International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)
Journal Home page: www.iscientific.org/Journal.html

Comparison of EMS and Non-EMS Transportation Outcomes among ST-Segment Elevation Myocardial Infarction (STEMI) Patients: A Systematic Review and Meta-Analysis

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Abstract

Emergency Medical Services (EMSs) are essential for diagnosing and treating myocardial infarction with ST-segment elevation (STEMI). The current meta-analysis aimed to compare the outcomes, survival rates and incidence of complications between STEMI patients transported by EMS vs. non-EMS transportations. The literature on prehospital care for STEMI sufferers was filtered out by examining the published research in online libraries from 2008 to 2023. The article at hand covered eight indicators of outcomes in total: (1) Symptom-to-balloon time (SBT), (2) Door-to-balloon time (DBT), (3) mortality rate, (4) symptom-to-door time (STDT), (5) heart rate (HR), (6) systolic blood pressure (SBP), (7) door to-needle time (DNT) and (8) symptom-to-door time (SNT). 7 papers reported patients' complications. To assess bias risk, Egger's test and a funnel plot were employed. 11 published papers were included with a total of 56579 STEMI patients (29607 patients in the EMS group and 26972 patients in the non-EMS group). The in-hospital mortality risk ratio among EMS and non-EMS STEMI patients did not significantly differ (p=0.17) (RR =1.09, 95% CI: 0.96 to 1.24). DBT of the STEMI patients transferred by EMS was significantly lower than STEMI patients transported by other means of transportations (SMD =−0.52, 95% CI: −0.97 to −0.08, P=0.02). SBP of the STEMI patients was lower among EMS patients than patients transported by non-EMS means (SMD =−0.27, 95% CI: −0.58 to −0.03, P=0.08). HR of the STEMI patients was significantly reduced among EMS transported patients than Non-EMS transported patients (SMD =−0.08, 95% CI: −0.16 to −0.01, P=0.03). SBT was significantly lower among STEMI EMS transported patients than non-EMS patients (SMD =−0.87, 95% CI: −1.29 to −0.46, P<0.001). STDT of the STEMI EMS transported patient significantly reduced than non-EMS patients (SMD =-0.94, 95% CI: -1.41 to -0.46, P< 0.001). DNT of the STEMI EMS transported patient was significantly lower than non-EMS patients (SMD =-0.46, 95% CI: -0.65 to -0.27, P< 0.001). The complications rate after treatment among non-EMS STEMI patients was significantly higher than those patients transported by EMS means (RR =1.24, 95% CI: 1.01 to 1.52, P=0.04). The current meta-analysis provided an evidence that STEMI sufferers who used EMS transport had a reduced mortality rate than patients who used other means of transportation. It is advised that healthcare administrators and legislators take the required steps to raise public health consciousness and education regarding the usage of emergency medical services (EMS), which will lower the death rate and problems associated with acute myocardial infarction (AMI).

Keywords: Emergency department, myocardial infarction with ST-segment elevation, survival rate, pre-hospital transport.

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1. Introduction

Being the main reason of death, the incidence of cardiovascular diseases (CVD) has emerged as one of the biggest threats to the medical sector in most cultures [1]. among the most significant cardiovascular conditions is acute myocardial infarction (AMI) with ST elevation (STEMI), which has the greatest rates of hospitalization and deaths [2]. STEMI patients and the healthcare system bear a substantial financial burden from the expenses of medical care, treatment, and re-admission [2, 3]. The World Health Organization (WHO) states that AMI accounts for 30% of mortality in developing nations and 50% of deaths in advanced economic nations [4, 5]. Numerous studies have demonstrated that, despite AMI's potentially fatal outcomes—such as heart attack, stroke, and death—its suitable management, prompt and efficient clinical procedures, and the timely transfer of patients to medical facilities all significantly lower the disease's complications and mortality rate [6]. Because early identification and treatment—such as initial angioplasty and the administration of thrombolytic medications, which restore blood flow to a blocked artery—have been effective in reducing the degree of associated risks and complications, half of AMI patients die if they do not receive treatment in the initial stages of the illness [7]. When it comes to management and treatment of AMI, timing is crucial. For example, the European Society of Cardiology suggested that the initial angioplasty be carried out no later than 120 minutes following the onset of symptoms [8]. There is a clear relationship between the onset of therapy and the patient's transportation to medical facilities. Researchers found that the effectiveness of treatment therapies would improve with a shorter transit time for individuals suffering from AMI. As a result, myocardial ischemia-related death and serious complications will be decreased [9]. According to scientists, patients with AMI—especially those who exhibit hemodynamic instability—who delay receiving emergency medical services (EMS) experience longer times before reperfusion and experience a higher 30-day mortality rate. Nonetheless, in certain cases, the delay results from providing emergency medical care prior to the patient's hospital transfer, which improves the patient's prognosis [10]. Apart from the duration of patient transfer, the emergency medical services provided by the ambulance can help lessen the effects of myocardial infarction [11]. Patients frequently travel to medical facilities in a variety of ways, which might impact how quickly they can receive emergency care and treatment while being transported. The research conducted by Pathan et al. evaluated the use of air and ground ambulances for the transportation of patients suffering from AMI in the United States and Qatar between 2012 and 2014. They discovered that while both ambulances offer emergency medical services (EMS) with paramedics who have received training, air ambulances—that is, a specially outfitted helicopter—are better able to adhere to the guidelines for intervention times, which clear blocked arteries and lower the death rate [12]. According to a research by Jollis et al. (2018), individuals with AMI who were transported by EMS to medical centers experienced shorter hospital stays and more successful therapeutic interventions than patients who were not transported by EMS [4]. To achieve the intended therapeutic goals, emergency medical technicians' and paramedics' appropriate patient transportation and primary care are therefore effective. Patients employ a variety of transport options to go to the medical facilities; for instance, some might choose EMS transport, while others may use private or public transportation. However, how individuals with AMI are transported may have an impact on the disease's outcomes, mortality rate and the disease complications. Therefore, the main objective of the current meta-analysis was to compare the outcomes, survival rates and incidence of complications between STEMI patients transported by EMS vs. non-EMS transportations.

2. Methods

2.1 Literature search

We looked through online libraries of PUBMED, Google scholar, Web of Science, Science direct and Embase to find publications about pre-hospital STEMI patients EMS transport care. Topic terms in combination with free words were used in the design of the research extraction method. Emergency department; myocardial infarction with ST-segment elevation (STEMI); survival rate; mortality rate; EMS; non-EMS meta-analysis were among the keywords searched. The searchable database has been modified to include papers published between 2008 and 2023, and English papers could be selected throughout the search:

2.2 Inclusion criteria

(1) Cohort study literature available through a number of sources; (2) An essay about the effectiveness and outlook of prehospital care for STEMI sufferers makes up the investigation's contents; (3) The EMS group acquired first aids and then transportation under the intervention procedures described in the literature, while the non-EMS admitted to healthcare centers by other means of transportations.

2.3 Exclusion criteria

(1) Papers with just the title and abstract of the relevant literature or incomplete content; (2) Non-cohort research, including news articles, reviews, and case studies; (3) The literature lacks some data, or the primary data—like main outcomes—cannot be included; (4) duplicated papers; (5) Papers written in a language other than English.

2.4 Outcome markers

The article at hand covered eight indicators of outcomes in total: The following outcomes are measured: (1) Symptom-to-balloon time (SBT), (2) Door-to-balloon time (DBT), (3) mortality rate, (4) symptom-to-door time (STDT), (5) heart rate (HR), (6) systolic blood pressure (SBP), (7) door to-needle time (DNT) and (8) symptom-to-door time (SNT). 7 papers reported patients' complications.
Assessment of literature quality and extraction of data Two investigators independently examine the abstracts and titles for initial assessment, studied the full text for rescreening, included papers that matched our standards, and gathered the necessary data from the included papers in accordance with the predetermined search formula and exclusion and inclusion criteria. Basic characteristics and outcome indicators were among the data that needed to be gathered; the former mostly contained the patient's age, the year the research publishing, the sample size, females to males' ratio, and other details. The latter included the eight outcome indicators' values. Following the gathering of data and literature, two researchers cross-checked their findings, and a third researcher was asked to mediate any disagreements. The Newcastle-Ottawa scale (NOS) was used to assess the retrospective papers' quality. The scale consists of eight items, which are pertaining to the choice of study population, comparability, assessment of exposure, or assessment of outcome. Nine points total is the score; low, moderate, and high quality. For prospective studies, the Cochrane collaboration tool was applied.

