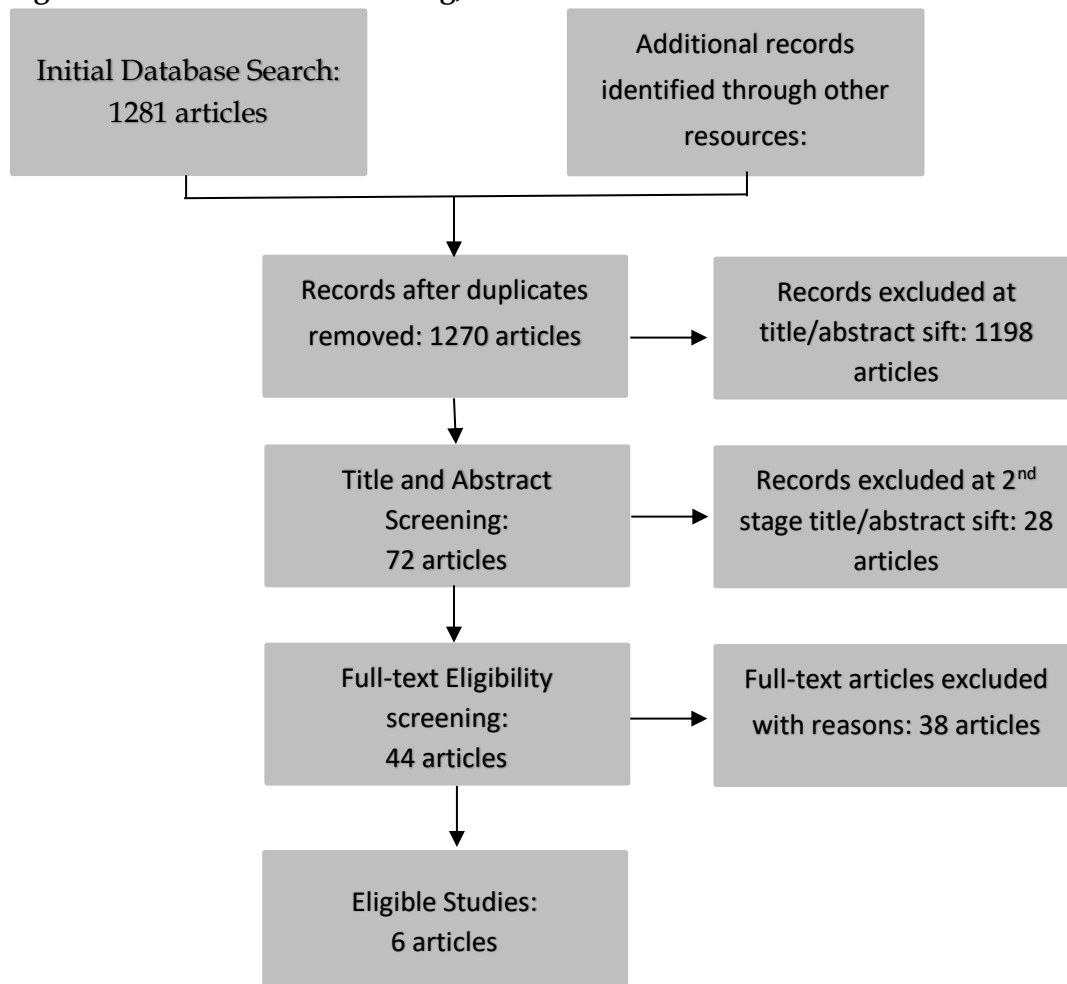
We applied a search strategy in Proquest, Medline, and Cochrane. We used keywords that consist of "out of hospital cardiac arrest", "CPR training", "bystander CPR", and "survival rate" on the advance search available on each database. The selection of the articles followed a set of inclusion and exclusion criteria. The inclusion criteria consist of studies with Randomized Controlled Trial (RCT), quasi-experimental, and observational designs. Studies that apply CPR training for laypeople and evaluate the bystander CPR by laypeople and the survival rate were eligible for inclusion. Study eligibility criteria and study outcomes can be seen in Table 1.

