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# A scientometric analysis of space medicine

## *Havacılık ve uzay tıbbının bibliyometrik analizi*

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# A Scientometric Analysis of Space Medicine

## *Highlights*

- *The first scientometric analysis of space medicine.*
- *Web of Science database is used.*
- *The study integrates aerospace and medicine areas.*

## *Graphical Abstract*

*In this study, all publications with the keywords of "space medicine" were searched in the database of Web of Science throughout 1970-2021. The publications are classified under publications years, document types, affiliations, publication titles, publishers, research areas, countries and languages headings.*


**Figure.** The methodology

## *Aim*

*The objective of this paper is to conduct a scientometric analysis that assesses scientific publications related to space medicine under the topic of aerospace.*

## *Design & Methodology*

*In this scientometric study, all publications with the keywords of "space medicine" were searched in the database of Web of Science throughout 1970-2021. The publications are classified under publications years, document types, affiliations, publication titles, publishers, research areas, countries and languages headings.*

## *Originality*

*This scientometric analysis of space medicine is the first comprehensive and most recent study by exploring both Web of Science database.*

## *Findings*

*The highest number of documents occur in 2020. There was a significant increase in publications from 2010 to 2021. The most used document type was the article in publications. China was the most productive country in publications, while the majority of all reviewed publications were the two written in English.*

## *Conclusion*

*The major results of the scientometric study are useful for all space medicine research of the aerospace and medicine areas worldwide.*

## *Declaration of Ethical Standards*

*The author(s) of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.*

# Havacılık ve Uzay Tıbbının Bibliyometrik Analizi

***Araştırma Makalesi / Research Article***

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**ÖZ**

Havacılık ve uzay tıbbı, tarama, sağlık hizmeti sunumu ve aşırı uzay ortamında insan performansının sürdürülmesi ve uzay yolcularının uzun vadeli sağlığının korunması dahil olmak üzere önleyici tıbbın tüm yönlerinin uygulamasıdır. Bu makalenin amacı, uzay tıbbı ile ilgili bilimsel yayınları havacılık ve uzay başlığı altında değerlendiren bir bibliyometrik analiz yapmaktır. Bu scientometrik çalışmada 1970-2021 yılları arasında Web of Science veri tabanında "havacılık tıbbı" anahtar kelimeleri ile tüm yayınlar taranmıştır. Toplamda 746 bilimsel yayın gözlemlenmiş ve bu yayınlar yayın yılları, belge türleri, üyelikler, yayın adları, yayıncılar, araştırma alanları, ülkeler ve diller başlıkları altında sınıflandırılmıştır. Bu çalışmanın sonuçları, havacılık ve tıp alanlarındaki araştırmalara uzay tıbbı hakkında bir fikir vermektedir.

**Anahtar Kelimeler: Uzay tıbbı, bibliyometrik analiz, havacılık.**

# A Scientometric Analysis of Space Medicine

**ABSTRACT**

Space medicine is the exercise of whole phases of preventative medicine in the risky atmosphere of space and supporting the health of space staff. The objective of this paper is to conduct a scientometric analysis that assesses scientific publications related to space medicine under the topic of aerospace. In this scientometric study, all publications with the keywords of "space medicine" were searched in the database of Web of Science throughout 1970-2021. Overall, 746 scientific publications were observed, and these publications are classified under publications years, document types, affiliations, publication titles, publishers, research areas, countries and languages headings. The results of this study provide an insight into the space medicine to researches of the aerospace and medicine fields.

**Keywords: Space medicine, scientometric analysis, aerospace.**

## 1. INTRODUCTION

Astronauts confront numerous health issues while surviving and operating in space due to microgravity, radiation and separation. In order to help them while current missions to the International Space Station (ISS), the space medicine group is functioning to distinguish, assess and create novel space advances and strategies. Dr. Hubertus Strughold who is recognized as the "Father of Space Medicine ", invented "space medicine" expression in 1948 and was the initial and sole Professor of Space Medicine at the U.S. Air Force School of Aerospace Medicine [1]. Space medicine is "the practice of all aspects of preventative medicine including screening, health care delivery, and maintaining human performance in the extreme environment of space and preserving the long-term health of space travelers" [2]. Latest progressions within the field of space medicine and innovation have expanded the limitations of space travel, showing humanity with the capacity to investigate unfamiliar environments [3]. It is global, intercultural and multi-disciplinary, working at the limits of investigation, science, innovation and medicine [4]. Similar to some other medical fields, space medicine includes both proactive and receptive consideration of people to enhance physical, physiological and mental well-being inside the one of a kind compels of an extraordinary environment [5]. It is important to realize the improvement of scientific information about space medicine to guide future research and evidentiary policy-making.

