

# Assessment of Female Researchers Presented as First Author or Senior Author in the 100 Most Cited Articles in Intensive Care Literature

Yoğun Bakım Literatüründe En Çok Atıf Alan 100 Makalede İlk Yazar veya Kıdemli Yazar Olarak Sunulan Kadın Araştırmacıların Değerlendirilmesi

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## Abstract

**Objective:** To present potential mechanisms for female authorship in intensive care research by evaluating the ratio of female first author to senior author in the top 100 most cited articles.

**Methods:** In the Web of Science search engine, by typing the search key "SU=CRITICAL CARE OR WC=CRITICAL CARE" and in advanced mode; to investigate the female sex ratio in the first and senior author in the top 100 most cited research articles in the international literature written in the field of intensive care.

**Results:** When the first 100 most cited articles were analyzed regarding the first name and last name gender difference, the rate of first name female authors was 16%. The country with the highest number of female authors writing first names was the United States. In the analysis, when the gender of the first name and the gender of the last name was evaluated, no statistically significant relationship was found between them ( $p=0.327$ ). A statistically significant difference was found between the gender of the first author and the journal in which the article was published ( $p=0.021$ ). A significant relationship was found between the gender of the first name and the country of the journal in which the article was published ( $p=0.032$ ).

**Conclusion:** When evaluated in terms of article authorship, gender inequalities were identified in scientific activities and academic leadership positions in intensive care. Female gender is underrepresented in the international literature in the field of intensive care.

**Keywords:** Gender differences, female, first author, last author, intensive care medicine

## Öz

**Amaç:** En çok atıf yapılan ilk 100 makaledeki ilk kadın yazar ve kıdemli yazar oranını değerlendirerek, yoğun bakım araştırmalarında yazarlar arasındaki kadın cinsiyet oranını ve rol oynayan potansiyel mekanizmaları tespit etmeyi hedeflemiş bulunmaktayız.

**Yöntem:** Web of Science arama motorunda "SU=CRITICAL CARE OR WC=CRITICAL CARE" arama anahtarını yazarak ve gelişmiş modda; Uluslararası literatürde yoğun bakım alanında yazılmış en çok atıf alan ilk 100 araştırma makalesi ve bu ilk 100 makaledeki ilk ve kıdemli yazarda kadın cinsiyet oranını araştırıldı.

**Bulgular:** En çok atıf alan ilk 100 makalenin, ilk isimleri ve son isimleri cinsiyet açısından incelendiğinde, ilk isimde kadın yazar oranı %16 olarak bulundu. İlk isim yazarın kadın yazar sayısının en fazla olduğu ülke Amerika Birleşik Devletleri oldu. Analizde ilk ismin cinsiyeti ile son ismin cinsiyeti arasında istatistiksel olarak anlamlı bir ilişki bulunmadı ( $p=0,327$ ). Buna karşı ilk yazarın cinsiyeti ile makalenin yayımlandığı dergi ve makalenin yayımlandığı derginin ülkesi arasında anlamlı bir ilişki bulundu ( $p=0,021$ ,  $p=0,032$ ).



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**Öz**

**Sonuç:** Yoğun bakım alanındaki bilimsel faaliyetler ve akademik liderlik pozisyonları, makale yazarlığı açısından değerlendirildiğinde cinsiyet eşitsizlikleri tespit edilmiştir. Yoğun bakım alanında uluslararası literatürde kadın cinsiyeti yeterince temsil edilmemektedir.