Table 1 Study Eligibility Criteria and Study Outcomes

Study Type	<ul style="list-style-type: none"> • Randomized Controlled Trials, before-after, Case-controlled, or Cohort studies • Peer reviewed • Studies from 2009- 2019 • Published in English
Population	• Patients with Out-of-Hospital Cardiac Arrest
Intervention	• Cardiopulmonary resuscitation training for laypeople
Comparison	• No training or dispatcher-assisted CPR with no previous training
Primary outcomes	<ul style="list-style-type: none"> • Frequency of bystander CPR by lay people • Survival rate: survival to discharge, one-month survival, pre-hospital survival, and Return of Spontaneous Circulation.

The CPR training means training in conducting CPR, including first aid training, basic life support training, pediatric basic life support training, basic trauma and cardiac life support training, advanced life support training, and advanced cardiac life support training (Meaney et al., 2010). In this review, advanced life support and advanced cardiac life support training were excluded since it is for professional health workers. Bystander CPR is defined as a CPR performed by someone present but is not part of the emergency medical system or first responder (Perkins et al., 2015). Since the training should target laypeople, this review excluded bystander CPR performed by professional health workers. However, studies that measured the bystander CPR by laypeople and off-duty health professional separately were also eligible.

Figure 1. Flow Chart of Screening, Inclusion and Exclusion of Retrieved Articles



From the three databases, we gathered 1282 articles and downloaded the reference into the reference manager. We removed the duplication using the system's feature, and two reviewers assessed the articles separately for their eligibility. The first selection was conducted through the titles and abstracts. A reference was also included if a decision could not be met in this step. The full texts of the selected references were retrieved to be reviewed further for their eligibility.

Evidence Appraisal

The reviewers evaluated the selected articles' quality using the Critical Appraisal Skills Programme (CASP) checklist (Critical Appraisal Skills Programme, 2018). The items assessed in CASP could depict the three main components of the study: the results, the validity of the results, and the implication in the population (Critical Appraisal Skills Programme, 2018). The selected studies were also evaluated based on the level of evidence. The quality of the studies was ranked as good, fair, and low.

Data Collection and Analysis

This study's primary outcome is the bystander CPR, and the secondary outcome is the survival rate discharge of OHCA patients. We extracted the data on survival-to-hospital discharge, 30-day survival, favorable neurological outcome, and return of spontaneous circulation for the survival rate. We analyzed the selected studies using SPSS 21 for the odds ratio and 95% confidence interval. Studies that did not provide this parameter were analyzed or described separately.

RESULTS AND DISCUSSION

After the duplications were removed, 1270 papers were screened in two stages through the titles and abstracts. We retrieved 44 full-text papers that were potentially eligible. After the eligibility assessment, six observational studies were selected for review. The flow chart of the selection process is presented in figure 1. Four studies are retrospective, one study with a prospective design, and one study with a cross-sectional design. The detail of each study can be seen in Table 2.

Bystander CPR Trend Before and After The Training

Most studies assess bystander CPR's trend as an evaluation of a community-based program that includes CPR training for laypeople (Bergamo et al., 2016; Fordyce et al., 2017; Nishiyama, Kitamura, et al., 2019; Uber, Sadler, Chassee, & Reynolds, 2018). The results of these studies are varied. Two studies show an increased number of bystander CPR (Bergamo et al., 2016; Fordyce et al., 2017), and two studies show a downward trend in bystander CPR (Nishiyama, Kitamura, et al., 2019; Uber et al., 2018). One study, which is considered fair in quality, shows an upward trend of bystander CPR, with the difference in the percentage being 0.13 (OHCA in homes) and 0.095 (OHCA in public) (Fordyce et al., 2017). The other study, which is considered low in quality, identifies a significant growth of bystander CPR percentage ($p < 0.05$) from the beginning of a peer-to-peer training program to the end of the study regardless of the counties' risk level (Bergamo et al., 2016).

A downward trend of bystander OHCA is shown in a study by Nishiyama et al. (2019), which is appraised as a good quality of evidence. Based on this study's results, the bystander CPR in 2015 is more than threefold from 2010. However, the incidence of OHCA also spikes more than the resuscitation number, causing the percentage of bystander CPR to the OHCA to lower than the previous years. Another study also shows decreased bystander CPR from before to after a one-day training program for laypeople (Uber et al., 2018). The mean trend of the four studies is 6.69% (95% CI -1.53-14.9).

Bystander CPR Trend Between Trained and Untrained Group

The last study that shows a favorable outcome in bystander CPR for a trained group is a cross-sectional study evaluated as low-quality evidence (Jarrah, Judeh, & AbuRuz, 2018). This study collected the data using a questioner to assess the knowledge about CPR mainly. However, some questionnaire items also assess the percentage of the respondent performing CPR, divided into trained (0.214) and untrained groups (0.071). The complete data about the trend of bystander CPR can be seen in Table 3.