In the literature, there are several research on space medicine in various disciplines. McGinnis and Harris [6] reviewed the history of space medicine in the United States. They presented the current conceptions of space medicine, and postulated the need for space medicine to mature as a distinct discipline. In one of recent papers, Winnard et al [7] provided evolution of space medicine synthesis methods. The scholars proposed space medicine systematic analysis direction for procedure arranging, quantifiable and subjective synthesis, sourcing gray information, and evaluating quality and transferability of space medicine human spaceflight simulation training settings. Wong [8] published a comprehensive reference textbook which covers the main aspects of aviation and space medicine. Chang et al. [9] developed a methodical assessment of publications related to psychological health scientific novelty and space medicine. Robertson et al. [10] identified the medical actions with likely for rescue, and categorized them based on the possible influence on staff health and mission accomplishment through exploration missions. Moreover, they developed a list of non-technical skills to educate for managing in-flight

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medical actions. Chen et al. [11] assessed the quality of sleep by evaluating sleep time, sleep efficiency, and stages of sleep-wake rhythm by the motion records from Actiwatch. Moreover, the authors evaluated the heart rate records through the Actiheart in crew members beforehand, during and afterward a 15-day spaceflight. Popoy [12] presented an analytical diagnostics perception for space medicine; specifically, possible resolutions appropriate for well-being risk evaluation and managing were investigated. Yeung and McGregor [13] developed a policy for the data integration of existing health care and countermeasure tool that gather biological statistics from astronauts onboard the ISS with a present stand to allow analytical and investigative systematic supplies.

By an increasing trend on space medicine related publications throughout the world, a scientometric study may light up the recent position of universal publications and give important visions on further research. Scientometric studies have been carried out on various subjects to characterize the pattern of publications in recent years. A study on space medicine has not been conducted yet. To the best of knowledge, this scientometric analysis of space medicine is the first comprehensive and most recent study by exploring both Web of Science database. The purpose of this study is to assess publications to evaluate the progress of information on space medicine and thereby identify the most productive researchers, institutes, organizations and countries engaged in space medicine related research.

The remainder of this paper is organized as follows. Section 2 focuses on materials and methods. Results is provided in Section 3. Finally, Section 4 concludes this paper.

## 2. MATERIALS AND METHODS

Publications were obtained from the database of Web of Science using the keywords of "space medicine" for the period 1970 to 2021. A total of 746 publications have had the records in terms of a number of fields such as the year of publications, document types, affiliations, publication titles, publishers, research areas, countries and languages were collected. Microsoft Excel was utilized to analyze the data. For the most comprehensive results, in this paper, scientometric data were collected from the databases of Web of Science including "Web of Science Core Collection, KCI-Korean Journal Database, Russian Science Citation Index and SciELO Citation Index" which are the foremost scientific information databases globally. The data were obtained in October 2021.

