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META ANALYSIS

Meta-analysis of Prognostic Indicators in Burned Patients

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Abstract

Background: **The chance of death after a burn injury is considerable. There is a dearth of recent epidemiological data on burn injury and mortality rates in Egypt.**

Objective: **This study used meta-analysis to look at the prognostic markers in burn victims.**

Materials and methods: **This was a meta-analysis, and articles from PubMed, PLOS, and Clarivate - Scopus were searched for relevant material. To retrieve articles from the previous 10 years, we used a variety of search engines, including EKB. A total of 20 studies were included, 6 were retrospective studies, 1 case series, 1 case control, 1 cross sectional, and 1 prospective study.**

Results: **18 studies showed the differences between survivors and nonsurvivors according to TBS burned showed significant higher in TBS burned among nonsurvivors with *P* value less than 0.0001, and three studies showed the differences between survivors and nonsurvivors according to Modified Baux score showed significant higher in Modified Baux score among non survivors with *P* value less than 0.0001.**

Conclusion: **The most significant predictive markers for burn injury in this study were age, comorbidities, inhalational injury, and burn size.**

Keywords: Baux score, Burn unit, Burns, Fatality rate are all used and inhalation injury

1. Introduction

One of the most frequent traumas encountered by medical workers is burn injuries. Compared with other injuries, severe burn injuries have a higher rate of morbidity and disability.[1]

Burn injuries can have an impact on a patient's entire being, including their physical and mental health. Burn injuries can happen to people of any age, including infants and the elderly, and they can be a concern in both developed and poor nations. Burn injuries create pain and suffering that last longer than just the moment they occur. Both obvious physical wounds and unseen psychological wounds heal slowly and frequently result in persistent impairment.[2]

The outcome of severe burn damage might be fatal. According to a research, 62 (6.3%) of the 980 patients who received treatment died. Additionally, there were found favourable associations between age, degree, kind, and percentage of burn injuries and death.[3]

Over the past three decades, scoring systems for the evaluation, classification, and outcome prediction of immediately posttraumatic patients have become more and more popular. The Glasgow coma scale, the trauma score, and the injury severity score have all gained general acceptance among the many different scores.[4]

An index's usefulness for optimizing therapeutic decisions increases with its accuracy. Because of this, a number of burn indices based on various statistical techniques have recently been examined in an effort to improve their predictive abilities. However, a burn centre can acquire an accurate prognostic index either by adapting one of the existing indices to its own requirements and

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conditions or by creating a brand-new index and regularly updating it.[4]

Burn trauma is in need for prognostic indicators or admission scores. This aims for realistic documentation of the burn injury, expectation of the prognosis, and to facilitate a patient stratification to evaluate therapeutic strategies. Variable studies were found related to that issue; the reliable indicators found had been classified as general or specific clinical and laboratories indicators. All of them had certain prognosis importance. We believe that we still lack the proper prognostic indicator in burn patients. This study aims to organize a more reliable prognostic indicator and scoring system for burn patients. The aim of the Work was to investigate the prognostic factors in burned patients through Meta-analysis.

2. Methodology meta-analysis

2.1. Data sources

Literature was sourced from the databases PubMed, PLOS, and Clarivate-Scopus listed articles. We will use a variety of search engines, like EKB, to obtain articles from the previous 10 years.

2.2. Study selection

All articles that have been published and look into burn patients' prognostic variables.

2.3. Data extraction and synthesis

Data extraction was carried out methodically by two independent reviewers while following the PRISMA recommendations. In a meta-analysis using a random-effects model, summary measures were pooled.

Outcomes and measures through a meta-analysis, a study evaluated prognostic markers in burn patients.

2.4. Statistical analysis of the data

MedCalc software programme version 15.8 was used to examine the data after it was supplied into the computer. A P value of 0.05 or less was considered statistically significant, and the confidence interval (CI) was set at 95%. I (observed variance for heterogeneity) and Q were used to evaluate statistical heterogeneity (Total variance for heterogeneity). Quantitative data are provided as mean and SD standard deviation, but qualitative data are reported as total number and number of events.

3. Results

A total of 20 studies were included 6 were retrospective studies, 1 case series, 1 case control, 1 cross sectional, and 1 prospective study. Tables 1 and 2.

