

# A bibliometric analysis of publications on trauma in critical care medicine during 1980–2018: A holistic view

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## ABSTRACT

**BACKGROUND:** There is not a holistic bibliometric study evaluating the publications in the literature even though trauma is a paramount subject in the field of critical care. This study aimed to investigate the important articles and journals receiving the most citations and publishing the most articles, revealing international cooperation and uncovering trend topics in this subject as a consequence of analyzing articles on trauma in the field of critical care published between 1980 and 2018 using bibliometric analysis methods.

**METHODS:** Publication scan in this study was performed using Web of Science (WoS) database. Literature review was limited to only publications indexed in the field of Critical Care. “Trauma” was used as the keyword to reach relevant publications. Linear regression analysis was performed to predict the number of articles foreseen to be published in the upcoming years in the subject of trauma.

**RESULTS:** As a result of the literature review, a total of 10851 publications were found. Six thousand four hundred and eighty-nine (59.8%) of these publications were under the category of article. First three countries with the most publications were respectively as the United States of America (4096) (63.1%), Canada (401) and Germany (380). Turkey ranked 21 with 41 publications. The article titled “Evaluating trauma care - the triss method” published in 1987 had received the most citations. The journal with the most publications and citations was “Journal of Trauma Injury Infection and Critical Care”.

**CONCLUSION:** This study will be a useful guide to all scientists and clinicians conducting research on trauma in critical care.

**Keywords:** Bibliometric analysis; critical care; trauma; trends.

## INTRODUCTION

Trauma can be defined as injury that arises from an acute exposure to mechanic, thermal, electric or chemical energy.

[1,2] Trauma maintains a significant health issue rising mortality and morbidity rates with the contribution in technological advancements, accidents and acts of violence. Some studies have indicated that trauma-related deaths rank fifth in all-cause deaths for every age group in the United States of America.[3] Critical care units, which are vital centers to prevent primary and secondary damage infliction at the time of trauma and as a direct result of trauma itself, are multidisciplinary structures dealing with potentially life-threatening diseases and conditions. These units are special with

airway support, mechanical ventilation, current treatment methods, efficient application of drugs, and monitorization techniques.[4]

Bibliometry can be defined as a holistic analysis of written publications like books or articles using various statistical methods.[5,6] Parallel to the gradual increase in the number of publications on worthy databases, such as Web of Science, Pubmed, and Scopus, the value of bibliometric analyses ensuring the evaluation of the publications holistically rises every passing day.[7,8] The most impactful publications, institutions, active journals, international cooperation and trend topics in one subject are revealed, and these studies act as a guide to researchers.[9–10] Thanks to bibliometric studies, researchers

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can access information on a subject in a short time through these studies summarizing the literature.<sup>[11]</sup>

There is not a holistic bibliometric study evaluating the publications in the literature although trauma is a paramount subject in the field of critical care. This study aimed to investigate the important articles and journals receiving the most citations and publishing the most articles, revealing international cooperation and uncovering trend topics in this subject in consequence of analyzing articles on trauma in the field of critical care published between 1980 and 2018 using bibliometric analysis methods.

## MATERIALS AND METHODS

Publication scan in this study was addressed using the Web of Science (WoS) database. Literature review was limited to only publications indexed in the field of Critical Care. “Trauma” was used as the keyword to reach relevant publications (Title: (trauma) Refined by Web of Science Categories: (Critical Care Medicine) Timespan: 1975–2018. Indexes: SCI-Expanded, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI).

Bibliometric analyses and network visualization were performed using VOSviewer (Version 1.6.10) package program.<sup>[12]</sup> “Gunn Map” (<http://lert.co.nz/map/>) online world map was used to show the publication distribution of world countries. SPSS (Version 22.0, SPSS Inc., Chicago, IL, ABD, License: Hitit University) program was used for statistical analyses. Data distribution was evaluated using the Shapiro-Wilk test. Linear regression analysis was performed to predict the number of articles foreseen to be published in the upcoming years in the subject of trauma.  $P < 0.05$  was accepted as statistically significant.

