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A Bibliometric Analysis and Visualisation of Research Trends in Implants and Allergy

Harjot Singh
Department of Mechanical Engineering, Chandigarh University, Mohali-140413, Punjab, India
Email:jasgurpreet.me@cumail.in

Abstract
Various types of allergies had been reported with a small percentage of Implants. Thebibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of "Allergy and Implants".All published articles related to "Allergy and Implants" from "Scopus", were analyzed using the VOS viewer to develop analysis tables and visualization maps.This article had set the objective to consolidate the scientific literature regarding "Allergy and Implants"and also to find out the trends related to the same.The most active journals in this research domain wereContact Dermatitis and Clinical oral implants research. The most active countries were the United States of America, Spain, and Germany. The leading organization engaged in this research domain was the Ludwig-Maximilian University of Germany. The most active author of this research domain was Thomas P.

Keywords: Allergy,Implants, Material engineering,Bibliometric analysis, VOS viewer,

INTRODUCTION

Engineered biomaterials placed inside the human body are called implants and various types of implants had been used in modern medicine and include sensory implants, neurological implants, cardiovascular implants, orthopedic implants, contraceptive implants, and cosmetic implants. Some latest developments related to implants include bioactive glass/ bioglass coating, surface texturing, and additive manufacturing to improve the quality, life, and performance of implants [1].Different types of metals and materials are used to create implants and the most popularly used metals and alloys for bio-implants are stainless steel, cobalt-chromium alloy, and Titanium[2].

Even though severe allergies are rare in the case of implants, metals like Nickel, chromium, cobalt and acrylates and gen-tamicine can create allergic reactions or in the form of eczema, delayed wound/bone healing, recurrent effusion, pain, or implant loosening[3]localized pain, swelling, warmth, loosening, instability, itching, or burning; localized rash[4]. In various cases, it led to the failure of implants too [5][6][7]. Various types of tests are used to check allergies in advance like patch test and histopathology of periimplant tissue[3][7][8]. Allergic tests should be conducted on patients before the implantation procedure [9]Allergic reactions to foreign pathogens, especially to titanium implants are not severe but lack of universally accepted and properly designed and analyzed Patch test is a challenge in the current scenario[10]. Implants based on Nickel, Cobalt, and Chromium are not advised to patients

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having a metal sensitivity [4][11] Chromium and Cobalt-based implants may cause allergies and can even lead to failure of implants [7]. Titanium is one of the safest and popular metals for implants, however, Titanium implants are also prone to allergies and Zirconium implant as an alternative to titanium implant can be considered, in the case of type IV titanium allergy [12].

The promising research niches related to material engineering[13]–[16] and allergy issues associated with implants are the development of new materials for implants, new technology against allergies, and the tests for identifying allergic materials. This bibliometric analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding bio-implants. This article is arranged into four sections. The first section is the introduction, followed by the discussion of the methodology by which the research was conducted. The third section deals with results and discussion. The fourth section deals with the conclusion. The following research objectives and research questions were framed for conducting bibliometric analysis systematically.

1.1 Research Objectives

a) To consolidate the literature regarding allergy and implants
b) To find out the trends related to research in allergy and implants

1.2 Research Questions

a) Who are the active researchers working on allergy and implants?
b) Which are the main organizations and countries working on allergy and implants?
c) Which are the main journals related to allergy and implants?

RESEARCH METHODOLOGY

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE (allergy and implants)on 20/01/2021. All the tables in this paper were created by using Microsoft Excel and VOS Viewer. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation.This paper had been inspired by bibliometric analysis in its presentation style, analysis, and methodology from the works [17]–[23].

RESULTS AND DISCUSSION

1.1 Results

This first round of search produced an outcome of73 documents, infivelanguages, out of which 45 documents were in English. The classification of document categories is shown in Figure 1. For improving the quality of the analysis, we had selected only the peer-reviewed articles and all other documents had not been considered. Thus after using filters “Article”and “English” the second round search produced an outcome of 26 English articles (both open access and others) andhad been used to conduct bibliometric analysis and visualization using VOS Viewer. The English research articles in this domain since 1977 had been shown in Figure 2.