Table 2 Summary of Evidence

Author, Year, Design, Country	Sample Size	Population Description	Study Intervention	Outcomes	Quality
Nishiyama et al., 2019, Prospective Observational, Japan	722 OHCA	411 No bystander CPR; 311 bystander CPR (121 High-quality CPR and 99 Low-quality CPR)	CPR Training	Number of Bystander CPR (no healthcare provider vs healthcare provider); 1-month survival; 1-month neurological survival	Good
Fordyce et al., 2017, Retrospective Observational Study, USA	8,269 OHCA	5,602 OHCA at home and 2667 OHCA in public	the Hearth Rescue Project; intervention for EMS Personnel, first responders, hospital administration and staff, and community member (chest-compression only CPR).	Incidence of OHCA at home and in public, Neurological survival from 2010-2014 Number of Initiated CPR by bystander, Survival to hospital discharge rate from 2010-2014	Fair
Uber, Sadler, Chassee, and Reynolds, 2018, Retrospective Observational, USA	1,486 OHCA	899 OHCA before Community CPR Training Day; and 587 OHCA after community CPR Training Day	One-day Community CPR Training (Chest compression only CPR)	ROSC; Survival to hospital discharge; Number of Bystander CPR; Hands-only CPR Neurologic outcome at hospital discharge	Fair
Tanigawa, Iwami, Nishiyama, and Kawamura, 2011, Prospective	120 OHCA	60 OHCA CPR by trained bystander; 60 OHCA CPR by untrained bystander	CPR training	Survival rate (Pre-Hospital ROSC); one-month survival; Neurological one-month survival	Fair

observational, Japan						
Bergamo et al., 2016, Descriptive observation (retrospective), USA	2,474 OHCA	896 (36.3%) had CPR initiated by bystander; OHCA incidence in High-risk Zip Code was 6 per 10,000 people per year; OHCA incidence in Low-risk Zip Code was 4 per 10,000 people per year	TAKE10 (10 minutes compression only CPR)	Incidence of OHCA, Number of Bystander CPR from 2008 to 2013		Low
Jarrah, Judeh, and AbuRuz (2018), Descriptive- Cross-sectional, Jordan	20 OHCA	15 Trained bystander CPR; 5 Untrained bystander CPR	CPR Training	Number of Bystander CPR (trained vs untrained);		Low

Table 3 Outcome on Bystander CPR Percentage

Study	Time of Observation	Type of Outcome	Outcome			
			Value	Difference	Trend	Measure
Bergamo et al. (2016)	2008-2013	Difference in percentage within one group	2008: 0.42 2013: 0.47	0.05	Upward	T-test, p=0.05

Fordyce et al. (2017)	2010-2014	Difference in percentage within five years	Home	0.13	Upward	Chi-square/Fisher Exact test, P< 0.01
			2010: 0.283 2011: 0.318 2012: 0.357 2013: 0.401 2014: 0.413			
			Public	0.095	Upward	Chi-square/Fisher Exact test P= 0.01
			2010: 0.610 2011: 0.674 2012: 0.702 2013: 0.686 2014: 0.705			
Uber, Sadler, Chassee, and Reynold (2018)	Period 1 (P1): 2010-2014 Period 2 (P2): 2014-2015	Difference in percentage within two periods	P1: 0.337 P2: 0.313	0.024	Downward	T-test, p=0.283
Nishiyama et al. (2019)	2010-2015	Difference in percentage within six years	2010: 0.433 2011: 0.416 2012: 0.443 2013: 0.458 2014: 0.418 2015: 0.420	0.013	Downward	Chi-square/Fisher Exact test 0.195
Jarrah, Judeh, and AbuRuz (2018)	unidentified	Difference in percentage between two groups	Trained: 0.214 Untrained: 0.071	0.143	Unavailable	Chi-square/Fisher Exact test 0.50