2.5 Statistical analysis

The data was analysed using Revman Version 5.4 software. The measurement results were described using the standard mean differences (SMD) and 95% CI, and the count results were described using 95% confidence interval (CI) and the risk ratio (RR) coefficient. For evaluation of data, either random effects models or fixed effects models were employed. I2 represented the test for heterogeneity across many trials. If I2 was greater than 50%, it was deemed that there was heterogeneity among the papers; if I2 was less than 50%, heterogeneity is low and a fixed effect model was applied [13, 14]. The literature works' publication bias was measured using a funnel plot and Egger's test, and the meta-analysis outcomes' significance level was assessed using two-sided P<0.05 [15].

3. Results and Discussion

3.1 Outcomes of a literature query

853 publications in all were acquired for the preliminary review; after duplicated papers were eliminated by the software, 108 articles were left. Following a review of the abstract and title, 613 papers that were blatantly at odds with the article's topic were eliminated, leaving 97 materials that could fit the inclusion criteria. A total of eleven articles were eventually included for full-text viewing after being included in the present article (Figure 1).

3.1.1 Basic attributes and an assessment of the included literature's quality

This analysis comprised 11 trials with n=56579 participants (29607 patients in the EMS group and 26972 patients in the non-EMS group). There were 9 retrospective and 2 prospective studies. Among the included articles, 9 papers reported mortality rate, 7 papers reported door to balloon time (DBT), 5 papers reported systolic blood pressure (SBP), 4 papers reported heart rate (HR), 4 papers reported symptoms to balloon time (SBT), 5 papers reported symptoms to door time (STDT), 4 papers reported door to needle time (DNT) and 7 papers reported the incidence of complications among EMS and non-EMS STEMI patients (Table 1).

3.1.2 Quality assessment

The quality of the prospective studies was assessed according to the risk of bias using the Cochrane collaboration tool. For the retrospective studies, the Newcastle-Ottawa Scale (NOS) was applied, and the assessments are shown in figure 2 and table 2, respectively.

Early medical interventions and prompt detection of myocardial infarction are critical in mitigating mortality, complications, and disability in patients [27-31]. Patients with acute AMI have unexpected conditions, and they could experience a deadly dysrhythmia at any time [32, 33]. Thus, prompt clinical procedures performed by emergency care professionals are crucial in lowering the disease's death and morbidity rates [34]. Alrawashdeh et al. [35] carried out research in Australia and Canada in which they demonstrated that EMS-transported AMI patients had superior outcomes from primary percutaneous coronary intervention (PPCI) and a decreased rate of cardiac arrest outside of the medical facility [35]. According to Varcoe et al. [36], individuals with AMI who were transported to the hospital by EMS within the first few minutes of their condition experienced good treatment outcomes. Additionally, Rodríguez-Leor et al. [37] demonstrated that the death rate in the ambulance and hospital was reduced for patients with AMI who received appropriate primary medical treatment and utilised efficient EMS transportation to the hospital. Additionally, this study demonstrated that EMS-transported AMI patients had better outcomes from PPCI than did non-EMS-transported patients [37]. Clinical recommendations state that improved treatment outcomes occur when patients receive interventional treatments more quickly, such as PPCI for AMI patients, and when they are transported to the hospital by EMS more quickly [38]. 1244 individuals in this study who suffered from AMI (55.43%) were transported to the hospital by non-EMS means. Furthermore, 113 (5.03%) of the 169 patients who died from AMI (7.26%) did not employ emergency medical services to go to the hospital. 52 patients utilising EMS transport had successful cardiopulmonary resuscitations (CPRs) performed on them. Ventricular fibrillation also resulted in an effective DC shock for 27 patients. The findings demonstrated that individuals with AMI who employed EMS transport had a reduced death rate than those who did not. Therefore, it is essential to undertake culture-building events to raise awareness among the general population about the need for emergency medical services (EMS) to transport patients, especially those who have had a myocardial infarction [38]. In this context, Ghasemi et al. [39] demonstrated that EMS technicians' performance of cardiopulmonary resuscitation is one of the most important variables reducing the death rate in patients with AMI. They demonstrated how the rate of death is increased when patients' relatives do not know how to handle patients experiencing AMI and cardiac arrest and do not use pre-hospital emergency services in these situations [39]. The results of this research are in line with the outcomes of Schultz et al.'s study [40], which demonstrated the elevated survival rates for individuals with STEMI complicated by OHCA and the critical role EMS plays in giving prompt CPR and defibrillation. Primary medical procedures, such as patient immobilisation, managing pain, oxygen utilisation, and the use of antiplatelet and anticoagulation medications like aspirin, are crucial in avoiding and minimising complications in patients suffering from AMI, according to medical recommendations and management protocols [41]. As a result, EMS will be helpful and effective in reaching the stated therapy objectives. Assume that both patients and their partners transport their patients to the medical centres by non-EMS means [4]. The patient's treatment outcomes will be affected if they are unable to receive primary care from emergency medical technicians. Since cardiac dysrhythmias, particularly ventricular fibrillation (VF), are the most common cause of death for patients with AMI in the first few minutes and hours after the event, the likelihood that these patients will die will rise if they employ non-EMS transport [42]. According to current meta-analysis, the mean time from the start of symptoms to hospital arrival was significantly lower among STEMI EMS-transported patients than non-EMS transported STEMI patients. However, non-EMS patients may experience cardiac arrest during transportation because their relatives lack the required clinical skills and knowledge to take appropriate action, endangering the patient's life. It should be pointed out that emergency medical professionals and paramedics execute the essential primary medical and therapeutic measures as well as, in certain instances, cardiopulmonary resuscitation, which may increase the survival time. This article demonstrates how EMS transportation can greatly enhance sufferers' clinical results by lowering mortality rate, SBP, heart rate, DBT, SBT, STDT, DNT and incidence of after-treatment complications.