**Anahtar Kelimeler:** Cinsiyet farklılığı, kadın, ilk yazar, son yazar, yoğun bakım hekimliği

**Introduction**

In the international literature, interest in raising awareness about gender inequalities in academic medicine and scientific studies on this subject has increased significantly in the last decade<sup>(1)</sup>. Studies show that the number of female medical school graduates has increased by 1% each year in the last two decades, and women now represent 50.2% of the medical profession<sup>(2)</sup>. Despite the increasing number of female physicians in medical faculties, the data in the literature emphasize that there are inequalities in areas such as academic progress, academic production and participation in production, promotion, leadership positions, and payment<sup>(3)</sup>. In support of these data, in our study, we analyzed the scientific production of academic anesthesiology and reanimation specialists (ARS) working in educational institutions in our country with H-index and bibliometric parameters, the number of publications, citation numbers, and H-index averages of the male anesthesiology and Reanimation specialists, and the ARS in the female gender. Found significantly higher than the experts<sup>(4)</sup>.

Worldwide, women comprise 20% and 50% of the intensive care workforce<sup>(5)</sup>. Only 30% of graduate trainees admitted to the intensive care unit (ICU) in the United States of America (USA) are women<sup>(6)</sup>. In a study on the subject, we found 473 intensive care specialists in Turkey<sup>(7)</sup>. While 214 (45.24%) of the intensive care specialists were female, the number of male intensive care specialists was 259 (56.87%). The same study determined that 95 (44.39%) of the female intensive care specialists and 143 (55.21%) of the male intensive care specialists were in the academic staff.

Academic productivity is an essential criterion for researchers taking leadership roles in their fields<sup>(8)</sup>. Past studies have examined academic achievement by analyzing an individual H-index, indicating that a higher H-index is associated with a higher academic level<sup>(9)</sup>. However, the fact that researchers with a high H-index receive more scholarships and are in leadership positions, especially in the USA, and that male researchers have a higher H-index in the academic medical literature may cause this to result against the female gender<sup>(10)</sup>. Academic progress is primarily driven by original

research in peer-reviewed journals<sup>(10)</sup>. Peer-reviewed publications are significant for career development, but data on gender differences in the authorship of studies in the ICU are limited<sup>(5)</sup>.

The concepts of the first and senior authors are as crucial as the number of articles published in peer-reviewed journals<sup>(11)</sup>. Although there are different opinions on this issue, the most accepted recommendation was that presented by Riesenber and Lundberg<sup>(3)</sup>. According to this suggestion, the first author should be the person who contributed the most to the study, including article writing<sup>(3)</sup>. For clinical studies, the person who plans and conducts the study, evaluates the data, and writes the article should be the first author. A senior author is an author who contributes to the planning and writing of the study, supervises it, and has at least 10 publications on that subject<sup>(12)</sup>. The authorship of academic articles is professionally stimulating and develops the researcher. However, the representation of gender in article writing is unclear<sup>(3)</sup>.

Our aim in this research is to understand gender differentiation in this field and to present potential mechanisms for female authorship in intensive care research by evaluating the ratio of the female first author and senior author in the top 100 most cited articles in the international literature in the field of intensive care in terms of article authorship, which is an important indicator of academic productivity.

**Materials and Methods****Data Source**

The study was initiated with the approval of the Dokuz Eylül University Ethics Committee (acceptance number: 2021-16-18, date: 27.05.2021). Because patient data were not used in the study, informed consent was not required. In the Web of Science search engine of the Institute for Scientific Information, the first 100 most cited research articles in the international literature written in the field of intensive care, by typing the phrase "SU=CRITICAL CARE OR WC=CRITICAL CARE" in the advanced mode, were scanned on 06.24.2021. Letters to the editor and case reports were excluded from this study.

## Author Identification and Journal Features

Authors were categorized in order of authorship as first and senior authors. The author rank method was used to determine the initial and senior authorship<sup>(3,12)</sup>. Author gender was determined by searching the author's names from a previously validated Genderize database containing 216,286 names in 79 countries and 89 languages<sup>(13)</sup>. To investigate the gender of authors whose names were not found in this database, they were identified by manual internet searches from author's professional websites, including author's photographs and/or references to authors with male or female pronouns. Articles whose first and last names and genders could not be found were excluded from the study.