Table 4 Outcome on Survival Rate

Study	Time of Observation	Type of Outcome	Outcome			
			Value	Difference	Trend	Measure
Fordyce et al. (2017)	2010-2014	Difference in percentage within five years	Survival to hospital discharge at Home 2010: 0.057 2014: 0.081	0.024	Upward	Chi-square/Fisher Exact test, P=0.047
			Survival to hospital discharge in Public 2010: 0.108 2014: 0.162	0.054	Upward	Chi-square/Fisher Exact test, P=0.04
Uber, Sadler, Chassee, and Reynold 2018	Period 1 (P1): 2010-2014	Difference in percentage within two periods	P1 ROSC: 0.29	0.02	Upward	T-test, p=0.52
	Period 2 (P2): 2014-2015		P2 ROSC: 0.31			
			P1 Survival to Hospital discharge: 0.10 P2: Survival to Hospital	0.001	Upward	T-test, p=0.98

			discharge: 0.101			
Nishiyama et al. (2019)	2010-2015	Difference in percentage within six years	1-month survival 2010: 0.115 2011: 0.047 2012: 0.071 2013: 0.082 2014: 0.174 2015: 0.051	0.064	Downward	P=0.915
Tanigawa, Iwami, Nishiyama, Noogi, and Kawamura (2011)	January- December 2008	Difference in percentage between two groups	ROSC Trained: 0.233 Untrained: 0.233	0.00	Unavailable	P=1.00
			1-month survival Trained: 0.133 Untrained: 0.083			P=0.279

Survival Rate

Four studies include survival rate in their outcome (Fordyce et al., 2017; Nishiyama, Kitamura, et al., 2019; Tanigawa, Iwami, Nishiyama, Nonogi, & Kawamura, 2011; Uber et al., 2018). These studies describe various types of survival rates. Two studies measure the ROSC (Tanigawa et al., 2011; Uber et al., 2018). Tanigawa et al. (2011) assess the ROSC between trained and untrained groups, which shows no difference in the percentage. The other study compares the ROSC before and after the training program, which increases by 0.02 (Uber et al., 2018).

Two studies that measure hospital discharge survival show an increased percentage (Fordyce et al., 2017; Uber et al., 2018). One study evaluates the survival rate within five years, which shows the increase of survival to hospital discharge both at home (0.024) and in public (0.054) (Fordyce et al., 2017). Another study shows an increased survival rate by 0.001, which is evaluated before and after the training program (Uber et al., 2018).

Two studies evaluate the one-month survival rate. Tanigawa et al. (2011) compare the one-month survival rate between trained and untrained bystanders who perform CPR, which shows a higher rate in the trained group (0.05). On the other hand, Nishiyama, Kitamura, et al. (2019) shows a decreased one-month survival rate trend by 0.064. Table 4 represents the data on the survival outcomes.

This study aims to assess the effect of CPR training for laypeople on bystander CPR trend and the survival rate of OHCA. Despite the causative nature of this objective, all studies included in this review are non-experimental. The CPR training program for laypeople is more likely delivered on an extensive community scale, often on a national scale, depicting how the program will benefit the OHCA cases. The included studies apply observational methods to evaluate the change in the bystander CPR percentage before and after a mass training program. Thus, the trend of bystander CPR can still be measured while considering the training programs as an influencing factor. As an evaluation of community programs, the trend of bystander CPR was evaluated in most studies. From the results described above, we can see an equal number of studies in both bystander CPR trends. However, studies showing an increased percentage of bystander CPR have higher differences and significance than the other two studies. Some of the studies focused on other outcomes, such as the comparison between districts and the quality of the CPR.

The positive difference in bystander CPR percentage is more likely to happen in studies with a large number of samples. The number of OHCA cases play a meaningful role in the bystander CPR trend. Thus, broad coverage of CPR training is pivotal in improving the ratio of rescuers and the case. A study argues that the fewer CPR training programs held in an area, the less CPR is performed (Bray et al., 2017). The increased OHCA case that surpasses the number of trained people might burden the bystander in performing CPR. Another factor might be that witnessed OHCA tend to have more possibility to receive CPR from the witness. As suggested in Straney et al. (2016), densely populated regions have a high bystander CPR. Thus, fewer people with CPR skills might worsen the CPR rate in that area in the less dense population.

One good quality study finds a lower percentage of bystander CPR at the end of the data collection period. Nevertheless, this study also assesses the number of high-quality CPR, which increases significantly after the community training programs. The other study, which finds a decreased bystander CPR also identified a higher percentage of hands-only CPR. These findings should be supported by further studies that identify whether the CPR technique's complexity would reduce the

probability of the actual CPR. As suggested by Lee et al. (2013), simple compression-only CPR increases laypeople's willingness to perform CPR. Thus, CPR training for laypeople should emphasize hands-only CPR. To raise the proportion of bystander CPR, we need to target a broader community consisting of people with various cognitive and psychomotor skills.

