VIA MEDICA

ORIGINAL ARTICLE

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A systematic review and meta-analysis of the impact of the pandemic on dispatcher-assisted cardiopulmonary resuscitation

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ABSTRACT

Introduction: The influence of the COVID-19 pandemic on the incidence and effectiveness of dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) in the context of out-of-hospital cardiac arrests (OHCA) remains an area of ambiguity and requires further elucidation. The study aims to conduct a systematic review and meta-analysis of the DA-CPR among pre- vs. during COVID-19 periods.

Material and methods: This search was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. A systematic review of the current literature was performed to identify articles that evaluated the impact of the pandemic on DA-CPR. English-language literature was searched up to December 11, 2023, in three databases, including MEDLINE (via PubMed), Embase, and the Cochrane Library.

Results: Six studies with 605,354 patients (431,308 patients with OHCA from before the pandemic period and 174,046 OHCA patients from the COVID-19 pandemic period) were included. Pooled analysis showed that DA-CPR before and during the COVID-19 period varied and amounted to 61.4% vs. 62.4%, respectively (OR = 0.94; 95% CI: 0.90 to 0.99; p = 0.02). Moreover, dispatchers recognized cardiac arrest by phone in 61.8% of cases in the pre-pandemic period as well as in the pandemic period (OR = 0.98; 95%CI: 0.95 to 1.01; p = 0.17).

Conclusions: This systematic review and meta-analysis suggest the resilience and adaptability of emergency response systems in maintaining DA-CPR effectiveness despite the challenges posed by the pandemic.

Keywords: dispatcher-assisted cardiopulmonary resuscitation, DA-CPR, out-of-hospital cardiac arrest, COVID-19, SARS-CoV-2

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Introduction

Dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) is an important element of pre-hospital care in the event of OHCA, positively influencing post-OHCA outcomes [1]. This tendency is not only observed among adults but also visible in paediatric cardiac arrests in which DA-CPR improves outcomes, although it depends on the place of occurrence of the cardiac arrest [2]. DA-CPR is very effective, meaning that bystanders can understand the dispatcher's instructions. One barrier is that bystanders may be worried about moving a person who is having a cardiac arrest, but this doesn't decrease the effectiveness of the intervention [3, 4]. Furthermore, research shows that DA-CPR is associated with a greater chance of return of spontaneous circulation [5]. However, it must be remembered that DA-CPR, although important, does not significantly improve neurological outcomes after OHCA compared to bystander cardiopulmonary resuscitation (CPR) [6]. Hence, efforts should be directed at improving the quality of DA-CPR as well as educating the public on the principles of CPR so that CPR can be started as soon as possible after cardiac arrest [7].

During the COVID-19 pandemic, various aspects related to health care systems as well as the outcomes of various medical interventions have changed significantly [8, 9]. Chavez et al. [10] showed that during the COVID-19 pandemic, the number of OHCAs increased significantly, the number of bystander CPRs decreased, the survival period until admission to the hospital decreased, and the in-hospital mortality rate increased. One of the direct causes was undoubtedly COVID-19 itself, which may have accounted for 10% of OHCA [11, 12]. The COVID-10 pandemic also had an impact on DA-CPR and had a special impact on the work and functioning of dispatchers [13]. Understanding the differences between DA-CPR during the pandemic compared to the pre-pandemic period may contribute to the design of interventions aimed at maintaining high quantities and quality of CPR in the event of renewed waves of the COVID-19 pandemic, as well as in the event of other epidemiological threats. Examining dispatchers' abilities to recognize cardiac arrest in conditions of increased stress and workload may, as a consequence, improve early recognition of OHCA and improve post-OHCA outcomes.

Taking into consideration all the above, the current meta-analysis aimed to evaluate whether there was a difference between DA-CPR during the COVID-19 pandemic compared to the pre-pandemic era. Moreover, the dispatcher's ability to recognize cardiac arrest by phone between the pre-pandemic and pandemic periods was also assessed. To the best of the authors' knowledge, this meta-analysis is the first attempt to conduct a meta-analysis in the context of the impact of the pandemic on DA-CPR.

Material and methods

Data sources and search strategy

This study was designed as a systematic review and meta-analysis and was accomplished based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [14]. The review protocol was prospectively submitted and registered on the International Prospective Register of Systematic Reviews (PROSPERO) database (registration number: CRD42023492242) and there were no amendments or protocol deviations.