## Statistical Analysis

The SPSS 24.0 package program was used in the analysis of the study. Variables with continuous values in the study are shown as mean  $\pm$  standard deviation, and variables indicating frequency are shown as frequency (n) and percentage (%). Kolmogorov-Smirnov and Shapiro-Wilk tests examined the standard test assumptions of the variables with continuous values. The data with continuous values in the study were tested using the Mann-Whitney U test and Kruskal-Wallis test, considering the group numbers and the results of normality tests. Pearson's chi-square and Fisher's Exact chi-square tests were used for group comparisons of frequency variables. A p-value of 0.05 was set as statistically significant.

## Results

In our study, the top 100 most cited articles in the field of intensive care in the international literature were analyzed. Studies were analyzed by an intensive care minor faculty member (VH) and an intensive care minor specialization assistant (OS). Studies not included in intensive care were excluded. All data are summarized in Table 1.

When the first 100 most cited articles were analyzed regarding the first name and last name gender difference, the rate of first name female authors was 16%. The country with the highest number of female authors writing first names was the USA. However, when the articles were evaluated based on the continent in which they were published, the rate of the female first name was 12% in the articles published in America. The rate of female first names from other continents was 23.5%. When the first name was evaluated according to the continent, no statistically significant difference was found between them ( $p=0.140$ ).

In the analysis, when the gender of the first name and the gender of the last name was evaluated, no statistically significant relationship was found between them ( $p=0.327$ ). When the 100 most cited articles in the international literature in the field of intensive care were evaluated, it was found that 16% of the publications were by female authors as senior authors. While the last name is a female author in 25% of the studies with the first name female author, 15% of the studies in which the first name is male author have been found as the last female author.

A statistically significant difference was found between the gender of the first author and the journal in which the article was published ( $p=0.021$ ). A significant relationship was found between the gender of the first name and the country of the journal in which the article was published ( $p=0.032$ ). The USA was found to be the host country of the journal in which the articles written by the first name female author were published. It was found that the articles with the first female eulogy author were published in 16 journals in total, while the other two journals were from England. Seventy-five percent of the journals in which the first name male authors' research is published are in American Journals; it was determined that 26.2% of them were published in journals of Dutch origin.

No significant relationship was found between the gender of the first name and the continents of origin of the journals ( $p=0.154$ ).

## Discussion

In our study, in which the top 100 most cited articles in the international literature in the field of intensive care were analyzed, the rate of first-name female authors was 16% and that of senior female authors was 16%. A statistically significant difference was found between the gender of the first author, the journal in which the article was published, and the country in which the journal was published. It was found that the country was hosting a journal in which the first female author's articles were published in the US. When evaluated in terms of the authorship of articles published in peer-reviewed journals, gender inequalities were determined in academic leadership positions and scientific activities in intensive care. Our findings show that the female gender is underrepresented in the international literature in the field of intensive care.

The participation of women in the medical profession has increased in the last two decades, but the "gender gap"

**Table 1. Characteristic features of the first and last authors**

		First author		Last author		p
		Female	Male	Female	Male	
First author's country	USA	8	58			0.140
	Other	8	26			
	Total	16	84			
First author's gender	Female			4	12	0.327
	Male			12	68	
First author's journal	Critical care medicine	1	15			0.021
	Chest	0 (0%)	20			
	American Journal of Respiratory and Critical Care Medicine	9	33			
	Critical Care	0	2			
	The Journal of Trauma	1	5			
	Intensive Care Medicine	1	5			
	Lancet Respiratory Medicine	2 (66.6%)	1 (33.3%)			
	Injury	0	2			
	Journal of Neurotrauma	2	1			
	Total	16	84			
First author's journal country	USA	14	59			0.032
	Holland	0	22			
	England	2	3			
	Total	16	84			
First author's journal continent	America	14	59			0.154
	Europe	2	25			
	Total	16	84			
First author's journal	Impact	18.30±8.45	13.95±7.05			0.083
	Citations	1832.12±945.47	2313.55±1737.42			0.297