A total of 177,127 patients were included with mean age 47.2 years; Patients were divided in included studies according to outcome to survivors and non survivors to assess the prognostic factors to outcome. Table 2.

18 studies examine differences between survivors and nonsurvivors according to age there was significant higher in age among nonsurvivors cases with P value less than 0.0001. Fig. 1.

5 studies assess differences between survivors and nonsurvivors according to co morbidities and showed that there was significant higher of cases with positive co morbidities among nonsurvivors P value less than 0.0001. Fig. 2.

1 studies assess effect of inhalational injury and found that higher percentage of cases with inhalational injury among nonsurvivors with P value less than 0.0001. Fig. 3.

18 studies showed the differences between survivors and non survivors according to TBS burned showed significant higher in TBS burned among non survivors with P value < 0.0001. Table 3.

8 studies showed the differences between survivors and nonsurvivors according to FTSA% showed significant higher in FTSA% among nonsurvivors with P value less than 0.0001. Table 4.

3 studies showed the differences between survivors and nonsurvivors according to burn index showed significant higher in burn index among nonsurvivors with P value less than 0.0001. Fig. 4.

Table 1. Study characteristics.

Author	Type of study
Lam NN et al.[5]	retrospective
Obed D et al.[6]	retrospective
Meuli JN et al.[7]	retrospective
Park JH et al.[8]	retrospective
Yoshimura Y et al.[9]	retrospective
Temiz A et al.[10]	retrospective
Kaita Y et al.[11]	retrospective
Lip HTC et al.[12]	retrospective
Lam NN et al.[13]	CASE SERIES
Setoodehzadeh F et al.[14]	case-control
Xu Y et al.,2018	retrospective
Zavlin D et al.[15]	retrospective
Anam K et al.[1]	cross-sectional
Lam NN et al.[16]	retrospective
Dokter J et al.[17]	Prospective
Yang HT et al.[18]	retrospective
Chen CC et al.,2012	retrospective
Finnerty CC et al.[19]	retrospective
Yang HT et al.,2012	retrospective
Mahar P et al.[20]	retrospective

Table 2. Patient's characteristics.

author	outcome	number	age	m\f
	Survivors	46	32.2 (15.3)	36\10
Lam NN et al.[5]	Nonsurvivors	268	41.5 (16.9)	208\60
	Survivors	528	46.7 ± 18.3	379\149
Obed D et al.[6]	Nonsurvivors	89	61.9 ± 18.7	63\26
	Survivors	29	28	24\5
Meuli JN et al.[7]	Nonsurvivors	10	58	9\1
	Survivors	533	52.0 ± 14.4	441/92
Park JH et al.[8]	Nonsurvivors	198	58.0 ± 15.9	166/32
	Survivors	7064	49	4417\2647
Yoshimura Y et al.[9]	Nonsurvivors	847	72	547\300
	Survivors	109	15.17 ± 18.23	61\48
Temiz A et al.[10]	Nonsurvivors	24	33.04 ± 26.64	8\16
	Survivors	45	49	28\17
Kaita Y et al.[11]	Nonsurvivors	24	65.5	18\6
	Survivors	463	33.7 ± 14.2	325\138
Lip HTC et al.[12]	Nonsurvivors	62	39.9 ± 16.8	47\15
	Survivors	375	74.1 7.8	195\180
Lam NN et al.[13]	Nonsurvivors	41	79.6 9.8	13\28
	Survivors	228	25	135\93
Setoodehzadeh F et al.[14]	Nonsurvivors	215	34.5	85\130
	Survivors	16	34 ± 10	12\4
Xu Y et al.,2018	Nonsurvivors	22	43 ± 12	18\4
	Survivors	132,531	30.5 ± 22.4	91814\40,717
Zavlin D et al.[15]	Nonsurvivors	4530	56.5 ± 22.5	2933\1597
	Survivors	91		
Anam K et al.[1]	Nonsurvivors	28		
	Survivors	267		191\76
Lam NN et al.[16]	Nonsurvivors	65		56\9
	Survivors	4103	25	2748\1355
Dokter J et al.[17]	Nonsurvivors	286	62.5	154\132
	Survivors	148	47 ± 14	115\33
Yang HT et al.[18]	Nonsurvivors	56	52 ± 14	46\10
	Survivors	22,665	30.74 (22.60)	14634\8031
Chen CC et al.,2012	Nonsurvivors	482	45.58 (21.27)	361\121
	Survivors	288	8 ± 5	204\48
Finnerty CC et al.[19]	Nonsurvivors	44	9 ± 6	23\21
	Survivors	166	47	138\28
Yang HT et al.,2012	Nonsurvivors	61	51	47\14
	Survivors	65	78.7 (0.81)	
Mahar P et al.[20]	Nonsurvivors	15	83.2 (2.0)	

3 studies showed the differences between survivors and nonsurvivors according to Modified Baux score showed significant higher in Modified Baux score among nonsurvivors with *P* value less than 0.0001. Table 5.