The results on bystander CPR trend between trained and untrained groups is inadequate both in the method and the number of the participants. This type of outcome is necessary to assess the effect of educational strategy on the actual CPR. The CPR training programs have been evaluated through the performance on manikins and cognitive evaluation. However, knowing whether this type of intervention could urge lay people to deliver their real event skills is paramount. Despite the slight increase in the trend and the higher percentage of bystander CPR in the people with previous CPR training, the difference is not significant. Likewise, the quality of the studies could not meet the requirement of our aim in this review. Comparing two groups or communities could best describe the effect of the CPR training on the bystander CPR. That is because there are factors that could intervene with the trend or percentage, such as increased number of OHCA (Nishiyama, Sato, et al., 2019), changed policy or accessibility of resuscitation devices (Lee et al., 2013).

The survival rate is increased in most studies. Nevertheless, only one study, with fair quality, shows a significant increase. The type of survival rate that seems to represent the quality of bystander CPR is the ROSC. This outcome is more likely obtained before any other intervention delivered by the health care professionals. The outcome in ROSC is the highest outcome observed from CPR intervention in OHCA, while the survival-to-discharge and 1-month survival become the lowest incidence happen in the patients (Yan et al., 2020). The one-month survival rate and hospital to discharge survival rate might not result from the bystander CPR alone. With the scarce evidence, we are less likely to indicate how effective the CPR training program is in improving the survival rate trend.

This study has some limitations. Firstly, the number of studies included in this review is too low to draw a vigorous conclusion. Moreover, statistical analysis is not possible to perform due to the heterogeneity of the studies. Future research in bystander CPR training needs to collaborate with the stakeholders to expand the coverage of the training program to a certain level of area so that the bystander CPR trend in a community could be observed. Secondly, other outcomes, such as the trend of high-quality bystander CPR is not looked over. The one-month survival rate and the hospital to discharge survival rate are influenced by many factors. Further studies with cohort retrospective design, which follow up the training programs, are needed. Studies on the ROSC of OHCA patients who received bystander CPR are also necessary.

CONCLUSION

The CPR training for laypeople could increase the percentage of bystander CPR and the survival rate of OHCA patients. However, the quantity and the quality of the evidence is low. Furthermore, the difference between the bystander CPR and the survival rate is not significant. Further studies that assess bystander CPR in regards to community training programs are needed. Broadening the CPR training scale for laypeople is pivotal to exceed the increased case of OHCA.

REFERENCE LIST

Berdowski, J., Berg, R. A., Tijssen, J. G. P., & Koster, R. W. (2010). Global incidences of out-of-hospital cardiac arrest and survival rates: Systematic review of 67 prospective studies. *Resuscitation*, 81(11), 1479–1487. <https://doi.org/10.1016/j.resuscitation.2010.08.006>