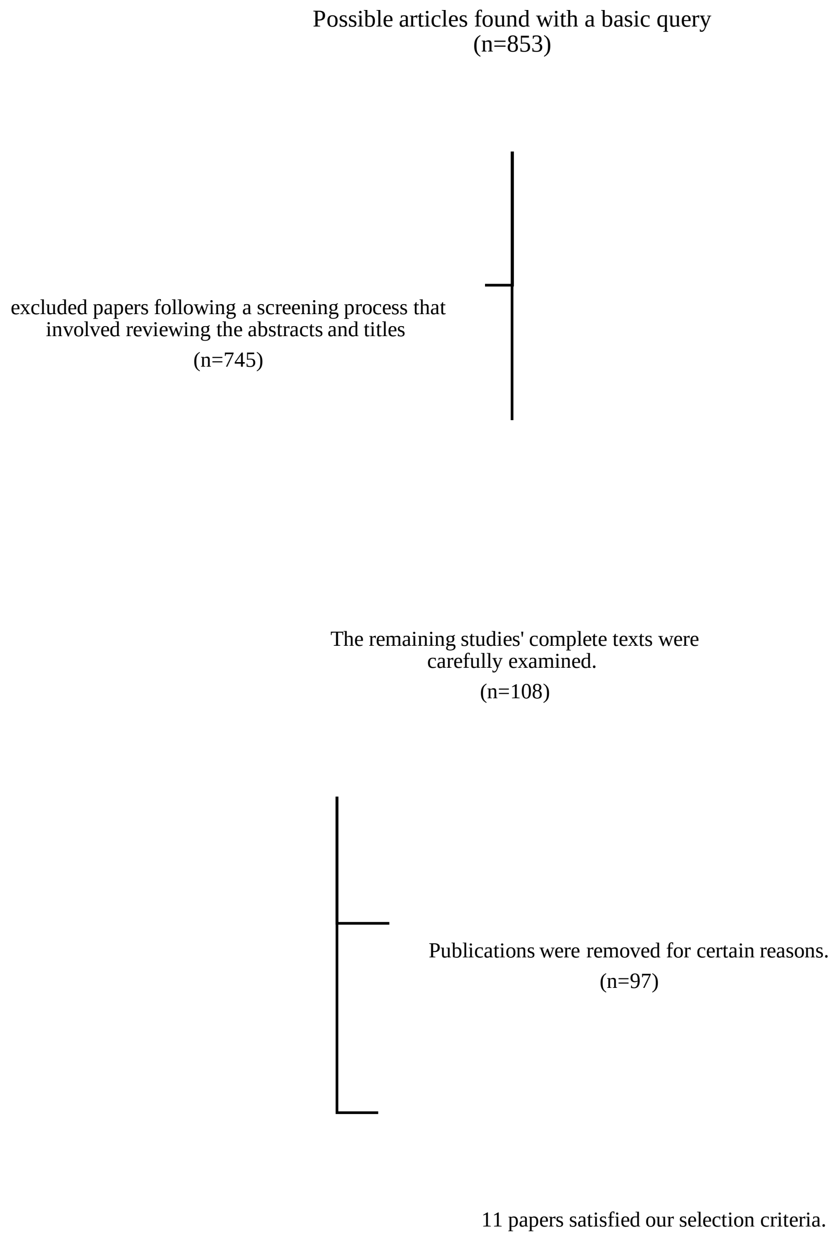

Figure 1: Diagram illustrating the steps involved in finding literature and selected studies.

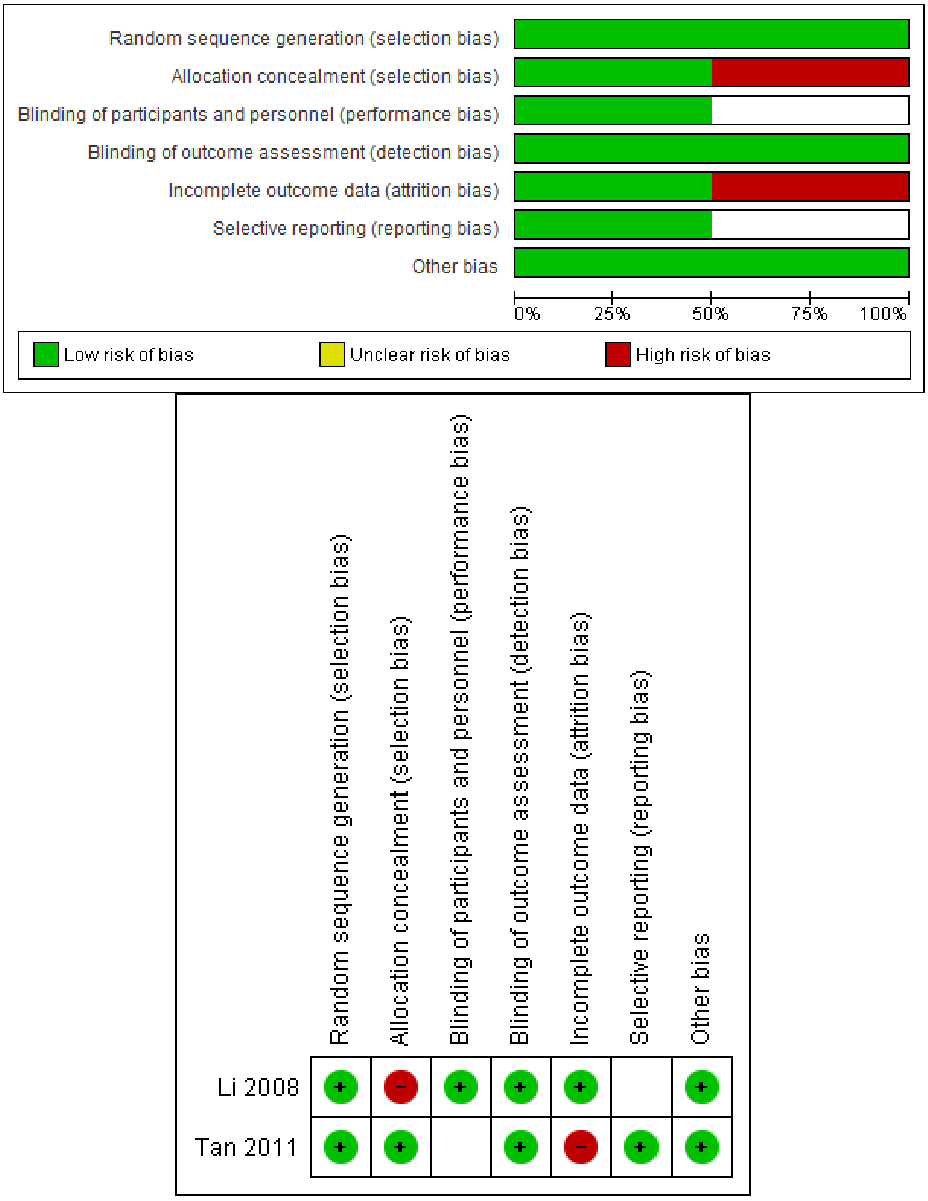

Figure 2: Risk of bias summary of the prospective including studies using the Cochrane collaboration tool

Table 2: Quality assessment of retrospective studies

Study	Selection	Comparability	Outcome	Score
Mathews et al., 2011 [17]	****	*	***	8
Scherer et al., 2012 [19]	****	*	***	8
Al Saleh, 2015 [20]	****	*	**	7
Ho et al., 2016 [21]	****	*	**	7
Silveira et al., 2017 [22]	****	*	***	8
Choi et al., 2020 [23]	****	*	***	8
Pereira et al., 2020 [24]	****	*	**	7
Kim et al., 2022 [25]	***	*	***	7
Najafi et al., 2022 [26]	****	*	***	8

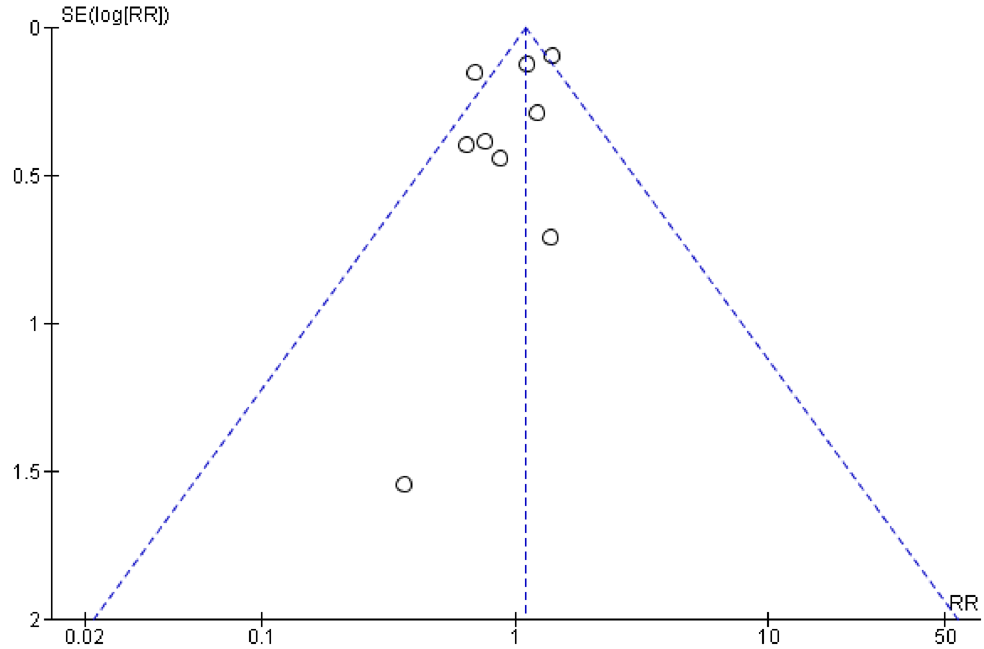

Figure 3: The forest plot of the comparison of mortality rate between EMS and non-EMS STEMI patients. CI, confidence interval; RR, risk ratio.