3 studies showed the differences between survivors and nonsurvivors according to length of mechanical ventilation (days) showed significant higher in length of mechanical ventilation (days) among nonsurvivors with *P* value less than 0.0001. Fig. 5.

4. Discussion

In middle- and low-income nations, burn-related fatalities account for over 90% of all burn-related deaths. Millions of people, most of whom are from low socioeconomic backgrounds, experience disability and disfigurement, which has an impact on their mental, emotional, and financial well-being as well as that of their families Sierra Zúñiga and colleagues.[21]

In order to assist clinicians in estimating the mortality risk of new patients, a prognostic model for burn patients has been created. These prognostic models frequently take into account the patient's demographics, the burn's total body surface area (TBSA), inhalation injury, and other variables. The Belgian Outcome of Burn Injury (BOBI), the Abbreviated Burn Severity Index, and the Revised Baux Score (rBaux) were some of the predictive models that were most frequently utilised in the

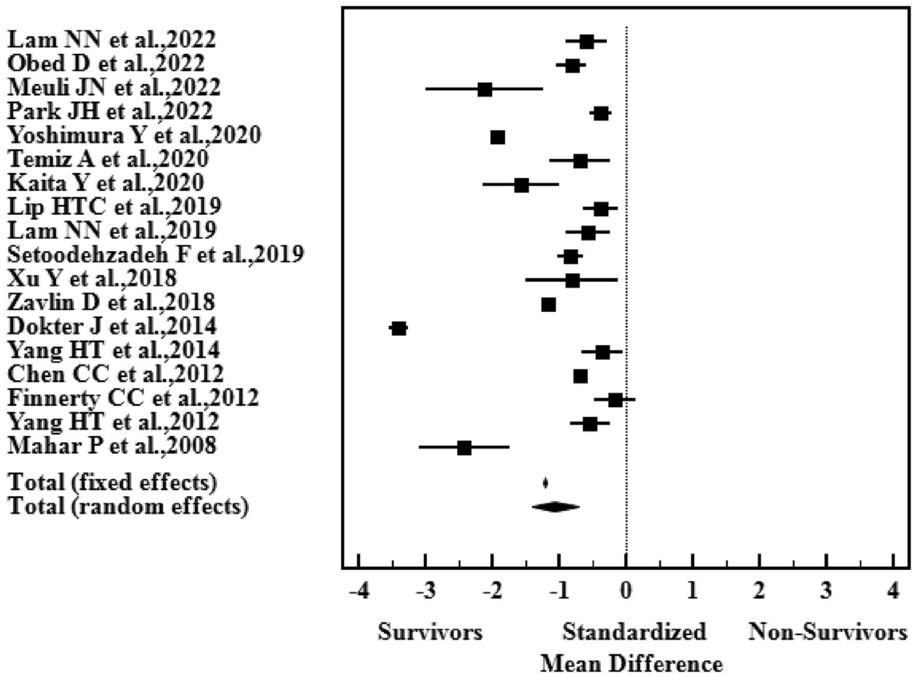

Fig. 1. Forest plot for age.

Indonesian clinical environment (ABSI) Herlianita and colleagues.[22]

In this work, we used meta-analysis to look at the prognostic markers in burn patients. In this meta-analysis, publications that were listed in PubMed, PLOS, and Clarivate-Scopus were searched for literature. To retrieve articles from the previous 10 years, we used a variety of search engines, including EKB.

A total of 20 studies were included 6 were retrospective studies, 1 case series, 1 case control, 1 cross sectional, and 1 prospective study.