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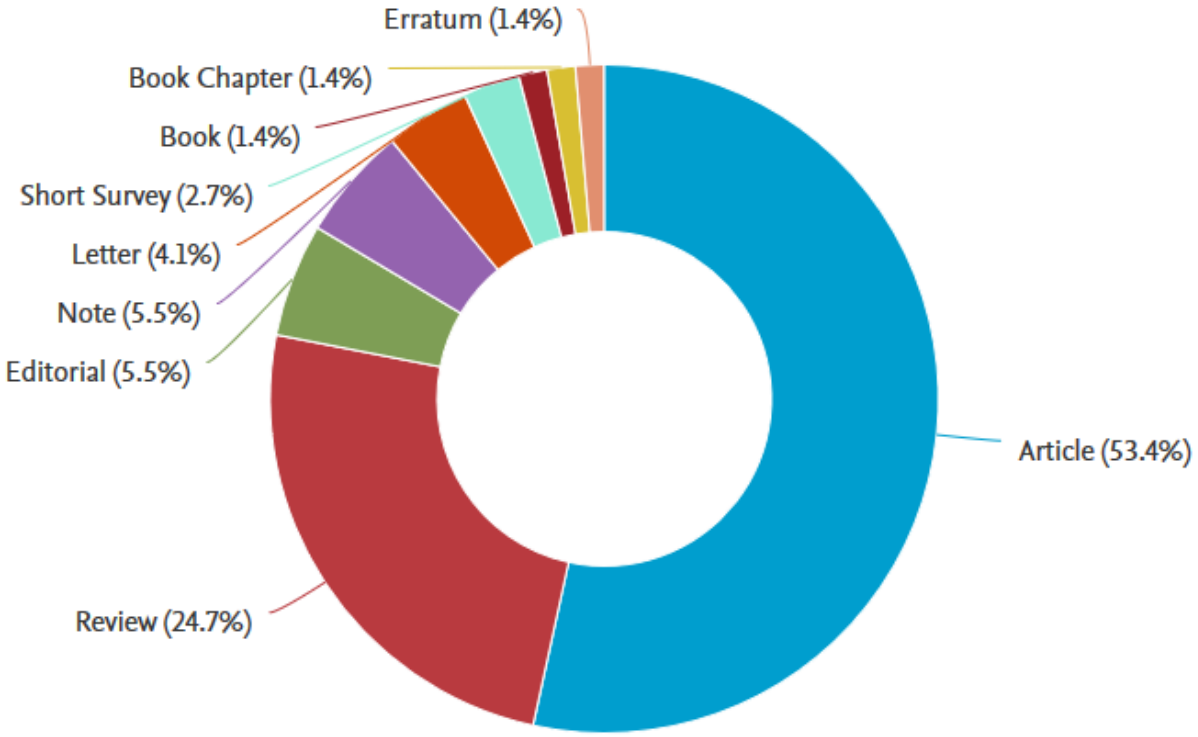

Figure 1: Classification of the documents on "Implants and Allergy", Source: www.scopus.com

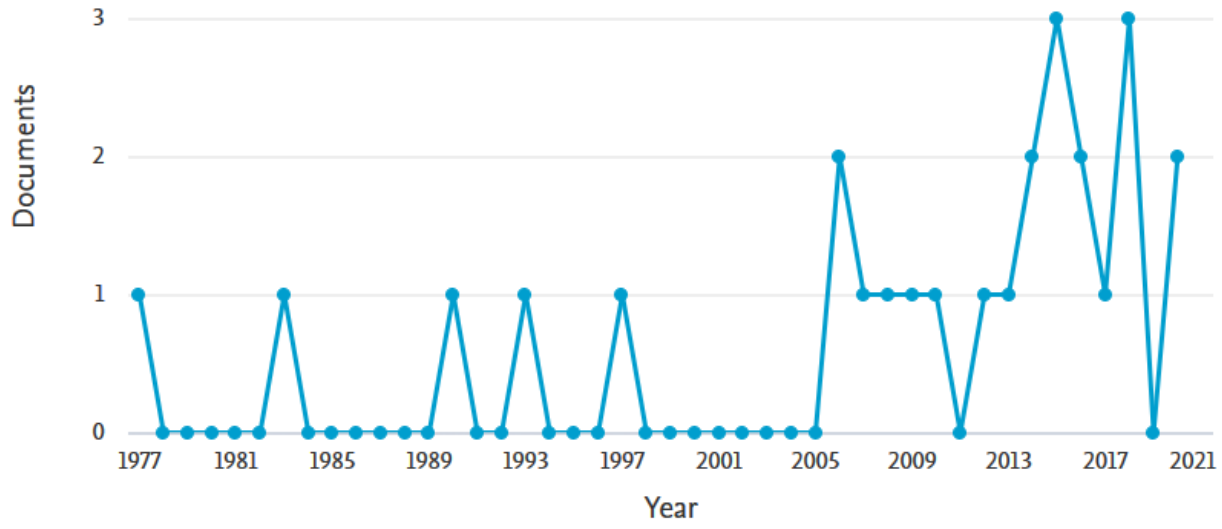

Figure 2: Period wise publication of articles, Source: WWW.scopus.com

Co-authorship analysis of top authors had been shown in figure 3. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as twoand the minimum number of citations of authors as one. This combination plotted the map of10 authors, in fiveclusters. The overlay visualization map of co-authorship analysis plotted in Figure 3, points out the major researchers with their strong co-authorship linkages and clusters involved.