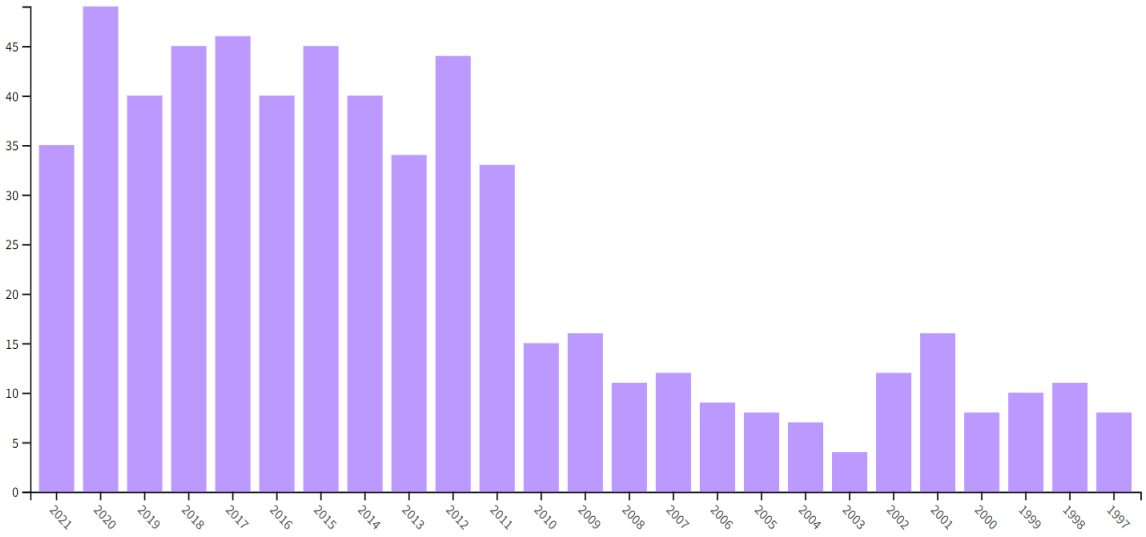


**Figure 1.** Documents by year

## 3. RESULTS

In this paper, 746 publications with the keywords "space medicine" was determined. The number of publications according to year throughput 1970-2021 has been shown in Figure 1. As can be seen from Figure 1, the number of publications has reached a peak in 2020. Since 2010, the number of publications has had significant growth

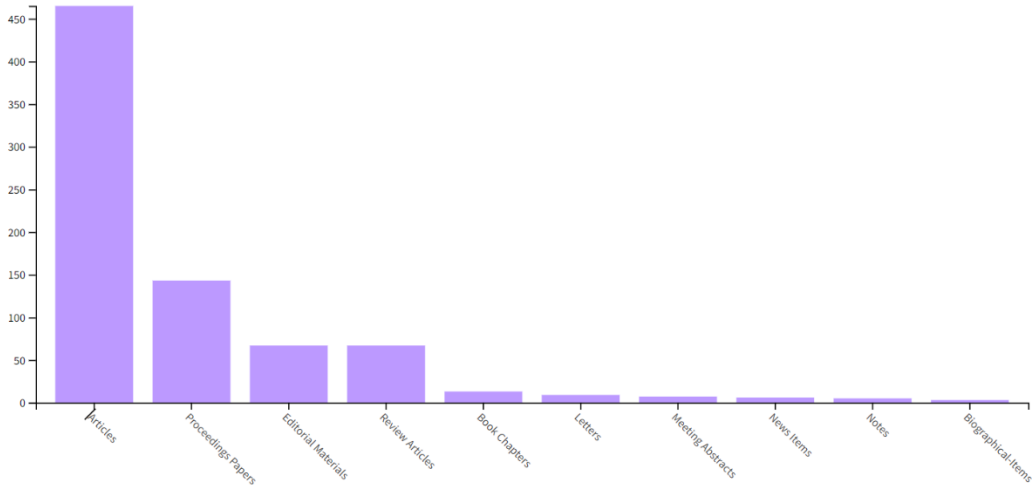


**Figure 2.** Documents by type

Figure 3 shows the characteristics of the most productive affiliations. China Astronaut Research Training Center was the most productive institute, followed by National Aeronautics Space Administration (NASA), NSAS Johnson Space Center, Baylor College of Medicine, are shown in Table 1. Aviation Space and Environmental Medicine ranked first by 87 publications, followed by 41st International Congress of Aviation and Space Medicine, ACTA Astronautica, Aero-space Medicine and Human Performance and PLOS One.

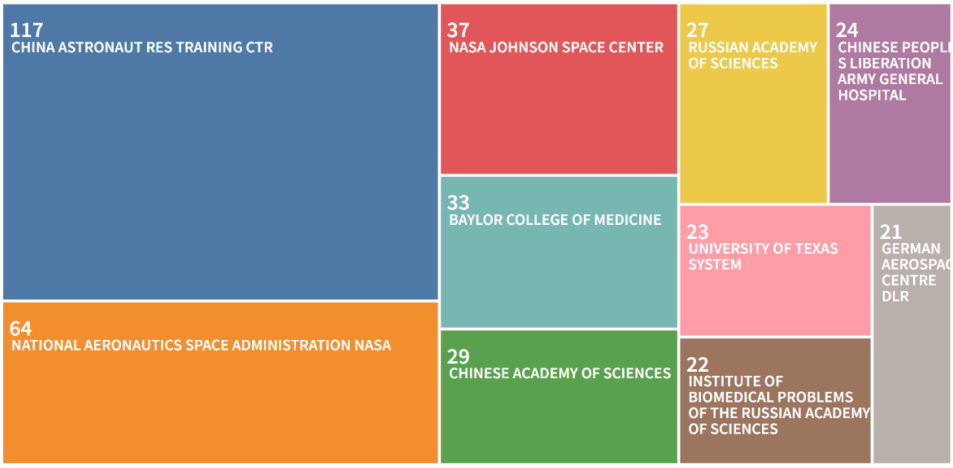


**Figure 3.** Documents by affiliation

Chinese Academy of Sciences, etc

The characteristics of the top 5 publication titles that published documents on the subject of space medicine