Study or Subgroup	EMS Events	EMS Total	Non-EMS Events	Non-EMS Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Al Saleh 2015	7	135	35	435	3.9%	0.64 [0.29, 1.42]
Ho 2016	216	2324	156	2343	36.3%	1.40 [1.15, 1.70]
Kim 2022	21	987	25	1429	4.8%	1.22 [0.68, 2.16]
Li 2008	9	186	20	312	3.5%	0.75 [0.35, 1.62]
Najafi 2022	56	934	113	1310	22.0%	0.70 [0.51, 0.95]
Pereira 2020	84	1474	215	4228	26.0%	1.12 [0.88, 1.43]
Scherer 2012	3	60	5	138	0.7%	1.38 [0.34, 5.59]
Silveira 2017	7	256	16	508	2.5%	0.87 [0.36, 2.08]
Tan 2011	0	89	2	163	0.4%	0.36 [0.02, 7.51]
Total (95% CI)		**6445**		**10866**	**100.0%**	**1.09 [0.96, 1.24]**
Total events	403		587			

Heterogeneity: Chi² = 17.79, df = 8 (P = 0.02); I² = 55%
Test for overall effect: Z = 1.37 (P = 0.17)

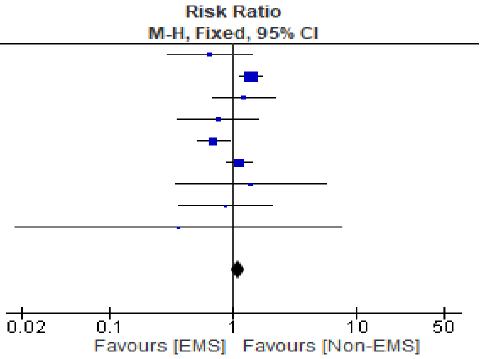

Figure 4: Funnel plot (mortality rate).

Study or Subgroup	EMS Mean	EMS SD	EMS Total	Nno-EMS Mean	Nno-EMS SD	Nno-EMS Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year
Li 2008	120	88.3	186	145	55.9	312	14.3%	-0.36 [-0.54, -0.17]	2008
Tan 2011	79.2	81.8	89	73.9	49.7	163	13.9%	0.08 [-0.17, 0.34]	2011
Mathews 2011	63	20.3	15805	76	30.2	10010	14.6%	-0.53 [-0.55, -0.50]	2011
Scherer 2012	50	25.6	60	62	43.2	138	13.7%	-0.31 [-0.61, -0.00]	2012
Silveira 2017	61	22.3	256	90	62.5	508	14.4%	-0.55 [-0.70, -0.40]	2017
Pereira 2020	29	11.5	1474	88	40.5	4228	14.6%	-1.67 [-1.73, -1.60]	2020
Kim 2022	140.02	452.64	987	294.19	560.21	1429	14.5%	-0.30 [-0.38, -0.22]	2022
Total (95% CI)			**18857**			**16788**	**100.0%**	**-0.52 [-0.97, -0.08]**	

Heterogeneity: Tau² = 0.36; Chi² = 1098.66, df = 6 (P < 0.00001); I² = 99%
Test for overall effect: Z = 2.30 (P = 0.02)

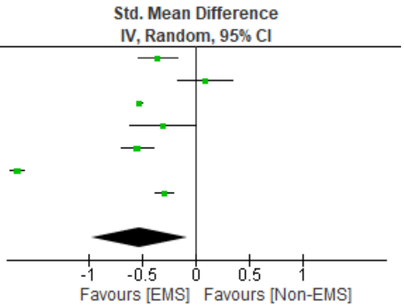

Figure 5: Forest plot of DBT between EMS and non-EMS STEMI patients. CI, confidence interval; SD, standard deviation; SMD, standard mean difference.

Table 1: Fundamental attributes of the included studies

Author	Country	Type of study	Total participants	Sample size		Sex ratio (F/M)		Age (years), mean ± SD		Outcome indicators*
				EMS group	Non-EMS group	EMS group	Non-EMS group	EMS group	Non-EMS group	
Li et al., 2008 [16]	China	Prospective	498	186	312	40/146	65/247	63.3±12.4	60.1± 12.1	5, 6, 2, 7, 8, 1, 3
Mathews et al., 2011 [17]	USA	Retrospective	37,634	22,585	15,049	7551/15034	4119/10930	62 (53–74)	59 (51–69)	5, 6; 2, 7, 3, 4
Tan et al., 2011 [18]	Singapore	Prospective	252	89	163	9/80	3/160	53.7 (9.5)	53.5 (10.4)	1, 2, 3
Scherer et al., 2012 [19]	USA	Retrospective	198	60	138	11/49	43/95	60 (54-70)	61 (53-69)	2, 3
Al Saleh, 2015 [20]	Arabian Gulf countries	Retrospective	**570**	135	435	8/128	32/406	51.8 ± 11.8	52.6 ± 10.7	5, 6, 7, 3
Ho et al., 2016 [21]	Singapore	Retrospective	4667	2324	2343	427/1897	446/1897	59.0 (21–102)	59.0 (21–97)	4, 2, 1, 3
Silveira et al., 2017 [22]	Portugal	Retrospective	764	256	508	66/190	139/369	62.71±13.03	62.60±13.48	6, 2, 3
Choi et al., 2020 [23]	Korea	Retrospective	1,634	577	1,057	131/446	224/833	62.6±12.9	61.7±13.4	4
Pereira et al., 2020 [24]	Portugal	Retrospective	5702	1474	4228	332/1142	1108/3120	64 ± 13	64 ± 14	5, 4, 6, 1, 8, 2, 7, 3
Kim et al., 2022 [25]	Korea	Retrospective	2416	987	1429	170/817	245/1184	61.26±12.66	60.84±11.79	2, 4, 3
Najafi et al., 2022 [26]	Iran	Retrospective	2244	934	1310	388/546	495/815	-	-	3

SBT: Symptom-to-balloon time; DBT: Door-to-balloon time; HR: heart rate, HR; SBP: systolic blood pressure, DBP: diastolic blood pressure; DNT: door to-needle time; STDT, symptom-to-door time; SD, standard deviation. SNT: symptoms to needle time. *outcome indicators: SBT [1], DBT [2], mortality rate [3], STDT [4], HR [5], SBP [6], DNT [7], SNT [8].