A comprehensive systematic literature search was performed from the following medical electronic databases: MEDLINE (via PubMed), Embase, and the Cochrane Library databases with the search terms: "video-assisted" OR "telephone-assisted" OR "dispatcher-assisted" AND "cardiopulmonary resuscitation" OR "resuscitation" OR "CPR" AND "coronavirus disease 2019" OR "COVID-19" OR "COVID 19" OR "COVID19" OR "novel coronavirus" OR "2019 novel coronavirus" OR "2019-nCoV" OR "2019 nCoV" OR "severe acute respiratory syndrome coronavirus 2" OR "SARS-CoV "OR "SARS-CoV-2". The studies were retrieved from January 1, 2020, to December 11, 2023. All references in the included articles were hand-searched and browsed to identify more potentially eligible studies. Due to the nature of the study, no ethics committee approval was mandatory.

Study selection

Two authors (AK and MP) conducted independent assessments of the titles and abstracts of all search results to determine eligibility. Once an item was deemed possibly eligible, both writers individually scrutinized the whole piece to determine its inclusion. The writers settled their disagreements through a conversation based on consensus. In addition, a simultaneous search of the reference lists of all the publications found was conducted to identify any other research that may potentially meet the eligibility criteria.

Included were all the peer-reviewed articles concerning DA-CPR among adult out-of-hospital cardiac arrest

patients before and during the COVID-19 pandemic. The following types of papers from this analysis were omitted: systematic reviews, reviews, meta-analyses, case reports, case series, editorials, and opinion articles. However, the authors still examined the references to identify any relevant studies. 1) studies examining further instances of infectious epidemics; and 2) research published in languages other than English in the absence of a translated version of the text.

Data extraction

Two authors (AK and AR), independently collected data from individual reports and documented it in an Excel spreadsheet. A third author (LS) settled any disagreement that arose between the two reviewers during the data extraction procedure. The data that was obtained consisted of the primary author, publication year, research methodology, nation, sample size, age range, gender distribution, presence of other medical conditions, percentage of DA-CPR, survival to hospital admission, survival to hospital discharge (SHD), and survival to hospital discharge with good neurological outcome (defined as 1–2 grade according to the Cerebral Performance Categories Scale) [15]. If publications lacked sufficient information on predictive accuracy to enable the compilation of 2 x 2 contingency tables, the authors were contacted via email to request their assistance. Studies were excluded if a further email failed to generate a response.

Outcomes

The primary outcome of interest was the difference in DA-CPR during out-of-hospital cardiac arrest between before and during the COVID-19 pandemic period. The secondary outcome was a difference in dispatcher recognition of cardiac arrest.

Bias assessment

Using the nine-item Newcastle-Ottawa Scale [16], two reviewers (AK and AR) independently evaluated the methodological quality of the chosen studies. The NOS scale evaluates three key aspects of the study: the appropriateness of selecting exposed and non-exposed cohorts, the comparability of these groups, and the quality of outcome evaluation. The scale assigns a total score ranging from 0 to 9. In addition, the NOS scale was divided into three categories: "0–3" for low quality, "4–6" for moderate quality, and "7–9" for excellent quality. All authors agreed on how to resolve disagreements that arose during the quality assessment of the research.

Statistical analysis

All statistical analyses were conducted using Review Manager 5.4 (RevMan 5.4) by the Cochrane Collaboration. A p-value less than 0.05 denotes statistical significance. The authors expressed pooled dichotomous effect measures as odds ratios (ORs) with 95% confidence intervals (CI) and pooled continuous effect measures as mean differences (MD) with 95% CI. The authors transformed continuous values presented as medians to means and interquartile range (IQR) to standard deviation (SD) using the formula described by Hozo et al. [17]. The presence of statistical heterogeneity was assessed with I^2, interpreted according to the Cochrane Handbook [18] 0–40%: might not be important; 30–60%: may represent moderate heterogeneity; 50–90%: substantial heterogeneity; 75–100%: considerable heterogeneity. The fixed-effects model was used when the I^2 value was 50%, otherwise, the random-effects model was used. Publication bias was assessed by Egger's test and funnel plots [19]. When at least 10 studies were included in the meta-analysis, publication bias was evaluated by visual inspection of funnel plots [20]. Additionally, a sensitivity analysis using leave-one-out was performed to test for the robustness of the findings.