continues, especially in the surgical field. Although the number of male and female medical students is similar, only 32% of surgical residents and only 9.8% of surgical professors are women<sup>(14)</sup>. At this rate, it will take until 2096 for men and women to be represented in surgery in equal numbers as professors. A systematic review of the clinician workforce found that the representation of certain groups (women, racial and ethnic minorities in medicine, sexual and gender minorities, and people with disabilities) in the workforce needed to optimize patient care is at high risk<sup>(6)</sup>. However, recent studies have shown that female physicians report greater satisfaction and lower 30-day mortality and readmission rates than male physicians<sup>(15)</sup>.

The role of women in academic advancement and leadership, and their underrepresentation in the profession,

remains unclear. In the report of the American National Institutes of Health Career Development Awards, they found that the rate of the senior female author is 4-6% in the academic literature, and there are "gender differences" in the representation of women as authors, especially in the surgical branch<sup>(16)</sup>.

Academic progress is largely driven by peer-reviewed original research, so Jaggi and Silver<sup>(17)</sup> sought to identify the number of female physician-researchers among authors of selected publications in medicine over the past 35 years; New England Journal of Medicine (NEJM), Journal of the American Medical Association (JAMA), Annals of Internal Medicine (Ann Intern Med), Annals of Surgery (Ann Surg), Obstetrics and Gynecology (Obstet Gynecol), and Journal of Pediatrics (J Pediatr) investigated gender analyses of both

primary and senior authors in six major medical journals. In their analysis, they found that the proportion of female first authors increased from 5.9% in 1970 to 29.3% in 2004, and the proportion of senior female authors increased from 3.7% to 19.3%. The proportion of female authors has increased sharply in obstetrics and gynecology. In the *Obstet Gynecol Journal*, while the rate of female first authors was 6.7% and that of senior authors was 6.8% in 1970, the rate of female first authors increased from 40.7% of senior authors to 28% in 2004. *Int J Pediatr*, while the rate of the female-first author was 4.3% and the rate of the senior author was 4.3% in 1970, the rate of the female-first author in this field was determined as 38.9% in 2004, and the rate of senior authors increased to 38% in 2004.

Similarly, it was determined that the rate of female first names and author writers in three journals with high impact values increased between 2001 and 2016 in academic pediatrics<sup>(11)</sup>. While the rate of female first author and 0.7% senior author in *Ann Surg Journal* was 2.3% in 1970, these rates increased to 16.7% for first author and 6.7% for senior author in 2004<sup>(17)</sup>. This slow upward trend in the surgical field was reported by Hunter et al.<sup>(18)</sup> and was also compatible with his study in the fields of orthopedics and traumatology. This situation supports the results of our study. Regarding academic progress, although the situation has progressed in favor of the female gender over the years, the rates are still very insufficient.

In the field of intensive care, Vranas et al.<sup>(5)</sup> in their study, in the journals where more than 18,000 articles from intensive care and basic science and more than 40 cited articles were published between 2008 and 2018, the rate of the first-name female author was 30.8%, and the last-name author was 19.5%. When the senior author is a female author, the chances of female co-authorship increase significantly. In high-impact journals, the rate of female first author is 30.4%, whereas this rate decreases to 20.1% for senior authors. However, this study did not evaluate the 100 most cited studies in the field of intensive care. In our study, among the 100 most cited studies in the field of intensive care, the rate of female-first author was 16%, and the rate of senior author was 16%. In our study, although the average of the impact factors of the journals in which the first 100 articles were published in the most cited articles was higher, no significant difference could be determined between the groups.