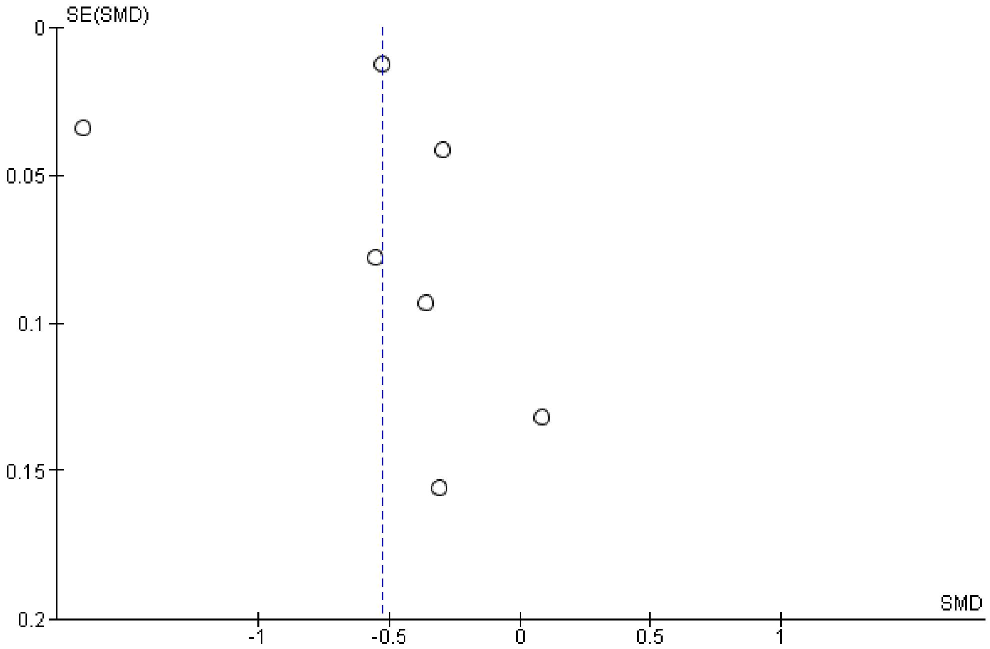

Figure 6: Funnel plot (clinical effect after treatment).

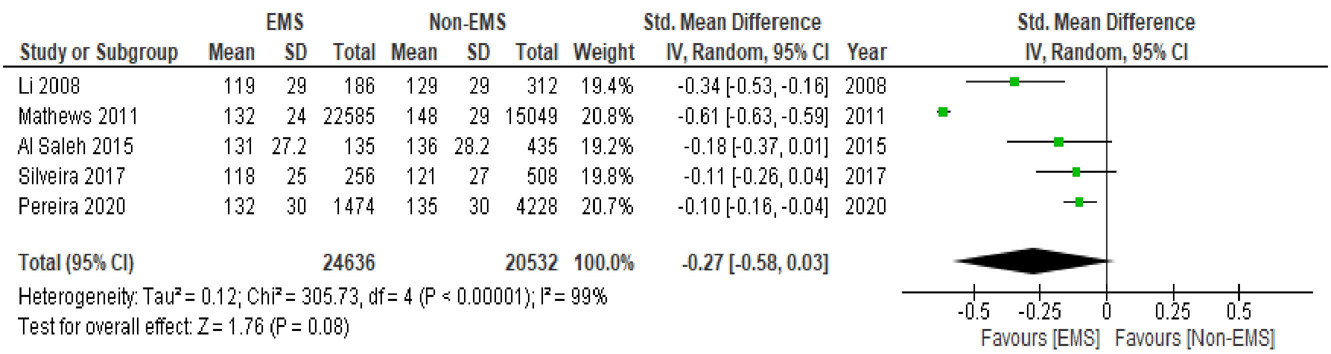

Figure 7: Forest plot of SBP comparison after treatment between EMS and non-EMS STEMI patients. CI, confidence interval; SD, standard deviation; SMD, standard mean difference.

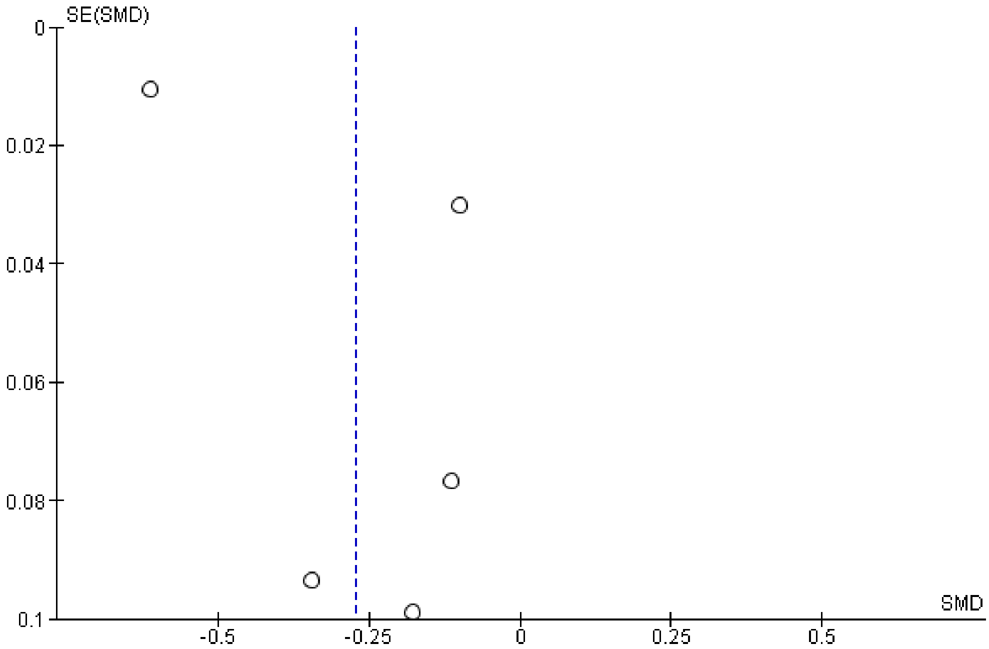

Figure 8: Funnel plot (SBP).

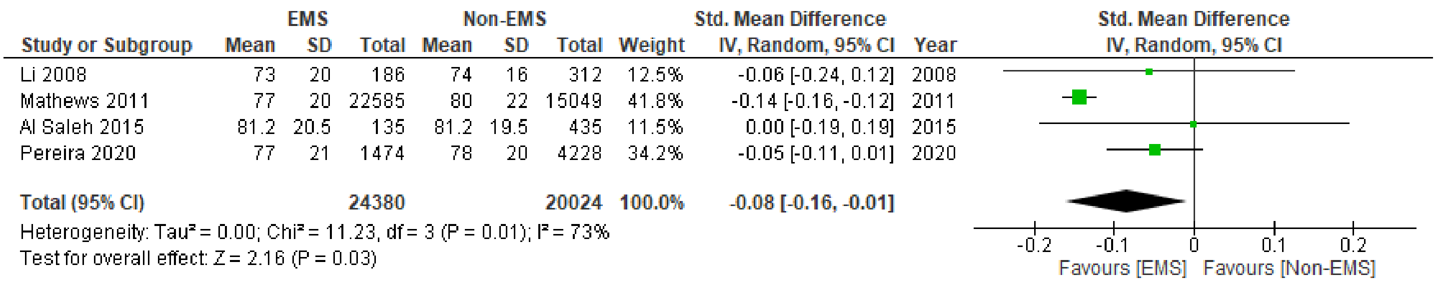

Figure 9: Forest plot of HR comparison after treatment between EMS and non-EMS STEMI patients. CI, confidence interval; SD, standard deviation; SMD, standard mean difference.