Results

A total of 391 articles were retrieved through different databases, i.e., PubMed Central, Scopus, EMBASE, and the Cochrane Library. Of these, 136 duplicate studies were excluded, and 241 studies were further excluded from the initial post-title and abstract screening based on the inclusion and exclusion criteria and comparison arm. The full-text review was conducted for the remaining 14 studies. Of these, 8 were excluded as they either had unmatching target populations, were not primary research articles or case reports, had duplicate data, or lacked a comparison arm. The flow diagram of the study selection is shown in Figure 1.

Finally, 6 studies with 605,354 patients (431,308 patients with OHCA from before the pandemic period and 174,046 OHCA patients from the COVID-19 pandemic period) were included in the meta-analysis [21–26]. The main characteristics of the included articles are presented in Table 1. Of these articles, two were carried out in South Korea and one in Japan, Germany, Taiwan,

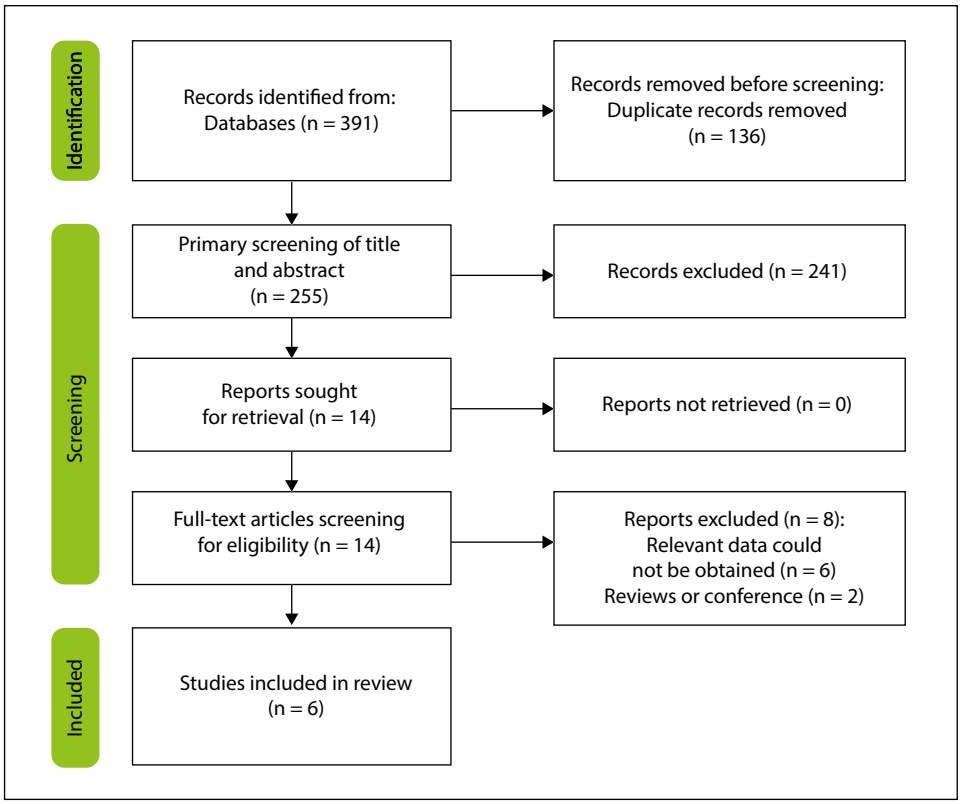


Figure 1. Flow diagram of the search strategy and study selection

and Singapore. Additional information about the studies included in the systematic review is provided in the supplementary file (Tab. S1. Detailed methodology characteristics of the studies included in the meta-analysis).

All six studies reported DA-CPR before and during the COVID-19 period. Pooled analysis showed that DA-CPR before and during the COVID-19 period varied and amounted to 61.4% vs. 62.4%, respectively (OR = 0.94; 95% CI: 0.90 to 0.99; p = 0.02; Fig. 2). An additional analysis based on two studies [21, 24] showed that the dispatcher recognized cardiac arrest by phone in 61.8% of cases in the pre-pandemic period as well as in the pandemic period (OR = 0.98; 95%CI: 0.95 to 1.01; p = 0.17).