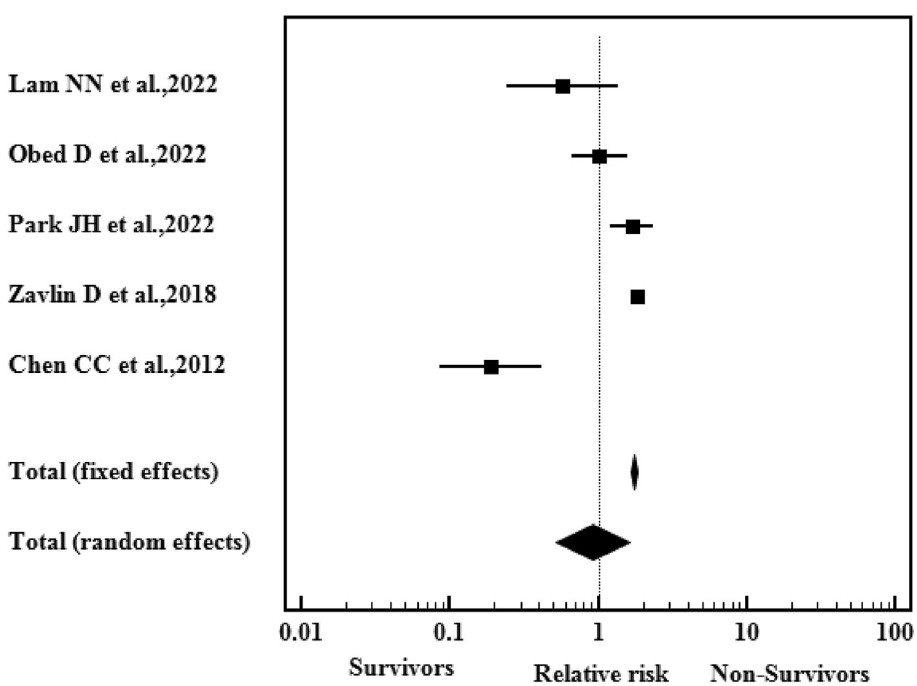

Fig. 2. Forest plot for comorbidities.

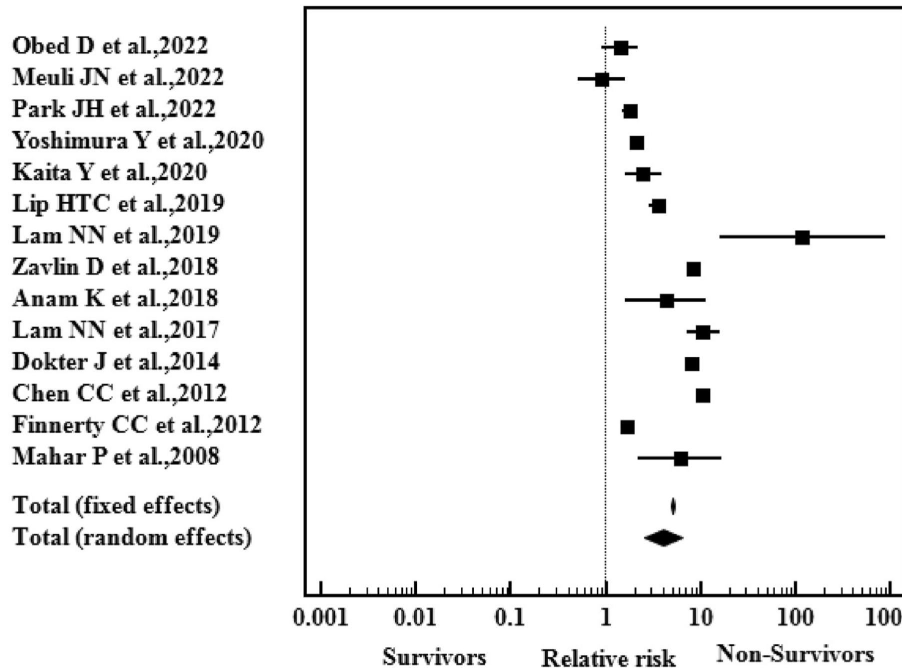

Fig. 3. Forest plot for inhalation injury.

Table 3. Meta-analysis for percent TBS burned.