Holliday et al.<sup>(19)</sup> in *The Journal of the American Society of Radiation Oncology*, in the study in which the last 30 years of radiation oncology were analyzed in the USA, the first

author reported that the female sex ratio from 13.4% in 1980 to 29.7% in 2012 and the female gender ratio of the senior author. It was determined that it increased from 3.2% to 22.6%. These findings are consistent with those of our study. Of the 16 journals in which the first author was female, 14 originated in the USA, and the highest number of female first authors were in the literature.

Although there has been an increase in the rate of female authors from past to present, this rate is lower, and progress is slower than that of male authors<sup>(20)</sup>. The low academic productivity of women reduces the possibility of gaining leadership roles in their departments<sup>(21,22)</sup>. Studies emphasize that women are less likely to hold leadership positions and more likely to leave academic medicine<sup>(21)</sup>. In particular, in much of the world, department heads are often chosen among those with high academic productivity. However, the low number of publications of female authors, the higher number of publications in low-impact journals, and the lower rate of being a senior author may prevent them from leading positions in their institutions<sup>(21)</sup>. Previous research has shown that lack of mentoring, an unfavorable work culture, and barriers to research contribute to female academic withdrawals<sup>(21,22)</sup>.

Unfortunately, there is no easy way to address gender inequality in academic medicine. Considering that institutions are extensions of the cultural codes of their societies, changing the established social practices and creating an organizational climate where leadership roles are appropriate for women can help solve the problem<sup>(23)</sup>. Organizational climate is often cited as a possible cause of gender disparities in academic medical school careers<sup>(24)</sup>. Institutions should work to address gender inequality. At the same time, women should be encouraged to participate in organizational initiatives and rise to leadership positions in the institutions where they work. The burnout of female academics and the prejudices they face should be addressed<sup>(24)</sup>.

According to the authors' literature knowledge, our study is the first to analyze gender differences in the first author and senior authorship of the top 100 most cited articles in the field of intensive care. When evaluated in terms of article authorship, gender inequalities were identified in scientific activities and academic leadership positions in intensive care. Female gender is underrepresented in the international literature in the field of intensive care. They were making women working in intensive care medicine equal to their male counterparts in terms of participation in



literary production, which should be among the first targets of intensive care medicine in the future.

### Study Limitations

Our study has some limitations. There may be information inaccuracies in the lists of websites used to obtain data in our study. In addition, female academics may have changed their surnames after marriage. Therefore, the name order in the publications was checked before and after the surname change.

### Conclusion

In terms of article authorship, which is one of the important indicators of academic productivity, our study evaluated the rates of female first authors and senior authors in the top 100 most cited articles in the international literature in the field of intensive care; when evaluated in terms of authorship of articles published in peer-reviewed journals, gender inequalities were identified in academic leadership positions and scientific activities in intensive care. Our findings show that female gender is underrepresented in the international literature in the field of intensive care and that more research is needed on this subject.

### Ethics

**Ethics Committee Approval:** The study was initiated with the approval of the Dokuz Eylül University Ethics Committee (acceptance number: 2021-16-18, date: 27.05.2021).

**Informed Consent:** Informed consent was not required.

### Authorship Contributions

Concept: Ö.Ö., V.H., Design: Ö.Ö., V.H., Data Collection or Processing: Ö.Ö., V.H., Analysis or Interpretation: Ö.Ö., V.H., Literature Search: Ö.Ö., V.H., Writing: Ö.Ö., V.H.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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### References