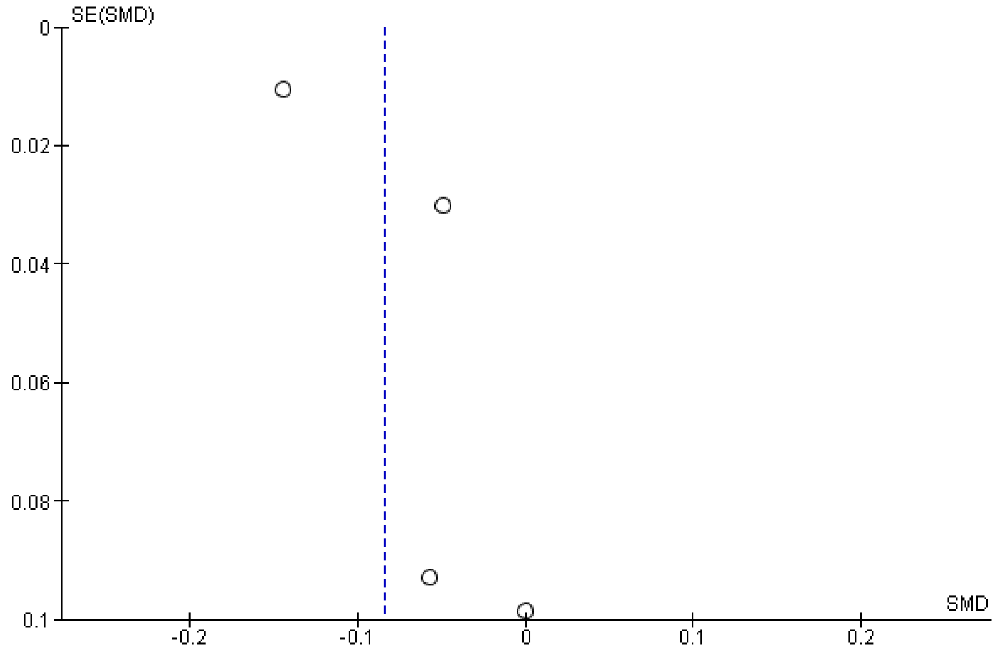

Figure 10: Funnel plot (heart rate)

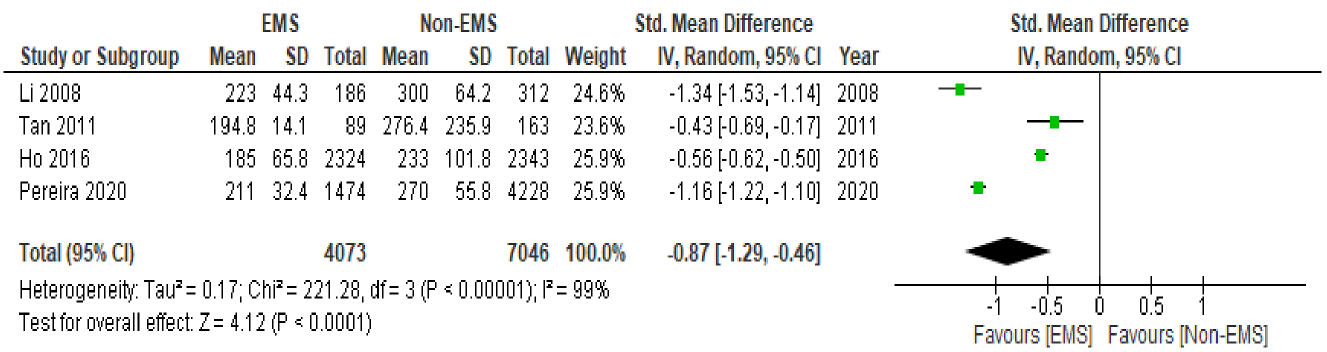

Figure 11: Forest plot of SBT comparison among EMS and non-EMS STEMI patients. CI, confidence interval; SD, standard deviation; SMD, standard mean difference.

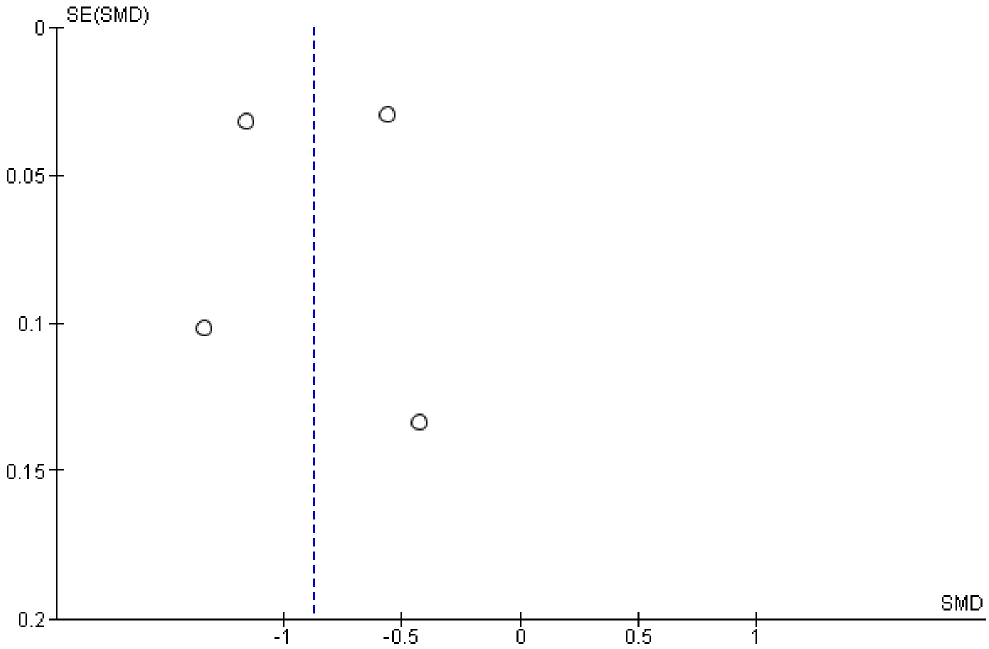

Figure 12: Funnel plot (SBT).

	EMS			Non-EMS				Std. Mean Difference	
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	Year
Mathews 2011	89	76.9	22585	120	99.7	15049	20.1%	-0.36 [-0.38, -0.34]	2011
Ho 2016	119	89.4	2324	182	101.8	2343	20.1%	-0.66 [-0.72, -0.60]	2016
Choi 2020	48	36.8	577	206	56.9	1057	19.7%	-3.11 [-3.26, -2.97]	2020
Pereira 2020	165	102.6	1474	183	120.6	4228	20.1%	-0.15 [-0.21, -0.10]	2020
Kim 2022	95.35	96.47	987	153.02	154.17	1429	20.0%	-0.43 [-0.51, -0.35]	2022
Total (95% CI)			**27947**			**24106**	**100.0%**	**-0.94 [-1.41, -0.46]**	

Heterogeneity: Tau² = 0.30; Chi² = 1456.55, df = 4 (P < 0.00001); I² = 100%
Test for overall effect: Z = 3.84 (P = 0.0001)

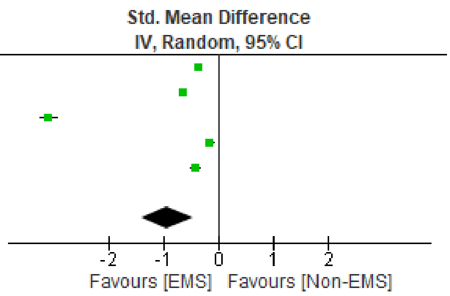

Figure 13: Forest plot of comparison of STDT among EMS and non-EMS STEMI patients. CI, confidence interval, SD: standard deviation.

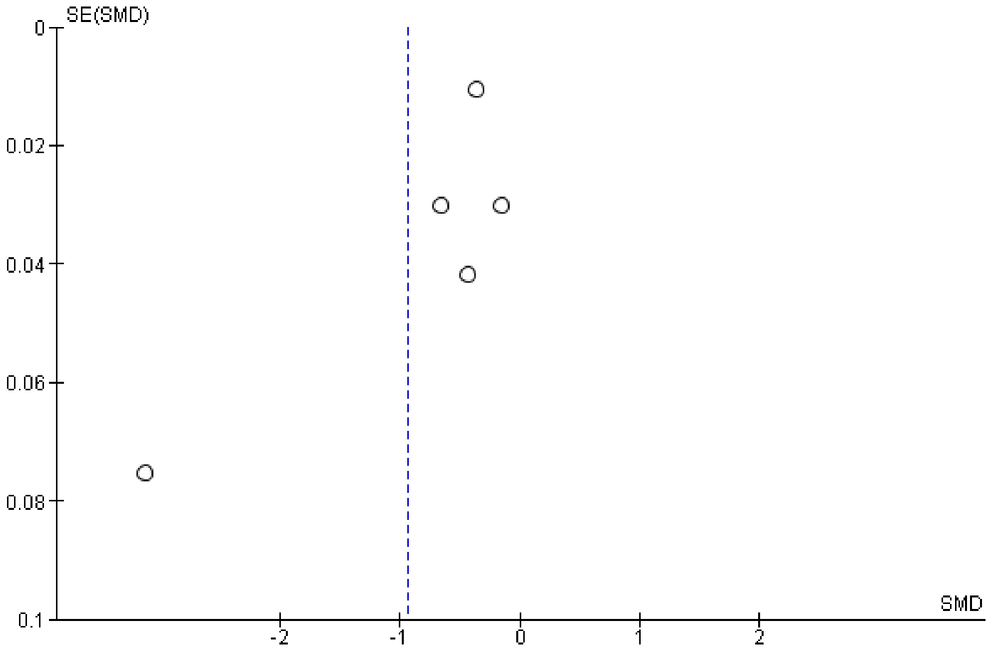

Figure 14: Funnel plot (STDT).