Discussion

The following analysis revealed a slight decrease in the rate of DA-CPR during the COVID-19 pandemic compared to the pre-pandemic era; more precisely, a 6% reduction was observed in terms of DA-CPR during the pandemic (OR = 0.94). The difference is statistically significant (p = 0.02, p < 0.05). There was no significant difference in the dispatcher's ability to recognize cardiac arrest by phone between the pre-pandemic and pandemic periods (p = 0.17), although a marginal decrease in recognition during the pandemic was detected. It seems that although the COVID-19 pandemic has significantly changed the functioning of many aspects of the healthcare system, its impact on DA-CPR does not seem to be substantial, at least in a quantitative context. However, it cannot go unnoticed.

Although quantitatively not much has changed, a reduction in the quality of CPR cannot be ruled out due to the fear of infection. Taking into account that systematically repeated training is necessary to ensure effective CPR and, more broadly, all first aid activities, the COVID-19 pandemic may have significantly worsened the quality of CPR due to the lockdown [27]. An additional factor, apart from the lockdown, was the fear of possible infection, mentioned already in the introduction of the article, which also limited the performance of CPR by the bystander [28]. Representatives of medical professionals also indicated that the fear of contracting COVID-19 was the basic factor demotivating them to perform CPR, as was the fear of contracting COVID-19, and as many as 34% were reluctant to perform CPR [29]. Another issue requiring in-depth analysis is aspects related to the course of OHCA for

Table 1. Baseline characteristics of included trials

Study	Country	Period	No.	Sex, male	Age [years]	Home location of OHCA	Shockable rhythm	Response time (min)	Survival to hospital discharge	Survival with good neurological outcome	NOS score
Ahn et al., 2021	South Korea	P-COVID	145	91 (62.8)	74.0 (61.5–82.0)	112 (77.2)	24 (16.6)	6.0 (5.0–7.0)	15 (10.3)	14 (9.7)	9
		D-COVID	152	102 (67.1)	76.0 (66.0–81.8)	127 (83.6)	20 (13.2)	8.0 (7.0–11.0)	7 (4.6)	5 (3.3)	
Lim et al., 2022	Singapore	P-COVID	1,118	683 (61.1)	73 (61, 84)	949 (84.9)	162 (14.5)	NS	45 (4.0)	NS	8
		D-COVID	1,241	764 (61.6)	74 (61, 84)	1,080 (87.0)	161 (13.0)	NS	34 (2.7)	NS	
Liu et al., 2023	Taiwan	P-COVID	567	313 (55.4)	76.0 (64–85	427 (75.3)	102 (18.3)	4 (3–5)	30 (5.3)	29 (5.1)	9
		D-COVID	497	292 (59.0)	78 (65–85)	384 (77.7)	95 (19.6)	5 (3–6)	11 (2.2)	9 (1.8)	
Park et al., 2023	South Korea	P-COVID	61,180	39,438 (64.5)	66.9 (18.8)	NS	5,217 (8.5)	7.0 (5.0;9.0)	5,019 (8.2)	3,075 (5.0)	8
		D-COVID	22,092	14,133 (64.0)	67.9 (18.5)	NS	1,689 (7.6)	8.0 (6.0; 10.0)	1,457 (6.6)	991 (4.5)	
Ristau et al., 2022	Germany	P-COVID	5,016	3,270 (65.2)	69.7 (16.9)	3,145 (62.8)	1,111 (22.2)	8.7 (4.3)	645 (13.9)	NS	8
		D-COVID	5,308	3,503 (66.0)	69.7 (16.6)	3,519 (66.5)	1,073 (20.3)	9.1 (4.7)	475 (10.2)	NS	
Tanaka et al., 2023	Japan	P-COVID	418,344	218,433 (52.2)	84 (78–89)	284,770 (68.1)	21,881 (5.2)	9 (8–12)	14,313 (3.4)	5,916 (1.4)	9
		D-COVID	144,756	77,479 (53.5)	84 (78–89)	100,344 (69.3)	7,390 (5.1)	10 (8–12)	5,206 (3.6)	2,436 (1.7)	

D-COVID — during COVID-19 pandemic; NOS — Newcastle Ottawa Scale; NS — not specified; OHCA — out-of-hospital cardiac arrest; P-COVID — pre-COVID-19 pandemic