## RESULTS

As a result of the literature review, a total of 10851 publications were found. Six thousand four hundred and eighty-nine

(59.8%) of these publications were indexed under the category of article, 2194 (20.2%) under meeting abstracts, 1502 (13.8%) under proceedings papers, 1124 (10.3%) under editorial materials, 460 (4.2%) under reviews, and 634 (6%) under other categories (such as letter, book chapter, book review, note, correction, discussion, biographical item). Only 6489 papers published under the category of the article were downloaded through WoS and analyzed using bibliometric methods.

Ninety-eight point seventy-five percent ( $n=6408$ ) of the articles were published in English and the rest of the articles was published in other languages (German:  $n=55$ , Spanish:  $n=25$ , Turkish:  $n=1$ ). Six thousand four hundred and eighty-nine publications received 195429 citations in total. Mean citation count per article was 30. The h-index value of all articles was 144.

### Active Institutions

The highest number of publications was produced in the following institutions: Washington University ( $n=238$ ), Maryland University ( $n=195$ ), Pittsburgh University ( $n=165$ ), Toronto University ( $n=154$ ), California San Francisco University ( $n=140$ ), and Colorado University ( $n=140$ ). Our most active institutions in Turkey were Ankara Numune Training and Research Hospital ( $n=5$ ) and Selcuk University ( $n=5$ ), respectively.

### Active Authors

The first five authors contributing vastly to the literature concerning publication number were found respectively as follows: Moore EE. ( $n=124$ ), Inaba K. ( $n=97$ ), Demetriades D. ( $n=93$ ), Scalea TM. ( $n=84$ ), and Jurkovich GJ. ( $n=81$ ). The most active writers in Turkey Ustun M. E. ( $n=5$ ), followed by Duman A. ( $n=4$ ) and Gurbilek M ( $n=4$ ), respectively.

### Distribution of the Publications According to Years

Figure 1 shows the distribution of the articles published on trauma according to years. 5-year (2019–2023) publication prediction numbers obtained by linear regression analysis are

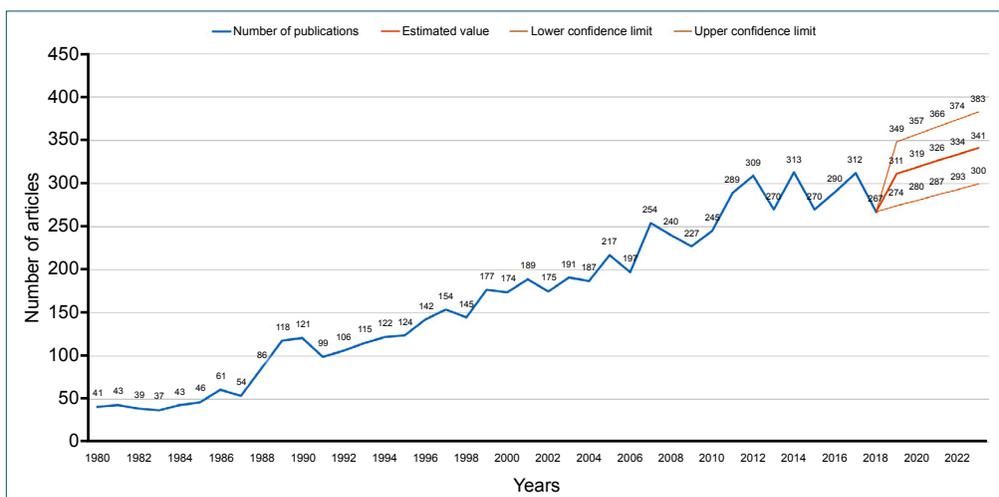


Figure 4. Distribution of the articles on trauma in critical care according to years.

also given in Figure 1. It was predicted that there would be 311 articles published in 2019 (95% CI: 274–349) and 341 articles (95% CI: 300–383) published in 2022.

### Articles Receiving Most Citations

The first 15 articles on trauma receiving the most citations are given in Table 1. In Turkey, the most cited study with a

total of 61 citations was “Prospective study investigating routine usage of ultrasonography as the initial diagnostic modality for the evaluation of children sustaining blunt abdominal trauma” that was published by Akgür et al.