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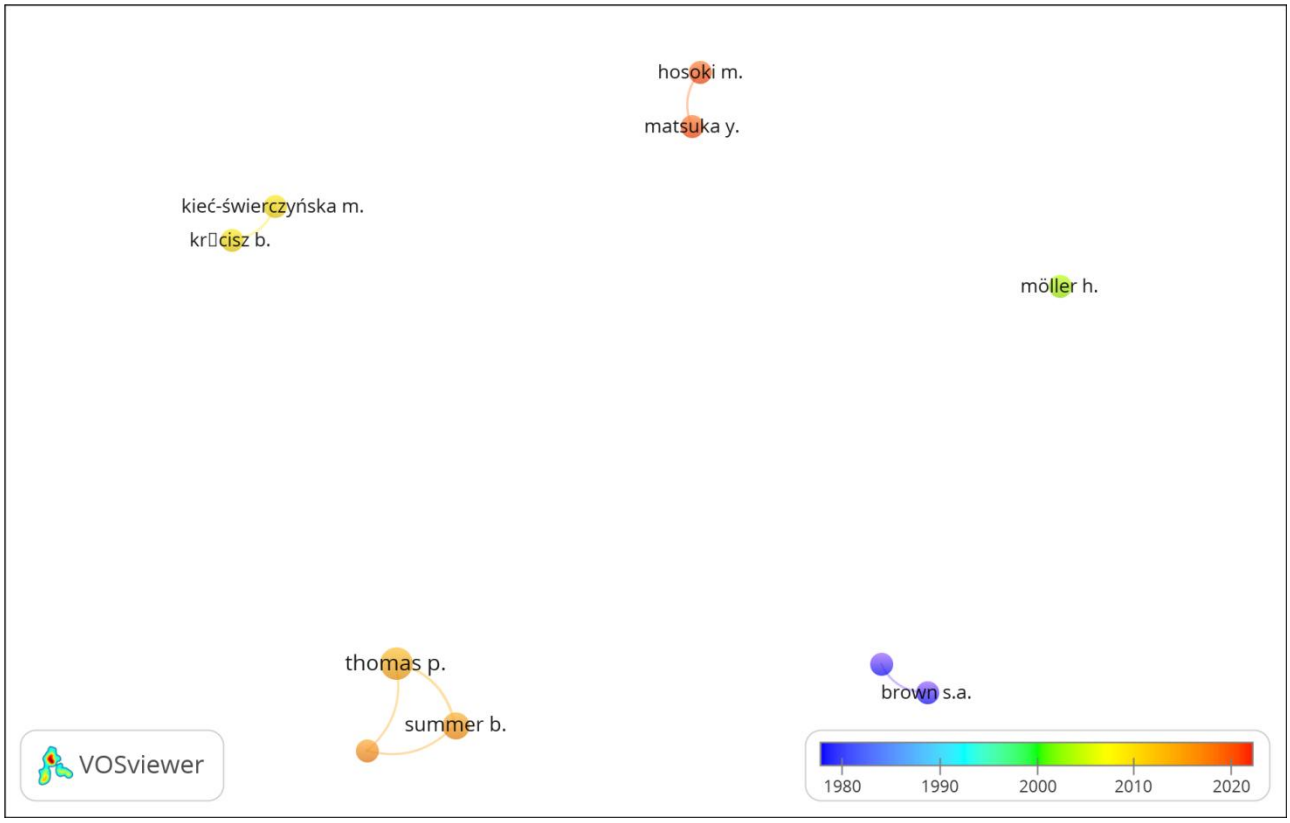

Figure 3: Co-authorship analysis on basis of authors

The citation analysis of top authors had been shown in table 1, along with co-authorship links.For the citation analysis, the parameters used were the minimum number of documents of an author as one and the minimum citations of an author as one.