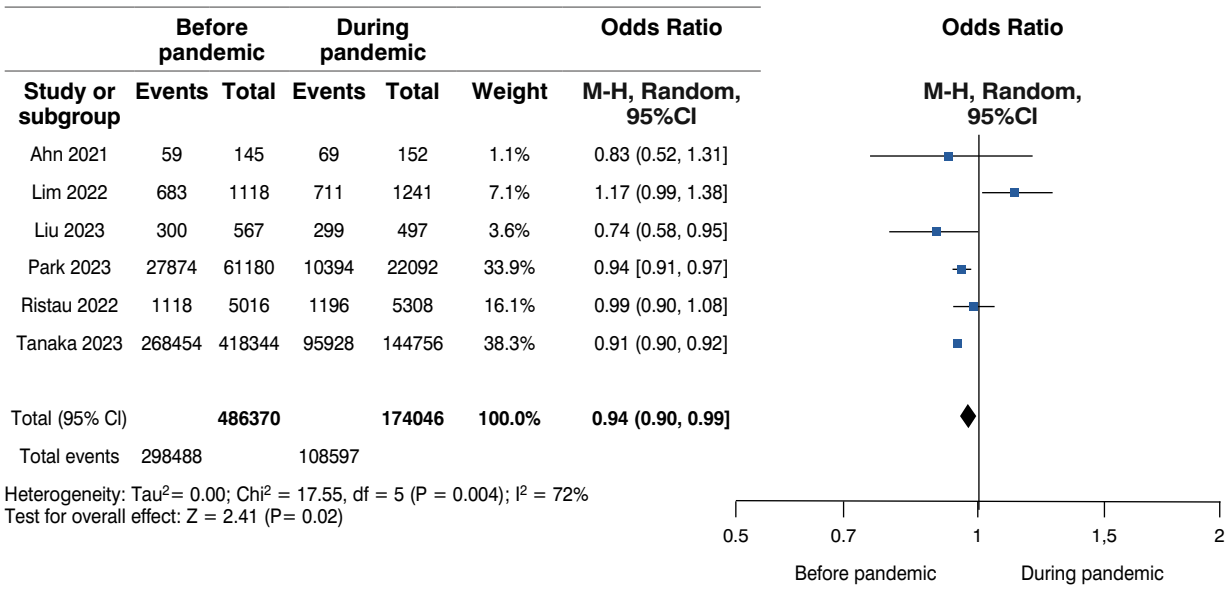
patients belonging to ethnic or racial minorities as well as gender differences. Chavez et al. [10] showed that black OHCA patients had a significantly lower chance of CPR performed by bystanders compared to white OHCA patients (aOR = 0.73; 95% CI: 0.65–0.82). The same study also showed that female OHCA patients had a greater chance of surviving until admission to the hospital (aOR = 1.29; 95% CI: 1.15–1.44).

Particularly in the initial stage of the COVID-19 pandemic, the number of patients who received CPR by bystanders decreased significantly by 15.6%. The same study also showed a significant increase (by 58%) in out-of-hospital cardiac arrests (OHCA) between 2019 and 2020 [30]. Moreover, during the first wave of the COVID-19 pandemic, an increased number of OHCAs was observed, along with a lower number of bystander cardiopulmonary resuscitation (CPR) in places where the incidence of COVID-19 was high [31].

Another significant factor was the significant delay in the arrival of emergency medical teams to the OHCA [32]. Taking into account all the above factors (lockdown, fear of contamination, reduction in the number of CPR by bystanders) and the decrease in the rate of DA-CPR during the COVID-19 pandemic shown in the following meta-analysis, it is not surprising that the outcomes after OHCA during COVID-19 have significantly worsened compared to pre-pandemic times [4]. The following meta-analysis may constitute an important voice in the discussion on the reasons for the worsening of outcomes after OHCA during the COVID-19 pandemic.

In addition, the following study showed a lack of statistical significance in terms of dispatchers' recognition of cardiac arrests over the phone during the pandemic compared to the pre-pandemic period. This may prove the high level of training of the dispatchers, who were able to properly select calls even during periods of increased demand. It is also worth emphasizing that dispatchers are exposed to mental problems and a significant risk of burnout, which has become more severe during the COVID-19 pandemic [33, 34]. Making efforts to improve the working conditions of dispatchers seems to be the right direction to improve the functioning of the health care system.