### Active Countries

The country with the highest number of publications was

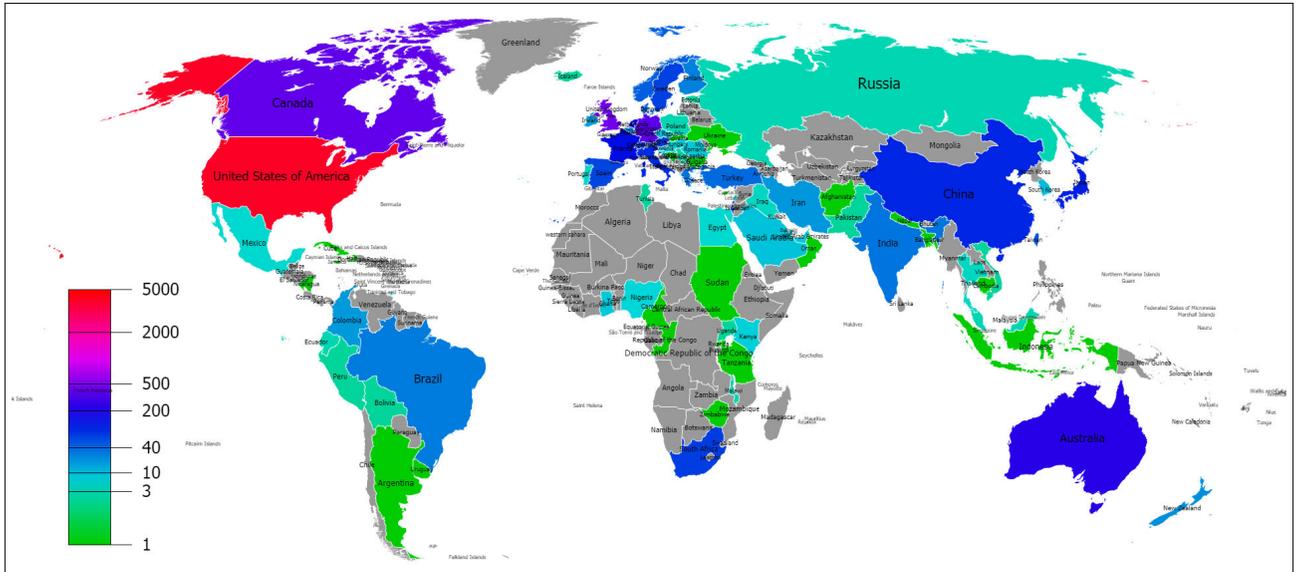
**Table 1.** The 15 most cited manuscripts on trauma in critical care medicine

No	Article	Author	Journal	PY	TC	AC
1	Evaluating trauma care - the triss method	Boyd, CR. et al.	Journal of Trauma-Injury Infection and Critical Care	1987	1338	40,55
2	Epidemiology of trauma deaths - a reassessment	Sauaia, A. et al.	Journal of Trauma-Injury Infection and Critical Care	1995	1193	47,72
3	A revision of the trauma score	Champion, HR. et al.	Journal of Trauma-Injury Infection and Critical Care	1989	1134	36,58
4	The major trauma outcome study - establishing national norms for trauma care	Champion, HR. et al.	Journal of Trauma-Injury Infection and Critical Care	1990	793	26,43
5	Early coagulopathy predicts mortality in trauma	MacLeod, JBA. et al.	Journal of Trauma-Injury Infection and Critical Care	2003	691	40,65
6	Trauma score	Champion, HR. et al.	Critical Care Medicine	1981	636	16,31
7	Impact of hemorrhage on trauma outcome: an overview of epidemiology, clinical presentations, and therapeutic considerations	Kauvar, DS. et al.	Journal of Trauma-Injury Infection and Critical Care	2006	618	44,14
8	Ten versus tpm following major abdominal-trauma - reduced septic morbidity	Moore, FA. et al.	Journal of Trauma-Injury Infection and Critical Care	1989	570	18,39
9	Recombinant factor via as adjunctive therapy for bleeding control in severely injured trauma patients: two parallel randomized, placebo-controlled, double-blind clinical trials	Boffard, KD. et al.	Journal of Trauma-Injury Infection and Critical Care	2005	526	35,07
10	Management of bleeding and coagulopathy following major trauma: an updated European guideline	Spahn, DR. et al.	Critical Care	2013	510	72,86
11	The effect of selective decontamination of the digestive-tract on colonization and infection-rate in multiple trauma patients	Stoutenbeek, CP. et al.	Intensive Care Medicine	1984	474	13,17
12	Prospective study of blunt aortic injury: multicenter trial of the American association for the surgery of trauma	Fabian, TC et al.	Journal of Trauma-Injury Infection and Critical Care	1997	471	20,48
13	Acute coagulopathy of trauma: hypoperfusion induces systemic anticoagulation and hyperfibrinolysis	Brohi, K. et al.	Journal of Trauma-Injury Infection and Critical Care	2008	460	38,33
14	Management of bleeding following major trauma: an updated European guideline	Rossaint, R. et al.	Critical Care	2010	458	45,8
15	Blood transfusion, independent of shock severity, is associated with worse outcome in trauma	Malone, DL. et al.	Journal of Trauma-Injury Infection and Critical Care	2003	437	25,71