Study	Survivors		Nonsurvivors			SE	95% CI
	No.	Mean ± SD.	No.	Mean ± SD.	SMD		
Lam NN et al.[5]	46	45.1 ± 26.9	268	72.7 ± 21.5	1.231	0.167	0.904–1.559
Obed D et al.[6]	528	19.8 ± 10.6	89	43.5 ± 13.9	2.126	0.129	1.872–2.381
Meuli JN et al.[7]	29	60 ± 13.8	10	84 ± 21.9	1.456	0.395	0.655–2.257
Park JH et al.[8]	533	38.5 ± 15.1	198	63.6 ± 20.7	1.493	0.092	1.312–1.673
Yoshimura Y et al.[9]	7064	6 ± 8.9	847	50 ± 12.9	4.676	0.052	4.574–4.778
Temiz A et al.[10]	109	22.92 ± 9.11	24	52.04 ± 23.52	2.250	0.263	1.730–2.771
Kaita Y et al.[11]	45	38 ± 1.8	24	81.5 ± 5.9	11.463	1.007	9.453–13.474
Lip HTC et al.[12]	463	15.7 ± 13.2	62	50.5 ± 26.1	2.275	0.152	1.976–2.574
Lam NN et al.[13]	375	7.1 ± 9.7	41	35.5 ± 23.9	2.394	0.184	2.033–2.756
Setoodehzadeh F et al.[14]	228	29.5 ± 13.8	215	60 ± 16.8	1.986	0.116	1.758–2.214
Xu Y et al., 2018	16	69 ± 20	22	71 ± 22	0.092	0.322	−0.560–0.745
Zavlin D et al.[15]	132531	8.0 ± 10.4	4530	43.2 ± 29.4	3.051	0.016	3.019–3.082
Anam K et al.[1]	267	21 ± 17.8	65	74.5 ± 17.9	2.996	0.180	2.641–3.350
Lam NN et al.[16]	4103	5 ± 11.9	286	38 ± 13.8	2.742	0.068	2.609–2.875
Dokter J et al.[17]	148	42.4 ± 14.9	56	60.3 ± 18.9	1.108	0.166	0.782–1.435
Yang HT et al.[18]	288	59 ± 16	44	78 ± 14	1.203	0.168	0.873–1.534
Chen CC et al., 2012	166	40.8 ± 16.2	61	64.6 ± 20.8	1.352	0.162	1.032–1.672
Finnerty CC et al.[19]	65	11.25 ± 1.42	15	33.4 ± 5.4	8.358	0.719	6.926–9.790
Total (fixed effects)					3.023	0.014	2.995–3.051
Total (random effects)					2.595	0.258	2.090–3.100
Test for heterogeneity							
Q	2176.6631						
DF	17						
Significance level	<0.0001*						
I^2 (inconsistency)	99.22%						
95% CI for I^2	99.09–99.33						

Q: Total variance for heterogeneity.
SMD: Standardized Mean Difference.
I^2: Observed variance for heterogeneity.
CI, Confidence interval; (LL, Lower limit; UL, Upper Limit).

Table 4. Meta-analysis for FTSA%.

Study	Survivors		Nonsurvivors		SMD	SE	95% CI
	No.	Mean ± SD.	No.	Mean ± SD.			
Lam NN et al.[5]	46	23.3 ± 3.4	268	48.3 ± 23.5	1.145	0.166	0.819–1.471
Obed D et al.[6]	528	35 ± 6.8	89	79 ± 13.99	5.344	0.190	4.970–5.718
Yoshimura Y et al.[9]	7064	5 ± 9.7	847	14.6 ± 16.8	0.898	0.037	0.826–0.971
Kaita Y et al.[11]	45	16 ± 13.8	24	67.5 ± 8.9	4.127	0.431	3.266–4.987
Lam NN et al.[13]	375	2.1 ± 4.5	41	21.3 ± 18.8	2.647	0.188	2.277–3.016
Zavlin D et al.[15]	132531	2.8 ± 7.8	4530	31.6 ± 30.9	3.029	0.016	2.998–3.061
Lam NN et al.[16]	267	4.5 ± 3.6	65	42.7 ± 14.9	5.211	0.245	4.729–5.692
Mahar P et al.[20]	65	4.56 ± 0.79	15	22.1 ± 4.3	8.875	0.757	7.368–10.382
Total (fixed effects)					2.704	0.015	2.676–2.733
Total (random effects)					3.777	0.545	2.708–4.845
Test for heterogeneity							
Q	3242.7647						
DF	7						
Significance level	<0.0001*						
I^2 (inconsistency)	99.78%						
95% CI for I^2	99.75–99.82						

Q: Total variance for heterogeneity.
SMD: Standardized Mean Difference.
I^2: Observed variance for heterogeneity.
CI, Confidence interval; (LL, Lower limit; UL, Upper Limit).