The following meta-analysis also has limitations. First, a limited number of studies were included in the meta-analysis, but the number of patients included in the analysis is significant. Moreover, the studies included in the meta-analysis were observational in nature; therefore, the influence of confounding factors cannot be ruled out. It is also important that there may be a difference in the rate of DA-CPR depending on the wave of the pandemic; it can be assumed that in the



Study or subgroup	Before pandemic Events	Total	During pandemic Events	Total	Weight	Odds Ratio M-H, Random, 95%CI
Ahn 2021	59	145	69	152	1.1%	0.83 (0.52, 1.31]
Lim 2022	683	1118	711	1241	7.1%	1.17 (0.99, 1.38]
Liu 2023	300	567	299	497	3.6%	0.74 (0.58, 0.95]
Park 2023	27874	61180	10394	22092	33.9%	0.94 [0.91, 0.97]
Ristau 2022	1118	5016	1196	5308	16.1%	0.99 (0.90, 1.08]
Tanaka 2023	268454	418344	95928	144756	38.3%	0.91 (0.90, 0.92]
Total (95% CI)		**486370**		**174046**	**100.0%**	**0.94 (0.90, 0.99]**
Total events	298488		108597			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 17.55$, df = 5 (P = 0.004); $I^2 = 72\%$
Test for overall effect: Z = 2.41 (P= 0.02)

Figure 2. Forest plot of dispatcher-assisted cardiopulmonary resuscitation before and during COVID-19 pandemic periods. The centre of each square represents the standardized mean differences for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results

early period of the pandemic when disinformation about COVID-19 dominated and there was an atmosphere of uncertainty, the difference shown by the meta-analysis could have been even greater [35]. Another limitation is the great geographical diversity of countries with different healthcare systems and the organization of emergency medicine.

Conclusions

This systematic review and meta-analysis suggest the resilience and adaptability of emergency response systems in maintaining DA-CPR effectiveness despite the challenges posed by the pandemic.

Article information

Data availability statement: *The data that support the findings of this study are available on request from the corresponding author (LS).*
Ethics statement: *Not applicable.*
Author contributions: *conceptualization — AK and LS; methodology — AK and LS; software — AK, KK and KB; validation — AK, MY, FC and LS; formal analysis — AK and LS; investigation — AK, MP, ZZ, KB, and LS; resources — AK and LS; data curation — AK, KK, MP, and LS; writing: original draft preparation — AK, DS, MP and LS; writing: review and editing — KAK, KK, MP, FC, DS, JK, ZZ, MY, LS and KB; visualization — AK and LS; supervision — FC and LS; project administration — AK; all authors have read and agreed to the published version of the manuscript.*
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Conflicts of interest: *The authors declare no conflict of interest.*
Supplementary material: *Table S1. Detailed methodology characteristics of the studies included in the meta-analysis.*

References

1. Riva G, Jonsson M, Ringh M, et al. Survival after dispatcher-assisted cardiopulmonary resuscitation in out-of-hospital cardiac arrest. Resuscitation. 2020; 157: 195–201, doi: 10.1016/j.resuscitation.2020.08.125, indexed in Pubmed: 32918983.
2. Lee YuJ, Song KJ, Shin SDo, et al. Dispatcher-assisted cardiopulmonary resuscitation program and outcomes after pediatric out-of-hospital cardiac arrest. Pediatr Emerg Care. 2019; 35(8):