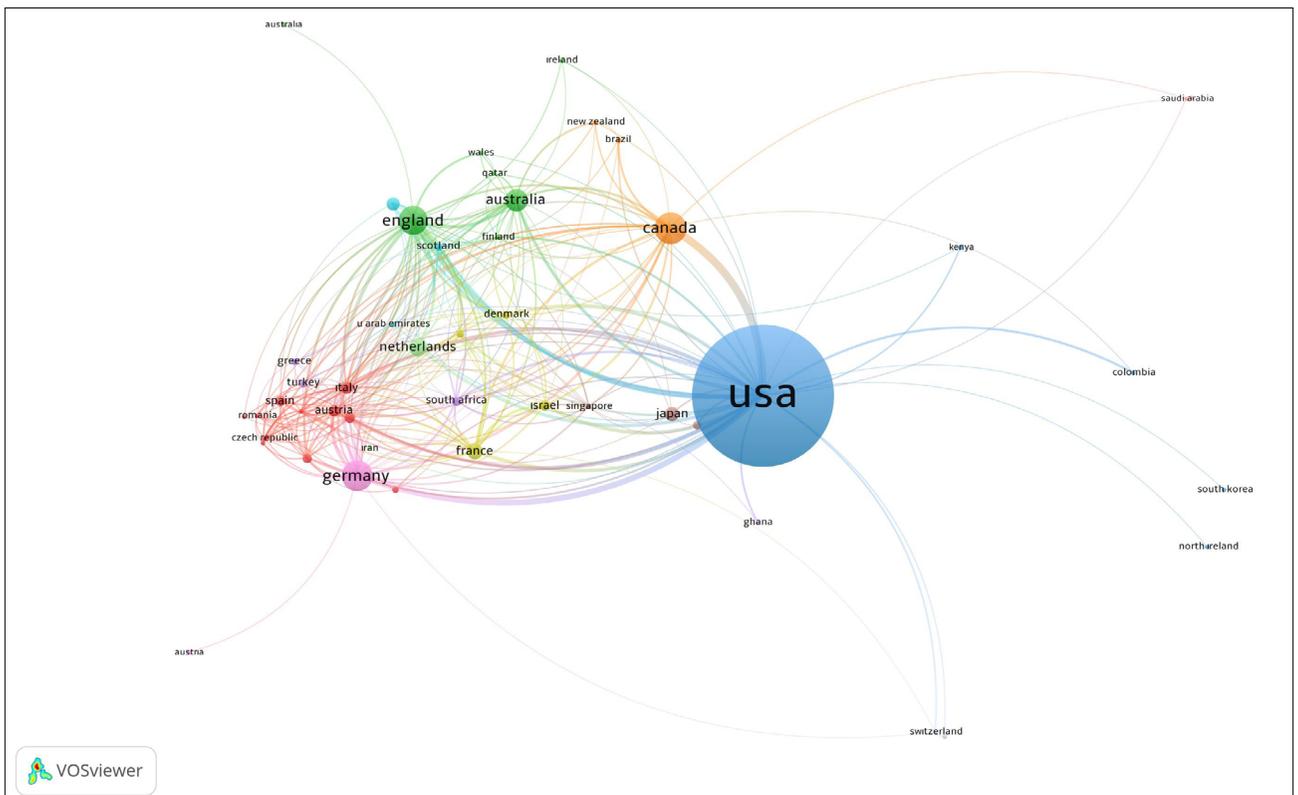
PY: Publication Year; TC: Total Citation; AC: Average Citations per Year.