This is come in agreement with the study of Colohan and Sh,[23] in which an electronic search of English-language publications that identify prognostic risk factors in thermal burns including IHT was carried out. Each article was reviewed systematically, and data extraction, quality assessment, and summarization of the articles were performed. Thirteen articles that met the inclusion/exclusion criteria of this study were reviewed.

Moreover, Hussain and Dunn,[24] sought to do electronic searches on MEDLINE, CINHAL, EMBASE, Online of Science, the Cochrane collection, and a general web search on Google in order to identify the pertinent factors, quantify the risk associated with these characteristics, and build predictive prognostic models. A manual search of the top burning journals' contents was added to the searches. The effectiveness of the studies that were

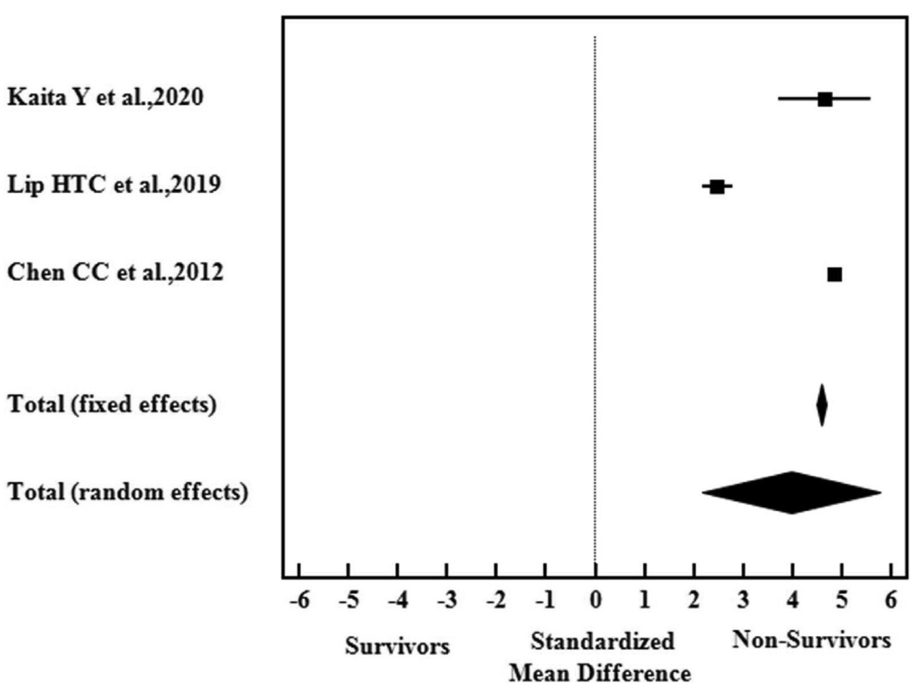

Fig. 4. Forest plot for burn index.

Table 5. Meta-analysis for Modified Baux score.

Study	Survivors		Nonsurvivors		SMD	SE	95% CI
	No.	Mean ± SD.	No.	Mean ± SD.			
Obed D et al.[6]	528	69.2 ± 21.2	89	108.9 ± 23.6	1.839	0.126	1.592–2.086
Meuli JN et al.[7]	29	111 ± 21.9	10	148 ± 19.8	1.693	0.407	0.868–2.518
Lip HTC et al.[12]	463	53.02 ± 21.63	62	104.16 ± 26.05	2.301	0.153	2.001–2.601
Dokter J et al.[17]	4103	33.5 ± 19.8	286	108 ± 2.9	3.888	0.074	3.743–4.032
Total (fixed effects)					3.174	0.058	3.060–3.288
Total (random effects)					2.449	0.630	1.215–3.684
Test for heterogeneity							
Q	251.6952						
DF	3						
Significance level	<0.0001*						
I^2 (inconsistency)	98.81%						
95% CI for I^2	98.17–99.22						

Q: Total variance for heterogeneity.
SMD: Standardized Mean Difference.
I^2: Observed variance for heterogeneity.
CI, Confidence interval; (LL, Lower limit; UL, Upper Limit).

part of the evaluation was assessed in comparison to existing guidelines for prognostic studies. After meeting the inclusion/exclusion criteria, 14 studies were included in the review.