**Table 1.** Top 5 Publication Titles

| Rank | Publication Title | Number of Publications | % Share in Publication |
|---|---|---|---|
| 1 | General Internal Medicine | 142 | 19.035% |
| 2 | Public Environmental | 130 | 17.426% |
| 3 | Engineering | 121 | 16.220% |
| 4 | Sport Sciences | 99 | 13.271% |
| 5 | Science Technology | 66 | 8.847% |

Figure 4 shows the characteristics of the most productive publishers. Elsevier published the most, followed by Aerospace Medical Association, Springer Nature, Monduzzi Editore, Wiley, etc.

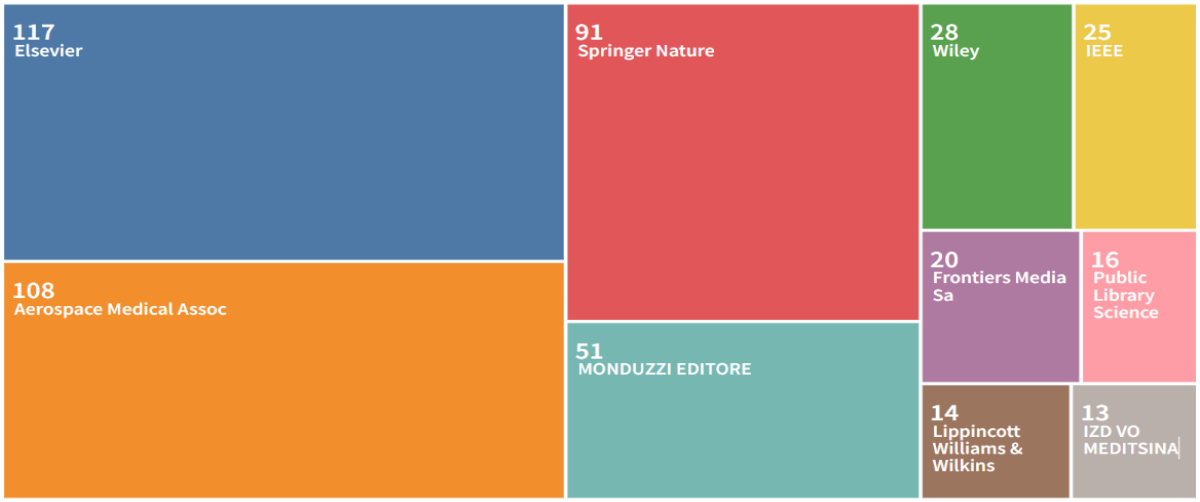


**Figure 4.** Documents by publishers

Most of the examined publications were connected to general internal medicine, followed by public environmental occupational health, engineering, sport sciences and science technology. The characteristics of the top 5 publication titles are shown in Table 2.

Among the analyzed papers, a total of 93.96% of reviewed publications were written in the English, and is followed by Russian, German, French and Spanish.

**Table 2.** Top 5 Research Areas

| Rank | Publication Title | Number of Publications | % Share in Publication |
|---|---|---|---|
| 1 | Aviation Space and Environmental Medicine | 87 | 11.662% |
| 2 | 41st International Congress of Aviation and Space Medicine | 51 | 6.836% |
| 3 | ACTA Astronautica | 36 | 4.826% |
| 4 | Aerospace Medicine And Human Performance | 19 | 2.547% |
| 5 | PLOS One | 16 | 2.145% |

Figure 5 shows the top 5 languages that are used in space medicine related publications.