the United States of America with 4096 publications (63.1%). The United States of America was followed respectively by Canada (401), Germany (380), England (377), Australia (239), the Netherlands (163), France (137), Japan (111), China (103), Italy (96), Austria (82), South Africa (76), Switzerland (76), Israel (75), Sweden (72), Spain (69), Taiwan (56), Norway

(48), Scotland (48), Denmark (44), and Turkey (41). The distribution of the publications according to world countries is shown in Figure 2. Six thousand four hundred and eighty-nine articles were written by authors from 111 world countries. Figure 3 shows the network map of international cooperation among 53 world authors who have at least five publications.



**Figure 2.** Distribution of the articles on trauma in critical care according to world countries. Footnote: In the indicator given at the bottom left of the figure, productivity increases from green to red.



**Figure 3.** Network visualization map for international cooperation of world countries publishing articles on trauma in critical care. Footnote: The size of the circle shows a large number of articles. The colors indicate the clusters and the thickness of the lines indicates the strength of the relationship.

### Active Journals

There were a total of 60 journals publishing the highest number of articles on trauma. Table 2 gives the first 35 journals among the 60 publishing at least five articles. Figure 4 demonstrates the citation network map among these journals.

### Trend Topics

Eight thousand thirty-five keywords were used in 6489 articles. One hundred and seven keywords used at least 20 times are shown in Table 3. The network map obtained as a result of the clustering analysis for these keywords is presented in Figure 5 (Footnote: Indicator shows current publications from blue to red). Figure 6 demonstrates the network map of the trend topics according to the years of the keywords used. Moreover, the network map obtained according to the citation count of the articles with these keywords is given in Figure 7.

## DISCUSSION

We presented summarized information of 6489 articles published in a long time (1975–2018) on the subject of trauma in critical care in this comprehensive bibliometric study. The

most active institution was determined as the Washington University, and the most actively producing author was found as Moore EE. When the publications were investigated according to years, publication trends that started to increase in 1988 demonstrated a linear increase and have reached approximately 300 articles in recent years. According to the result of the regression analysis, it is seen that research conducted on this subject will increase every passing day.

The articles receiving the most citations on this subject were that of Boyd et al. titled “Evaluating trauma care - the triss method” published in 1987 in the Journal of Trauma-Injury Infection and Critical Care and that of Sauaia et al. titled “Epidemiology of trauma deaths - a reassessment” published in 1995. Furthermore, salient studies as regards mean citation count were that of Spahn et al. (2013) titled “Management of bleeding and coagulopathy following major trauma: an updated European guideline” and that of Rossaint et al. (2010) titled “Management of bleeding following major trauma: an updated European guideline”. We are of the opinion that these are studies that should be primarily read by researchers interested in this subject.