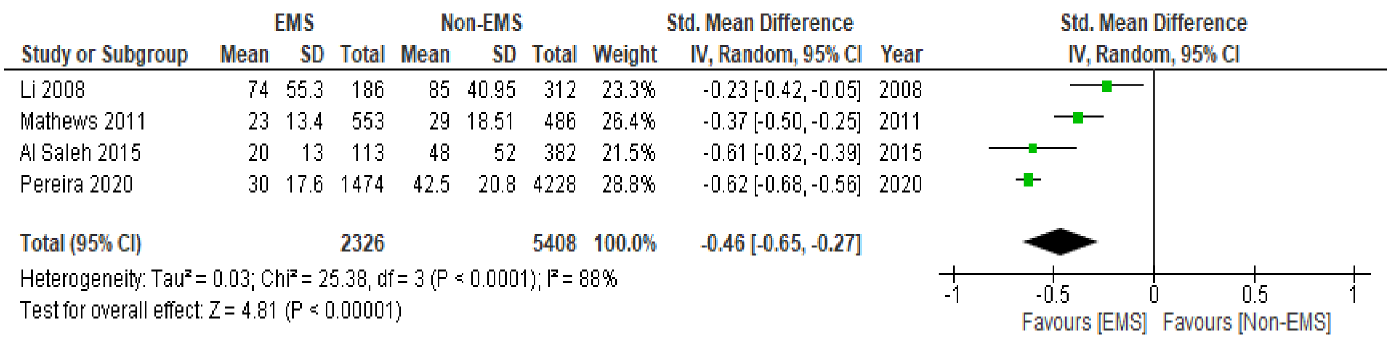

Figure 15: Forest plot of comparison of DNT among EMS and non-EMS STEMI patients. CI, confidence interval, SD: standard deviation.

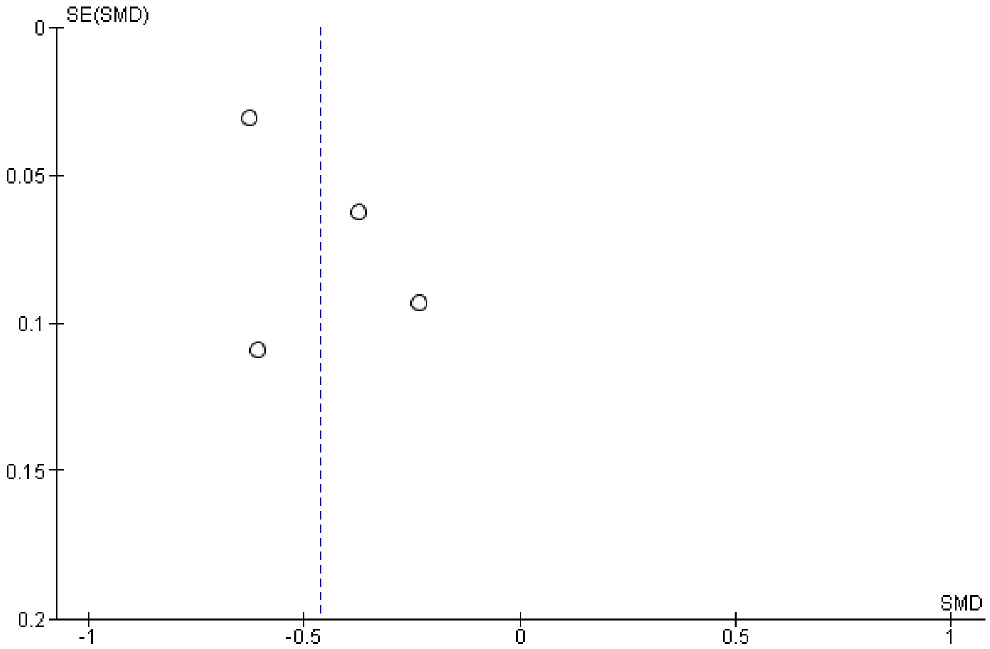

Figure 16: Funnel plot (DNT).

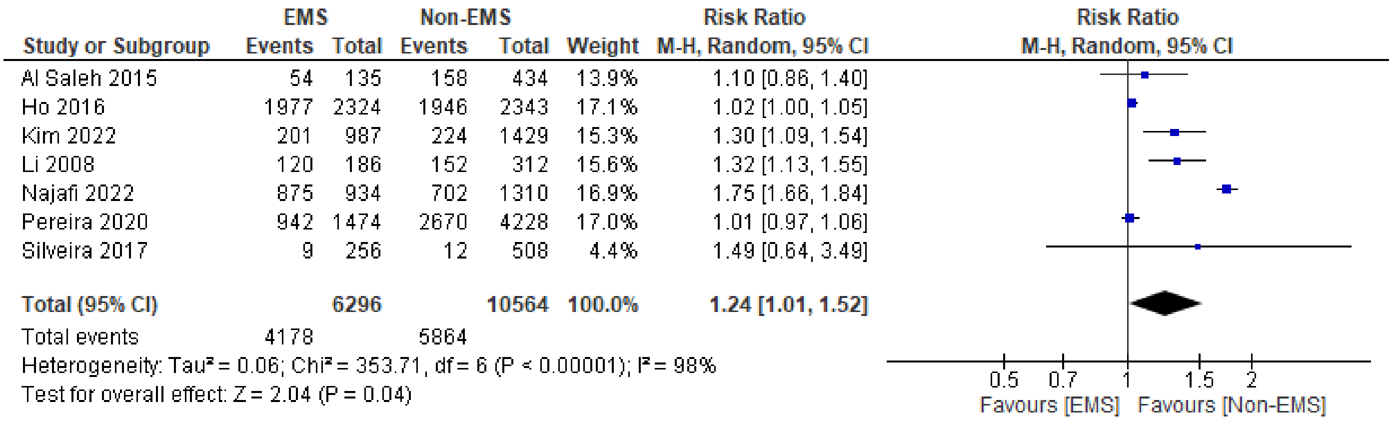

Figure 17: Forest plot of comparison of complication rates among EMS and non-EMS STEMI patients. CI, confidence interval; RR, risk ratio.