561–567, doi: 10.1097/PEC.0000000000001365, indexed in Pubmed: 29200138.
3. Ho AF, Sim ZJ, Shahidah N, et al. Barriers to dispatcher-assisted cardiopulmonary resuscitation in Singapore. Resuscitation. 2016; 105: 149–155, doi: 10.1016/j.resuscitation.2016.05.006, indexed in Pubmed: 27288652.
4. Bielski K, Böttiger BW, Pruc M, et al. Outcomes of audio-instructed and video-instructed dispatcher-assisted cardiopulmonary resuscitation: a systematic review and meta-analysis. Ann Med. 2022; 54(1): 464–471, doi: 10.1080/07853890.2022.2032314, indexed in Pubmed: 35107406.
5. Siman-Tov M, Strugo R, Podolsky T, et al. Impact of dispatcher assisted CPR on ROSC rates: A National Cohort Study. Am J Emerg Med. 2021; 44: 333–338, doi: 10.1016/j.ajem.2020.04.037, indexed in Pubmed: 32336582.
6. Eberhard KE, Linderoth G, Gregers MC, et al. Impact of dispatcher-assisted cardiopulmonary resuscitation on neurologically intact survival in out-of-hospital cardiac arrest: a systematic review. Scand J Trauma Resusc Emerg Med. 2021; 29(1): 70, doi: 10.1186/s13049-021-00875-5, indexed in Pubmed: 34030706.
7. Ng JY, Sim ZJ, Siddiqui FJ, et al. Incidence, characteristics and complications of dispatcher-assisted cardiopulmonary resuscitation initiated in patients not in cardiac arrest. Resuscitation. 2022; 170: 266–273, doi: 10.1016/j.resuscitation.2021.09.022, indexed in Pubmed: 34626729.
8. Smereka J, Szarpak L. COVID-19 a challenge for emergency medicine and every health care professional. Am J Emerg Med. 2020; 38(10): 2232–2233, doi: 10.1016/j.ajem.2020.03.038, indexed in Pubmed: 32241630.
9. Smereka J, Szarpak L. The use of personal protective equipment in the COVID-19 pandemic era. Am J Emerg Med. 2020; 38(7): 1529–1530, doi: 10.1016/j.ajem.2020.04.028, indexed in Pubmed: 32305157.
10. Chavez S, Huebinger R, Chan HK, et al. The impact of COVID-19 on incidence and outcomes from out-of-hospital cardiac arrest (OHCA) in Texas. Am J Emerg Med. 2022; 57: 1–5, doi: 10.1016/j.ajem.2022.04.006, indexed in Pubmed: 35468504.
11. Sultanian P, Lundgren P, Strömsöe A, et al. Cardiac arrest in COVID-19: characteristics and outcomes of in- and out-of-hospital cardiac arrest. A report from the Swedish Registry for Cardiopulmonary Resuscitation. Eur Heart J. 2021; 42(11): 1094–1106, doi: 10.1093/eurheartj/ehaa1067, indexed in Pubmed: 33543259.
12. Bielski K, Szarpak A, Jaguszewski MJ, et al. The influence of COVID-19 on out-hospital cardiac arrest survival outcomes: an updated systematic review and meta-analysis. J Clin Med. 2021; 10(23), doi: 10.3390/jcm10235573, indexed in Pubmed: 34884289.
13. Ushimoto T, Yao S, Nunokawa C, et al. Association between the COVID-19 pandemic in 2020 and out-of-hospital cardiac arrest outcomes and bystander resuscitation efforts for working-age individuals in Japan: a nationwide observational and epidemiological analysis. Emerg Med J. 2023; 40(8): 556–563, doi: 10.1136/emermed-2022-213001, indexed in Pubmed: 37280044.
14. Page M, McKenzie J, Bossuyt P, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021: 372, doi: 10.1136/bmj.n71.
15. Phelps R, Dumas F, Maynard C, et al. Cerebral performance category and long-term prognosis following out-of-hospital cardiac arrest. Crit Care Med. 2013; 41(5): 1252–1257, doi: 10.1097/CCM.0b013e31827ca975, indexed in Pubmed: 23388519.
16. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. Eur J Epidemiol. 2010; 25(9): 603–605, doi: 10.1007/s10654-010-9491-z, indexed in Pubmed: 20652370.
17. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. BMC Med Res Methodol. 2005; 5: 13, doi: 10.1186/1471-2288-5-13, indexed in Pubmed: 15840177.
18. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA. Cochrane handbook for systematic reviews of interventions. John Wiley & Sons, Chichester (UK) 2019.
19. Egger M, Davey Smith G, Schneider M, et al. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997; 315(7109): 629–634, doi: 10.1136/bmj.315.7109.629, indexed in Pubmed: 9310563.