In the current research, a total of 177,127 patients were included with mean age 47.2 years, Patients were divided in included studies according to outcome to survivors and nonsurvivors to assess the prognostic factors to outcome. Furthermore, 18 studies examine differences between survivors and nonsurvivors according to age there was significant higher in age among nonsurvivors' cases with *P* value less than 0.0001.

In contrary to our findings, the study of Abdel-Wahab and colleagues,[25] reported that higher incidence of children with burns (48 cases), representing 59.8% of the total number of cases, and only 34 adults, representing 40.2% of cases. The mean age of our cases was 16.5 years. More male patients than females were admitted, with a male/female ratio of 1 : 1.5.

In a cross sectional study of Anam and Dachlan,[26] which sought to examine the predictive variables influencing the mortality of patients with second- and third-degree burn injuries. The majority of the burn victims were female and largely adult in age.

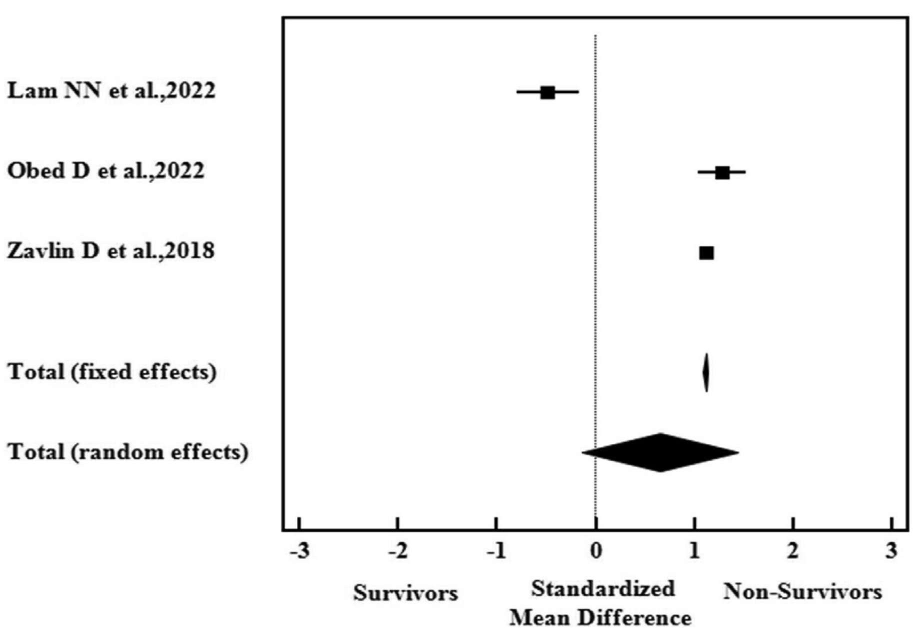

Fig. 5. Forest plot for length of mechanical ventilation (days).

The majority of the patients in this study were still alive. Majority of cases 63% were adult. On the other hand, we found that 5 studies assess differences between survivors and nonsurvivors according to co morbidities and showed that there was significant higher of cases with positive co morbidities among nonsurvivors P value less than 0.0001. Brando and colleagues[27] reported that a total of 677 adult patients were included in the study, 54.8% of whom were male. Their findings are consistent with ours.

The median TBSA burned was 7%, the median LOS was 15 days, and the median age was 60 years old. Inhalation injury was diagnosed in 11.5% of patients, while concomitant conditions were present in 57.5% of patients. Mortality rates in hospitals as a whole were 6.5%. Flame injury made up 54.6% of all burn trauma mechanisms.