**Table 2.** Active journals on trauma in critical care medicine

Journals	RC	%	C	Journals	RC	%	C
Journal of Trauma Injury Infection and Critical Care	3109	47.9	131167	Anaesthesia and Intensive Care	18	0.2	266
Injury International Journal of The Care of the Injured	962	14.8	14253	Pediatric Critical Care Medicine	17	0.2	354
Journal of Trauma and Acute Care Surgery	908	13.9	12791	Essentials of Trauma Anesthesia	15	0.2	9
Shock	225	3.4	6660	Indian Journal of Critical Care Medicine	14	0.2	18
Critical Care Medicine	211	3.2	9748	Neurocritical Care	13	0.2	120
Journal of Neurotrauma	147	2.2	4595	Anesthesiologie Intensivmedizin	12	0.1	8
Journal of Trauma Nursing	137	2.1	364	Minerva Anestesiologica	12	0.18	100
Intensive Care Medicine	90	1.3	3651	Critical Care Nurse	11	0.17	50
Critical Care	86	1.3	4971	American Journal of Respiratory And Critical Care Medicine	9	0.13	729
Resuscitation	75	1.1	2004	Journal of Acute Disease	9	0.13	3
Critical Care Clinics	55	0.8	553	Trauma Critical Care and Surgical Emergencies A Case and Evidence-Based Textbook	9	0.13	3
Journal of Critical Care	48	0.7	537	European Manual of Medicine	8	0.12	10
Burns	45	0.6	507	General Trauma Care And Related Aspects Trauma Surgery II	8	0.12	10
Anesthesiologie Intensivmedizin Notfallmedizin Schmerztherapie	40	0.6	143	American Journal of Critical Care	7	0.10	72
Current Trauma Reports	40	0.6	37	Annals of Intensive Care	7	0.10	54
Chest	32	0.4	1204	Anaesthesia Critical Care Pain Medicine	6	0.09	20
Medicina Intensiva	27	0.4	164	Journal of Intensive Care Medicine	5	0.07	14
Journal of Burn Care Research	20	0.3	167				

RC: Record Count; C: Number of Citation.



**Table 3.** The first 107 trend keywords on trauma in critical care medicine

Keyword	O	Keyword	O	Keyword	O	Keyword	O
trauma	1367	trauma centers	56	hypothermia	30	damage control	23
mortality	259	trauma system	56	blood transfusion	29	geriatric	23
outcome	153	transfusion	53	brain injury	29	length of stay	23
injury	121	complications	52	cervical spine	29	prehospital care	23
outcomes	121	prehospital	52	mechanical ventilation	29	rat	23
resuscitation	115	blunt abdominal trauma	51	multiple organ failure	29	rehabilitation	23
traumatic brain injury	112	cytokines	49	pulmonary embolism	29	severe trauma	23
blunt trauma	97	trauma registry	47	screening	29	trauma patients	23
multiple trauma	95	head injury	46	acute respiratory distress syndrome	28	burns	22
trauma systems	87	penetrating trauma	45	survival	28	emergency medicine	22
computed tomography	85	alcohol	43	injury severity score	28	laparotomy	22
coagulopathy	79	children	41	intensive care unit	27	pulmonary contusion	22
hemorrhage	78	polytrauma	41	lactate	27	ct scan	21
shock	76	ultrasound	40	abdominal trauma	26	deep venous thrombosis	21
critical care	72	ventilator-associated pneumonia	39	quality of life	26	education	21
injury	72	emergency medical services	37	ards	25	fracture	21
sepsis	68	quality improvement	37	atls	25	pediatrics	21
pediatric	66	major trauma	36	geriatric trauma	25	penetrating	21
pediatric trauma	66	trauma care	36	hypotension	25	prognosis	21
triage	65	venous thromboembolism	36	morbidity	25	trauma surgery	21
wounds and injuries	65	head trauma	35	pelvic fracture	25	iss	21
trauma center	60	blunt chest trauma	34	performance improvement	25	base deficit	20
elderly	57	risk factors	34	acute lung injury	24	infection	20
epidemiology	57	surgery	33	injury severity score	24	intensive care	20
hemorrhagic shock	57	critical illness	32	multiple injuries	24	pregnancy	20
inflammation	57	pneumonia	32	trauma outcomes	24	training	20
massive transfusion	56	thoracic trauma	32	triss	24		

O: Number of occurrences.

that the contribution of South Africa and Turkey, two developing countries, is related to the high rate of trauma prevalence in these countries. Especially from developing countries, it has been determined that Turkey was not involved in the first twenty countries. Considering international cooperation, regional cooperation was found to be made geographically.

Active journals producing the most publications were determined as the Journal of Trauma Injury Infection and Critical Care, Injury International Journal of The Care of the Injured and the Journal of Trauma and Acute Care Surgery. However, impactful journals receiving citations were as follows: Trauma Injury Infection and Critical Care, Critical Care Medicine, Critical Care, Intensive Care Medicine, Chest, and American Journal of Respiratory and Critical Care Medicine. Researchers wishing to publish studies in this subject are advised to consider these journals.