- Sela N, Anderson BL, Moulton AM, Hoffman AL. Gender Differences in Authorship Among Transplant Physicians: Are We Bridging the Gap? *J Surg Res.* 2021;259:271-5.
- Michigan State University Guidelines on Authorship, Adopted by the University Research Council, January 15, 1998 [Available from: <https://rio.msu.edu/authorship>].
- Riesenberg D, Lundberg GD. The order of authorship: who's on first? *JAMA.* 1990;264:1857.
- Yılmaz AS, Çinier G, Kahraman F, Çetin M, Çirakoğlu ÖF. The PR interval predicted major adverse cardiovascular events in patients with acute coronary syndrome who underwent percutaneous coronary intervention: 3 years follow-up results. *JAREM.* 2021;11:241-8.
- Vranas KC, Ouyang D, Lin AL, et al. Gender Differences in Authorship of Critical Care Literature. *Am J Respir Crit Care Med.* 2020;201:840-7.
- Silver JK, Bean AC, Slocum C, et al. Physician Workforce Disparities and Patient Care: A Narrative Review. *Health Equity.* 2019;3:360-77.
- Hancı V ÖÖ. Türkiye'de Akademik Görevlerde Yer alan Yoğun Bakım Uzmanlarının Cinsiyet Analizi 3Uluslararası 19 Mayıs Yenilikçi Bilimsel Yaklaşımlar Kongresi 16-19 Mayıs 2020; SAMSUN2020. s. 30-4.
- Jagsi R, Guancial EA, Worobey CC, et al. The "gender gap" in authorship of academic medical literature--a 35-year perspective. *N Engl J Med.* 2006;355:281-7.
- Hirsch JE. An index to quantify an individual's scientific research output. *Proc Natl Acad Sci U S A.* 2005;102:16569-72.
- Rad AE, Brinjikji W, Cloft HJ, Kallmes DF. The H-index in academic radiology. *Acad Radiol.* 2010;17:817-21.
- Fishman M, Williams WA, 2nd, Goodman DM, Ross LF. Gender Differences in the Authorship of Original Research in Pediatric Journals, 2001-2016. *J Pediatr.* 2017;191:244-9.e1.
- Bhattacharya S. Authorship issue explained. *Indian J Plast Surg.* 2010;43:233-4.
- Available from: <https://genderize.io>
- Brown MA, Erdman MK, Munger AM, Miller AN. Despite Growing Number of Women Surgeons, Authorship Gender Disparity in Orthopaedic Literature Persists Over 30 Years. *Clin Orthop Relat Res.* 2020;478:1542-52.
- Markit I. The complexities of physician supply and demand: Projections from 2015 to 2030. Association of American Medical Colleges. 2017.
- Lindman BR, Tong CW, Carlson DE, et al. National Institutes of Health Career Development Awards for Cardiovascular Physician-Scientists: Recent Trends and Strategies for Success. *J Am Coll Cardiol.* 2015;66:1816-27.
- Jagsi R, Silver JK. Gender differences in research reporting. *BMJ.* 2019;367:l6692.
- Hunter J, Grewal R, Nam D, Lefavre KA. Gender disparity in academic orthopedic programs in Canada: a cross-sectional study. *Can J Surg.* 2022;65:E159-69.
- Holliday EB, Jagsi R, Wilson LD, Choi M, Thomas CR, Fuller CD. Gender differences in publication productivity, academic position, career duration, and funding among U.S. academic radiation oncology faculty. *Acad Med.* 2014;89:767-73.
- Hill EK, Blake RA, Emerson JB, et al. Gender Differences in Scholarly Productivity Within Academic Gynecologic Oncology Departments. *Obstet Gynecol.* 2015;126:1279-84.
- Levine RB, Lin F, Kern DE, Wright SM, Carrese J. Stories from early-career women physicians who have left academic medicine: a qualitative study at a single institution. *Acad Med.* 2011;86:752-8.
- Carapinha R, McCracken CM, Warner ET, Hill EV, Reede JY. Organizational Context and Female Faculty' Perception of the Climate for Women in Academic Medicine. *J Womens Health (Larchmt).* 2017;26:549-59.
- Cropsey KL, Masho SW, Shiang R, Sikka V, Kornstein SG, Hampton CL. Why do faculty leave? Reasons for attrition of women and minority faculty from a medical school: four-year results. *J Womens Health (Larchmt).* 2008;17:1111-8.
- Dyrbye LN, Shanafelt TD. Physician burnout: a potential threat to successful health care reform. *JAMA.* 2011;305:2009-10.