When compared with patients who survived, patients who died were considerably older ($P = 0.001$), had larger percentages of TBSA burned ($P = 0.001$), were more likely to have inhalation injuries (P = 0.000.1) and comorbidities (P = 0.000.1), and had higher CCI scores ($P = 0.001$). On the other hand, Burns and colleagues[28] found a strong correlation between the length of hospital stay and mortality and a variety of comorbid conditions, including cardiac, pulmonary, renal, hepatic, and neurological problems. In the current meta-analysis, one study evaluated the impact of inhalational damage and discovered a greater percentage of cases among nonsurvivors with inhalational injury, with a P value of 0.0001. Inhalation injury, which lowers oxygen perfusion as a result of direct heat injury to the upper respiratory tract, chemical stimulation of the lower respiratory tract, and injury in response to noxious gases, such as carbon monoxide and cyanide, affects up to one-third of patients with serious burns. Inhalation injury increases the mortality risk in burn cases as a result. Hassan and colleagues[29] discovered that the PF ratio, TBSA burned, patient age, and inhalation injury were all predictive of death. Despite the fact that inhalation injury among burn victims is a strong predictor of death, there is currently no established diagnostic criteria and no indicators of its severity have been found. According to TBS burned, there were significant differences between survivors and nonsurvivors in the current study's 18 studies, with a P value of 0.0001 for the difference between TBS burned among nonsurvivors.

Kim and colleagues[30] showed that the mean % TBSA burnt varied greatly between survivors (26.7%) and nonsurvivors (66.2%), totalling 36.8% overall, which contrasts with our findings. Of the 676 patients, 541 (or 80%) suffered full-thickness burns.

Oenarta and colleagues,[31] stated that differences in age, burn severity, and TBSA features were discovered, and that these differences were greater in the mortality group.

In a similar vein, the distribution of predictive model scores varied across the two groups, with the mortality group's median score being greater.

In addition to above findings, in the present stud; 3 studies showed the differences between survivors and nonsurvivors according to burn index showed significant higher in burn index among nonsurvivors with P value less than 0.0001.

In agreement with our findings, Usmani and colleagues,[32] reported that survival rates significantly decreased between ABSI scores of 8−9 and 10−11, from 84.62% in the former to 16.67% in the latter. Patients in ABSI groups 10 and 11 require more intensive treatments to increase their chances of survival. These findings suggest that ABSI can predict death with a high degree of accuracy. Data analysis revealed that the sensitivity was 0.96 and specificity was 1. Between the groupings of positive and negative real estate, the ABSI score contains at least one tie.

These results supported those of the retrospective analysis on burns conducted by Gutierrez et al. in 2015. Nthumba and Oliech's research,[33] in a retrospective analysis of burns, found that overall survival significantly dropped between ABSI scores of 6−7 and 8−9, from 70% in the former to 20% in the latter.

In our systematic review, there were 3 studies showed the differences between survivors and nonsurvivors according to Modified Baux score showed significant higher in Modified Baux score among nonsurvivors with P value less than 0.0001. Studies of Tan and colleagues[34]; Rosanova and colleagues,[35] Additionally, a greater fatality rate was found when patients with severe burns were being mechanically ventilated.

According to Rosanova and colleagues study's[35] the mortality rate for intubated paediatric patients was 22%. Our understanding of the mortality rate in mechanically ventilated patients and its contributing components, however, still has a sizable knowledge gap.

It was found that mechanical ventilation was a major predictor of death. In the current investigation, three studies that compared the length of mechanical ventilation (days) between survivors and nonsurvivors revealed a significantly higher length of mechanical ventilation (days) among nonsurvivors with a P value of 0.0001. On the other hand, according to Ismaeil and colleagues findings[36] for patients who were admitted to ICUs and were receiving mechanical ventilation during the study period, the median time spent alive in the ICU was 11 days, and the total death rate was 37%.

(6−20 days, IQR). The study was limited to participants who had received mechanical breathing during the previous 30 days because the average interval was only 11 days.

(95% CI: 22.4 to 33.2) The mortality rate was March 27, 1000 person years. The total survival rate at 30 days after starting mechanical breathing was 82% after the fifth day and 75% after the tenth. Conclusion: It is crucial to be able to forecast the outcomes of severe burns in order to make clinical and financial decisions that will benefit patients' families and medical professionals. The ABSI score method may be used to determine age, comorbidities, inhalation injury, and other burn scores, making it a trustworthy and simple instrument for predicting burn injury fatality.

4.1. Conclusion

The ability to forecast the outcomes of severe burns is necessary to make therapeutic and economical decisions that benefit patients, their families, healthcare professionals, and the general public. The ABSI score method may be used to determine age, comorbidities, inhalation injury, and other burn scores, making it a trustworthy and simple instrument for predicting burn injury fatality.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflict of Interest

The authors declared that there were NO conflicts of Interest.

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