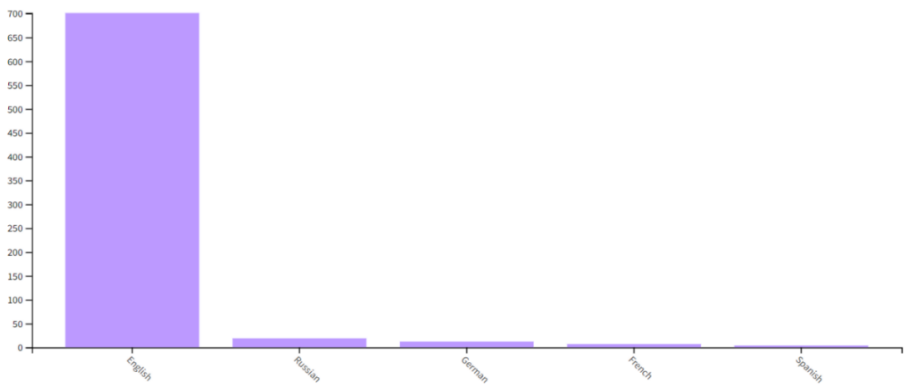


**Figure 5.** Documents by language

Figure 6 shows the characteristics of the most productive countries. Even though Chinese is not top 5 languages list in Figure 5, the majority of the analyzed papers were from China. The papers from United States of America, Germany, Canada, England, Russia and France were also noticeable.

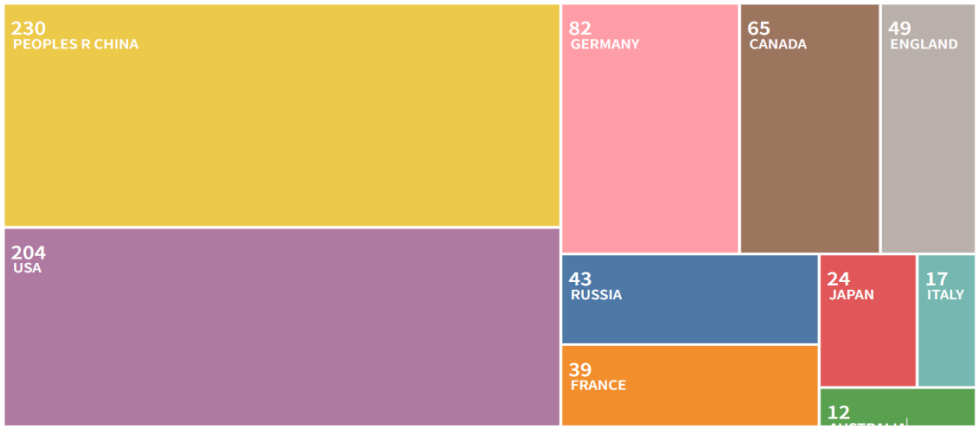


**Figure 6.** Documents by country

## CONCLUSION

This scientometric analysis evaluated all publications associated with space medicine in the database of Web of Science from 1970 to 2021. A total of 746 publications were analyzed. The published documents were evaluated by year of publications, document types, affiliations, publication titles, publishers, re-search areas, countries and languages. The highest number of documents occur in 2020. There was a significant increase in publications from 2010 to 2021. Furthermore, 4 document types were used mainly. The most used document type was the article in publications. General internal medicine, public environmental occupational health, engineering, sport sciences were the top research areas. The most productive institute was China Astronaut Research Training Center. Aviation Space and Environmental Medicine published the highest number of articles. China was the most productive country in publications, while

the majority of all reviewed publications were the two written in English.

The major results of the scientometric study are useful for all space medicine research of the aerospace and medicine areas worldwide. In addition, this scientometric study is helpful for researchers to find the most suitable publications related to their studies. Governments can find out the most productive countries and institutions in this area. Also, they can forecast the hotspots and trends of space medicine research in healthcare.

In conclusion, this study can be expanded by considering other types of databases for future studies to first aggregate more detailed information in this field. Although Web of Science is considered an authoritative database for most publications, some published documents in other databases may fail to notice. In the second place, the publications can be evaluated based on the authors in each institution to help fellows who search for an advisor in an institution for advanced studies related to this field. Thirdly, the co-author and author co-citation networks can be introduced for further researches.

## DECLARATION OF ETHICAL STANDARDS

The author(s) of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

## AUTHORS' CONTRIBUTIONS

**Kadir Öymen HANÇERLİOĞULLARI:** Conducted the study, collected the data, analyzed the results, wrote the manuscript.

## CONFLICT OF INTEREST

There is no conflict of interest in this study.

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