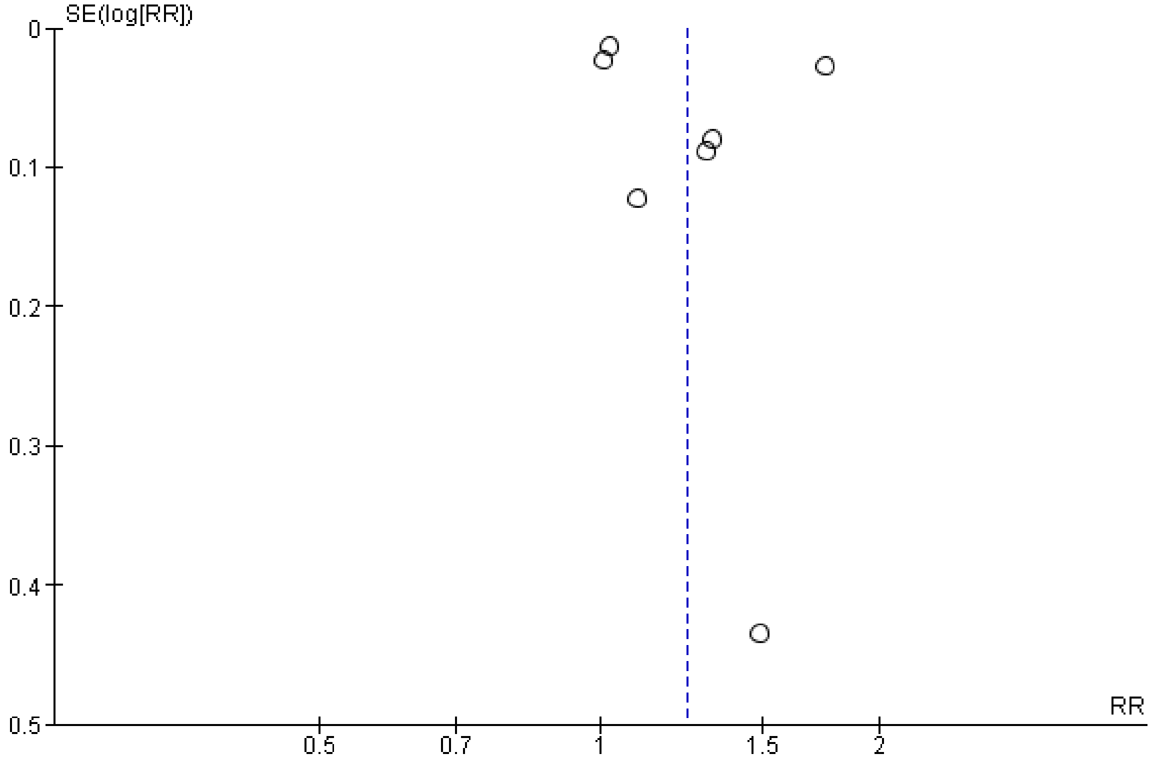

Figure 18: Funnel plot (clinical effect after treatment).

Reperfusion treatment is of the utmost importance because those suffering from AMI may have myocardial cells that are not sufficiently contractile and lose functionality as a result of ischemia. Time dependency is considerable with this form of therapy [43]. The patient's prognosis improves with a shorter reperfusion period during therapy. Consequently, restoring myocardial perfusion ought to constitute the first priority for patients requiring pre-hospital emergency therapy if they have a possibility of experiencing AMI [44]. Once the patient no longer has symptoms related to their heart rate, breathing, or blood pressure, they can be moved to a licensed hospital for all-encompassing care that will enhance their clinical outcome and prognosis [34].

3.2 Meta-analysis results

3.2.1Mortality rate

The death rate was reported in nine different articles. The fixed effect model was used to conduct the meta-analysis because there was minimal heterogeneity amongst the studies (I^2 = 55%). The results showed that the in-hospital mortality risk ratio among EMS and non-EMS STEMI patients did not significantly differ (p=0.17) (RR =1.09, 95% CI: 0.96 to 1.24; Figure 3). The overall symmetry was still evident, according to the death rate indicator's funnel plot analysis (Figure 4). There was no publication bias among the incorporated studies, according to the outcomes of Egger's test (P>0.05).

3.3 Comparison of door to balloon time (DBT)

Data on participants' DBT was provided in a total of 7 publications. Because of the high level of heterogeneity (I^2 = 99%) among the research studies, a random effect model was used to conduct the meta-analysis. The results showed that the DBT of the patients transferred by EMS was significantly lower than patients transported by other means of transportations (SMD =−0.52, 95% CI: −0.97 to −0.08, P=0.02; Figure 5). The overall symmetry was still evident, according to the funnel plot evaluation of DBT (Figure 6). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.4 Comparison of SBP after treatment

A total of 5 papers reported data on patients' SBP after treatment. There was high heterogeneity among the studies (I^2 =99%), so the meta-analysis was carried out using the random effect model. The results showed that the SBP of the patients was lower among EMS patients than patients transported by non-EMS means (SMD =−0.27, 95% CI: −0.58 to −0.03, P=0.08; Figure 7).

The overall symmetry was still evident, according to the funnel plot evaluation of the SBP (Figure 8). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.5 Comparison of heart rate after treatment

A total of 4 papers reported data on heart rate of patients after treatment. There was a high heterogeneity among the studies (I^2 =73%), so the meta-analysis was carried out by the random effect model. The results showed that the HR of the patients was significantly reduced among EMS transported patients than Non-EMS transported patients (SMD =−0.08, 95% CI: −0.16 to −0.01, P=0.03; Figure 9). The overall symmetry was still evident, according to the funnel plot evaluation of the HR (Figure 10). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.6 Comparison of symptoms to balloon time (SBT)

A total of 4 papers reported data on symptoms to balloon time of EMS and non-EMS STEMI patients. There was high heterogeneity among the studies (I^2 =99%), so the meta-analysis was carried out by the random effect model. The results showed that the SBT was significantly lower among EMS transported patients than non-EMS patients (SMD =−03.87, 95% CI: −1.29 to −0.46, P<0.001; Figure 11). The overall symmetry was still evident, according to the funnel plot evaluation of SBT (Figure 12). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.7 Comparison of symptoms to door time (STDT) among EMS and non-EMS STEMI patients

A total of 5 papers reported data on STDT. There was a high heterogeneity among the studies (I^2 =100%), so the meta-analysis was carried out by the random effect model. The results showed that STDT of the EMS transported patient significantly reduced than non-EMS patients (SMD =-0.94, 95% CI: -1.41 to -0.46, P< 0.001; Figure 13). The overall symmetry was still evident, according to the funnel plot evaluation of STDT (Figure 14). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.8 Comparison of door to needle time (DNT) among EMS and non-EMS STEMI patients

A total of 4 papers reported data on DNT. There was a high heterogeneity among the studies (I^2 =88%), so the meta-analysis was carried out by the random effect model. The results showed that DNT of the EMS transported patient was significantly lower than non-EMS patients (SMD =-0.46, 95% CI: -0.65 to -0.27, P< 0.001; Figure 15). The overall symmetry was still evident, according to the funnel plot evaluation of DNT (Figure 16). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.9 Comparison of incidence of complications after treatment

A total of 7 papers reported data on the incidence of complications in patients transported by EMS and those non-EMS transported patients. There was a high heterogeneity among the studies (I^2 =98%), therefore the meta-analysis was performed using the random effect model. The results showed that the incidence of complications after treatment among non-EMS patients was significantly higher than those patients transported by EMS means (RR =1.24, 95% CI: 1.01 to 1.52, P=0.04 (Figure 17). The overall symmetry was still evident, according to the funnel plot evaluation of complications rate (Figure 18). The included articles did not exhibit publication bias, according to the outcomes of Egger's test (P>0.05).

3.2 Limitations

There are a few other restrictions and issues with the study. First off, despite our best efforts to locate papers and track down sources for this article, there might still be omissions due to lack of some essential outcomes.

4. Conclusions

In conclusion, those suffering from STEMI can benefit clinically from the EMS pre-hospital first aid transport. This approach may successfully avoid the patients from getting worse, lower the risk of complications, and decrease the time it takes for patients to receive comprehensive medical care. This article demonstrates how EMS transportation can greatly enhance sufferers' clinical results by lowering mortality rate, SBP, HR, DBT, SBT, STDT, DNT and incidence of after-treatment complications. Additional high-quality randomised controlled trials are required to confirm this result.

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Acknowledgments

The author would like to express his gratitude to Dar Al Uloom University, Riyadh. KSA.

Financial support

There is no source of funding for this study.

Conflicts of interest

The author declares that there are no conflicts of interest.

Ethical approval

All ethical procedures were followed, and our study was validated by a provincial ethics commission.

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