- Bergamo, C., Bui, Q. M., Gonzales, L., Hinchey, P., Sasson, C., & Cabanas, J. G. (2016). TAKE10: A community approach to teaching compression-only CPR to high-risk zip codes. *Resuscitation*, 102, 75–79. <https://doi.org/10.1016/j.resuscitation.2016.02.019>
- Bobrow, B. J., Spaite, D. W., Berg, R. A., Stolz, U., Sanders, A. B., Kern, K. B., ... Ewy, G. A. (2010). Chest compression-only CPR by lay rescuers and survival from out-of-hospital cardiac arrest. *JAMA*, 304(13), 1447–1454. <https://doi.org/10.1001/jama.2010.1392>
- Bray, J. E., Straney, L., Smith, K., Cartledge, S., Case, R., Bernard, S., & Finn, J. (2017). Regions With Low Rates of Bystander Cardiopulmonary Resuscitation (CPR) Have Lower Rates of CPR Training in Victoria, Australia. *Journal Of The American Heart Association*, 6(6). <https://doi.org/10.1161/JAHA.117.005972>
- Critical Appraisal Skills Programme. (2018). Appraisal Checklists. Retrieved from <https://caspu-uk.net>
- Fordyce, C. B., Hansen, C. M., Kragholm, K., Dupre, M. E., Jollis, J. G., Roettig, M. L., ... Granger, C. B. (2017). Association of Public Health Initiatives With Outcomes for Out-of-Hospital Cardiac Arrest at Home and in Public Locations. *JAMA Cardiology*, 2(11), 1226–1235. <https://doi.org/10.1001/jamacardio.2017.3471>
- Hasselqvist-Ax, I., Riva, G., Herlitz, J., Rosenqvist, M., Hollenberg, J., Nordberg, P., ... Leif, S. (2015). Early cardiopulmonary resuscitation in out-of-hospital cardiac arrest. *The New England Journal Of Medicine*, 372(24), 2307–2315. <https://doi.org/http://dx.doi.org/10.1056/NEJMoa1405796>
- Jarrah, S., Judeh, M., & AbuRuz, M. E. (2018). Evaluation of public awareness, knowledge and attitudes towards basic life support: a cross-sectional study. *BMC Emergency Medicine*, 18(1), 37. <https://doi.org/10.1186/s12873-018-0190-5>
- Lee, M. J., Hwang, S. O., Cha, K. C., Cho, G. C., Yang, H. J., & Rho, T. H. (2013). Influence of nationwide policy on citizens' awareness and willingness to perform bystander cardiopulmonary resuscitation. *Resuscitation*, 84(7), 889–894. <https://doi.org/10.1016/j.resuscitation.2013.01.009>
- McNally, B., Robb, R., Mehta, M., Vellano, K., Valderrama, A. L., Yoon, P. W., ... Kellermann, A. (2011). 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 (Washington, D.C.: 2002)*, 60(8), 1–19. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=mdc&AN=21796098&site=ehost-live>
- Meaney, P. A., Topjian, A. A., Chandler, H. K., Botha, M., Soar, J., Berg, R. A., & Nadkarni, V. M. (2010). Resuscitation training in developing countries: A systematic review. *Resuscitation*, 81(11), 1462–1472. <https://doi.org/10.1016/j.resuscitation.2010.06.024>
- Nishiyama, C., Kitamura, T., Sakai, T., Murakami, Y., Shimamoto, T., Kawamura, T., ... Iwami, T. (2019). Community-Wide Dissemination of Bystander Cardiopulmonary Resuscitation and Automated External Defibrillator Use Using a 45-Minute Chest Compression-Only Cardiopulmonary Resuscitation Training. *Journal Of The American Heart Association*, 8(1), e009436–e009436. <https://doi.org/10.1161/JAHA.118.009436>
- Nishiyama, C., Sato, R., Baba, M., Kuroki, H., Kawamura, T., Kiguchi, T., ... Iwami, T. (2019). Actual resuscitation actions after the training of chest compression-only CPR and AED use among new university students. *Resuscitation*, 141, 63–68. <https://doi.org/10.1016/j.resuscitation.2019.05.040>
- Perkins, G. D., Jacobs, I. G., Nadkarni, V. M., Berg, R. A., Bhanji, F., Biarent, D., ... Zideman, D. A. (2015). Cardiac arrest and cardiopulmonary resuscitation outcome reports: Update of the Utstein resuscitation registry templates for out-of-hospital cardiac arrest. In *Circulation (Vol. 132)*. <https://doi.org/10.1161/CIR.0000000000000144>

- Straney, L. D., Bray, J. E., Beck, B., Bernard, S., Lijovic, M., & Smith, K. (2016). Are sociodemographic characteristics associated with spatial variation in the incidence of OHCA and bystander CPR rates? A population-based observational study in Victoria, Australia. *BMJ Open*, 6(11), e012434. <https://doi.org/10.1136/bmjopen-2016-012434>
- Tanigawa, K., Iwami, T., Nishiyama, C., Nonogi, H., & Kawamura, T. (2011). Are trained individuals more likely to perform bystander CPR? An observational study. *Resuscitation*, 82(5), 523–528. <https://doi.org/10.1016/j.resuscitation.2011.01.027>
- Uber, A., Sadler, R. C., Chassee, T., & Reynolds, J. C. (2018). Does Non-Targeted Community CPR Training Increase Bystander CPR Frequency? *Pre-hospital Emergency Care*, 22(6), 753–761. <https://doi.org/10.1080/10903127.2018.1459978>
- World Health Organization. (2017). Fact sheets: Cardiovascular Diseases (CVDs). Retrieved from [https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
- Yan, S., Gan, Y., Jiang, N., Wang, R., Chen, Y., Luo, Z., ... Lv, C. (2020). The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: A systematic review and meta-analysis. *Critical Care*, 24(1), 8–13. <https://doi.org/10.1186/s13054-020-2773-2>