20. Sterne JAC, Sutton AJ, Ioannidis JPA, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. BMJ. 2011; 343: d4002, doi: 10.1136/bmj.d4002, indexed in Pubmed: 21784880.
21. Ahn JY, Ryoo HW, Cho JW, et al. Impact of the COVID-19 outbreak on adult out-of-hospital cardiac arrest outcomes in Daegu, South Korea: an observational study. Clin Exp Emerg Med. 2021; 8(2): 137–144, doi: 10.15441/ceem.21.008, indexed in Pubmed: 34237819.
22. Lim SL, Toh C, Fook-Chong S, et al. Impact of COVID-19 on barriers to dispatcher-assisted cardiopulmonary resuscitation in adult out-of-hospital cardiac arrests in Singapore. Resuscitation. 2022; 181: 40–47, doi: 10.1016/j.resuscitation.2022.10.012, indexed in Pubmed: 36280214.
23. Liu CH, Tsai MJ, Hsu CF, et al. The influence of the COVID-19 pandemic on emergency medical services to out-of-hospital cardiac arrests in a low-incidence urban city: an observational epidemiological analysis. Int J Environ Res Public Health. 2023; 20(3): 2713, doi: 10.3390/ijerph20032713, indexed in Pubmed: 36768079.
24. Park JHo, Song KJ, Do Shin S, et al. The impact of COVID-19 pandemic on out-of-hospital cardiac arrest system-of-care: Which survival chain factor contributed the most? Am J Emerg Med. 2023; 63: 61–68, doi: 10.1016/j.ajem.2022.10.023, indexed in Pubmed: 36327751.
25. Ristau P, Wnent J, Gräsner JT, et al. Impact of COVID-19 on out-of-hospital cardiac arrest: A registry-based cohort-study from the German Resuscitation Registry. PLoS One. 2022; 17(9): e0274314, doi: 10.1371/journal.pone.0274314, indexed in Pubmed: 36103547.
26. Tanaka Y, Okumura K, Yao S, et al. Impact of the COVID-19 pandemic on prehospital characteristics and outcomes of out-of-hospital cardiac arrest among the elderly in Japan: A nationwide study. Resusc Plus. 2023; 14: 100377, doi: 10.1016/j.resplu.2023.100377, indexed in Pubmed: 36945239.
27. Ball J, Nehme Z, Villani M, et al. Abstract 11901: CPR quality during the COVID-19 pandemic — more evidence of collateral damage during out-of-hospital cardiac arrest. Circulation. 2021; 144(Suppl_2), doi: 10.1161/circ.144.suppl_2.11901.
28. Perman SM. Overcoming fears to save lives: COVID-19 and the threat to bystander CPR in out-of-hospital cardiac arrest. Circulation. 2020; 142(13): 1233–1235, doi: 10.1161/CIRCULATIONAHA.120.048909, indexed in Pubmed: 32795100.
29. Al-Shiakh S, Tran QK, Caggiula A, et al. Attitudes among healthcare professionals towards cardiopulmonary resuscitation during COVID-19. Am J Emerg Med. 2022; 52: 34–42, doi: 10.1016/j.ajem.2021.11.017, indexed in Pubmed: 34861518.
30. Baldi E, Sechi GM, Mare C, et al. Lombardia CARe Researchers. Out-of-hospital cardiac arrest during the COVID-19 outbreak in Italy. N Engl J Med. 2020; 383(5): 496–498, doi: 10.1056/NEJMc2010418, indexed in Pubmed: 32348640.
31. Baldi E, Klersy C, Chan P, et al. The impact of COVID-19 pandemic on out-of-hospital cardiac arrest: An individual patient data meta-analysis. Resuscitation. 2023 [Epub ahead of print]; 194: 110043, doi: 10.1016/j.resuscitation.2023.110043, indexed in Pubmed: 37952575.
32. Ageta K, Naito H, Yorifuji T, et al. Delay in emergency medical service transportation responsiveness during the COVID-19 pandemic in a minimally affected region. Acta Med Okayama. 2020; 74(6): 513–520, doi: 10.18926/AMO/61210, indexed in Pubmed: 33361871.
33. Schumann H, Böckelmann I, Thielmann B, et al. Recovery and stress of control center dispatchers in the first waves of the SARS-CoV-2 pandemic. Wien Klin Wochenschr. 2023; 135(9-10): 228–234, doi: 10.1007/s00508-022-02144-6, indexed in Pubmed: 36600144.
34. Makara-Studzińska M, Załuski M, Adamczyk K. Polish emergency dispatchers during a COVID-19 pandemic — burnout syndrome, perceived stress, and self-efficacy. Effects of multidimensional path analysis. Front Psychol. 2021; 12: 729772, doi: 10.3389/fpsyg.2021.729772, indexed in Pubmed: 34690886.
35. Nelson T, Kagan N, Critchlow C, et al. The danger of misinformation in the COVID-19 crisis. Mo Med. 2020; 117(6): 510–512, indexed in Pubmed: 33311767.