The results of keyword analysis revealed that although subjects, such as brain injury, head injury, and chest injury, were studied in first years, subjects, such as cytokines, acute respiratory distress syndrome, pneumonia, pulmonary embolism, inflammation, and hemorrhagic shock, were researched in subsequent years, and trend topics in recent years were determined to be outcomes, geriatric trauma, quality improvement, education, venous thromboembolism, transfusion, and coagulopathy. Outcomes and transfusion subjects preserved their significance in all years. Topics with the highest citation rates were detected as transfusion, coagulopathy, hemorrhage and ultrasound.

Our study is the first comprehensive bibliometric study conducted on this subject. Literature review put forth that Zhang et al.<sup>[14]</sup> (2018) have determined at least 2000 cited articles on critical care as a result of the bibliometric analyses they con-



and Scopus, were not considered. In analyses conducted with more than one database, there is an issue of including the same articles more than once to the analyses. Moreover, it can be said that WoS is a relatively important database since it indexes articles published in journals with high impact scores.

## Conclusion

Summarized information was provided to researchers on trauma in critical care in this study. Bibliometric analyses demonstrated the most important articles cited and the journals receiving citation on the subject “trauma in critical care” and those producing the highest number of publications and indicated international cooperation and trend topics on this subject.

**Peer-review:** Internally peer-reviewed.

**Authorship Contributions:** Concept: O.K., C.E.G.; Design: O.K., C.E.G.; Supervision: O.K., C.E.G.; Fundings: O.K., C.E.G.; Materials: O.K., C.E.G.; Data: O.K., C.E.G.; Analysis: O.K., C.E.G.; Literature search: O.K., C.E.G.; Writing: O.K., C.E.G.; Critical revision: O.K., C.E.G.

**Conflict of Interest:** None declared.

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## ORİJİNAL ÇALIŞMA - ÖZET

### Yoğun bakım alanında travma konusunda 1980–2018 yılları arasında yapılan yayınların bibliyometrik analizi: Bütünsel yaklaşım

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**AMAÇ:** Yoğun bakım alanında travma konusunun önemli bir yeri olmasına rağmen halen bu konuda literatürdeki yayınların bütünsel olarak değerlendirildiği bir bibliyometrik araştırma bulunmamaktadır. Bu çalışmada 1980 ve 2018 yılları arasında yoğun bakım araştırma alanında yayınlanmış travma konusundaki makalelerin bibliyometrik analiz yöntemleri kullanılarak analiz edilmesi sonucunda; en fazla alıntı yapılan önemli makalelerin ve bu konudaki en fazla atf alan ve yayın üreten dergilerin belirlenmesi, ülkelerarası işbirliklerinin ortaya konulması ve bu konudaki trend konuların ortaya çıkarılması amaçlanmıştır.

**GEREÇ VE YÖNTEM:** Araştırmamızda yayın taraması Web of Science (WoS) veri tabanı kullanılarak gerçekleştirildi. Literatür taraması sadece Yoğun Bakım araştırma alanında indekslenen yayınlarda yapıldı. İlgili yayınlara ulaşmak için arama anahtar kelimesi olarak “trauma” kullanıldı. Travma konusunda gelecek yıllarda yayınlanması öngörülen makale sayısını tahmin etmek amacıyla doğrusal regresyon analizi gerçekleştirildi.

**BULGULAR:** Literatür taraması sonucunda toplam 10.851 yayın bulundu. Bu yayınların 6.489'u (59.8%) makale kategorisinde idi. En fazla yayın yapan ilk üç ülke Amerika Birleşik Devletleri 4.096 (%63.1) Kanada (401) ve Almanya (380) idi. Türkiye 41 yayınlı 21. sırada idi. En fazla atfı 1987 yılında yayınlanan “Evaluating trauma care - the triss method” başlıklı makale almıştı. En fazla yayın üreten ve en çok atf alan dergi “Journal of Trauma Injury Infection and Critical Care” idi.

**TARTIŞMA:** Bu çalışma yoğun bakımda travma konusunda araştırma yapan klinisyenler ve bilim adamları için faydalı bir rehber olacaktır.

**Anahtar sözcükler:** Bibliyometrik analiz; travma; trendler; yoğun bakım.

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