Table 1: Highlights of most active authors

Description	Authors	Documents	Citations	Average citations per documents	Link strength
Authors with the highest publication, citations, and co-authorship links	Thomas P	4	199	49.75	25

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword asfive. This combination plotted the map of 26thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

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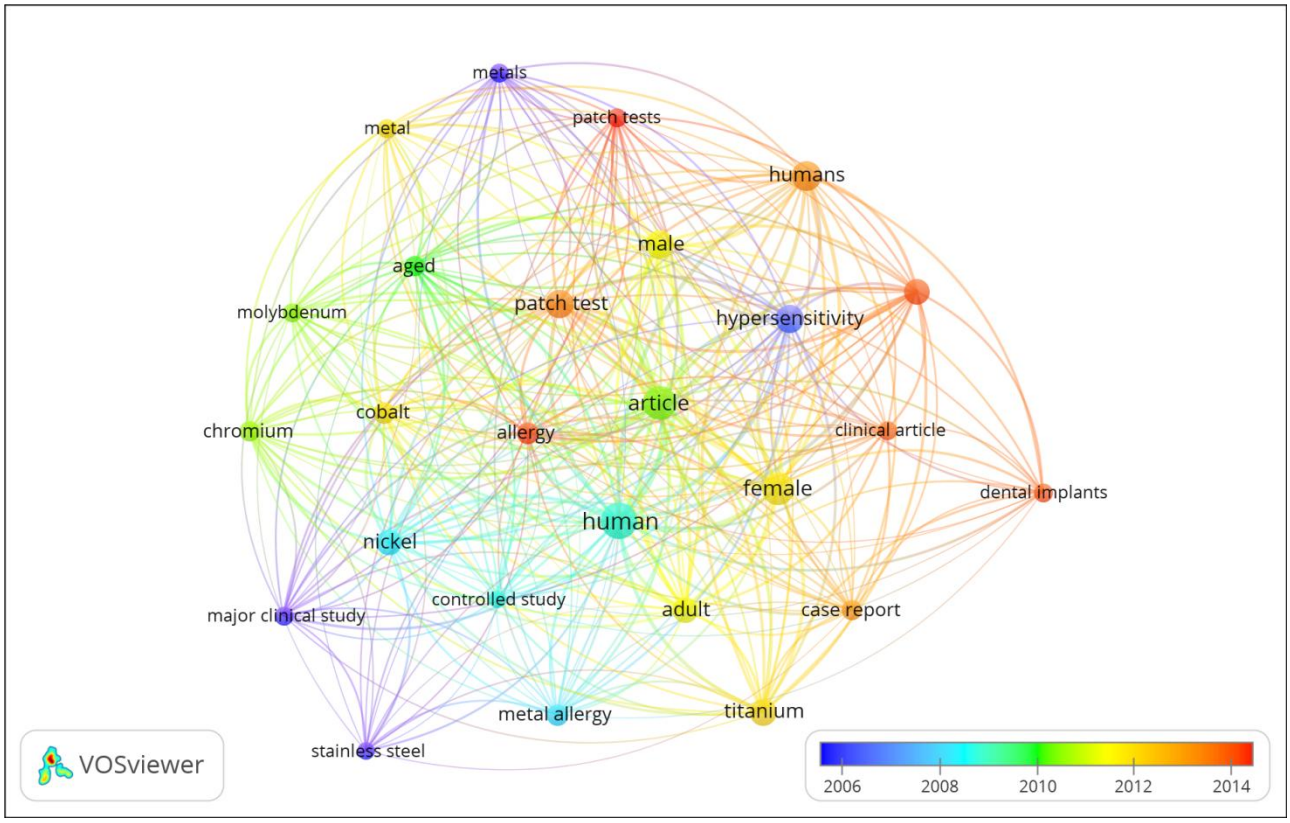

Figure 4: Co-occurrence analysis on basis of all keywords

The leading organizations engaged in research on “Implants and Allergy” had been found out by the volume of publications and citation analysis, the parameters used are the minimum number of documents of an organization as one and the minimum number of citations of organizations as one. The leading organization in the research regarding “Implants and Allergy”, with the highest number of publications and citations,was the Ludwig-Maximilian's University, Germany. (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Ludwig-Maximilian's University	Germany	4	199	49.75

Co-authorship analysis of the countries engaged in the research on “Implants and Allergy” had been shown in Figure 5. The overlay visualization map of co-authorship analysis plotted in Figure 5, points out the main countries with their strong co-authorship linkages and clusters involved.

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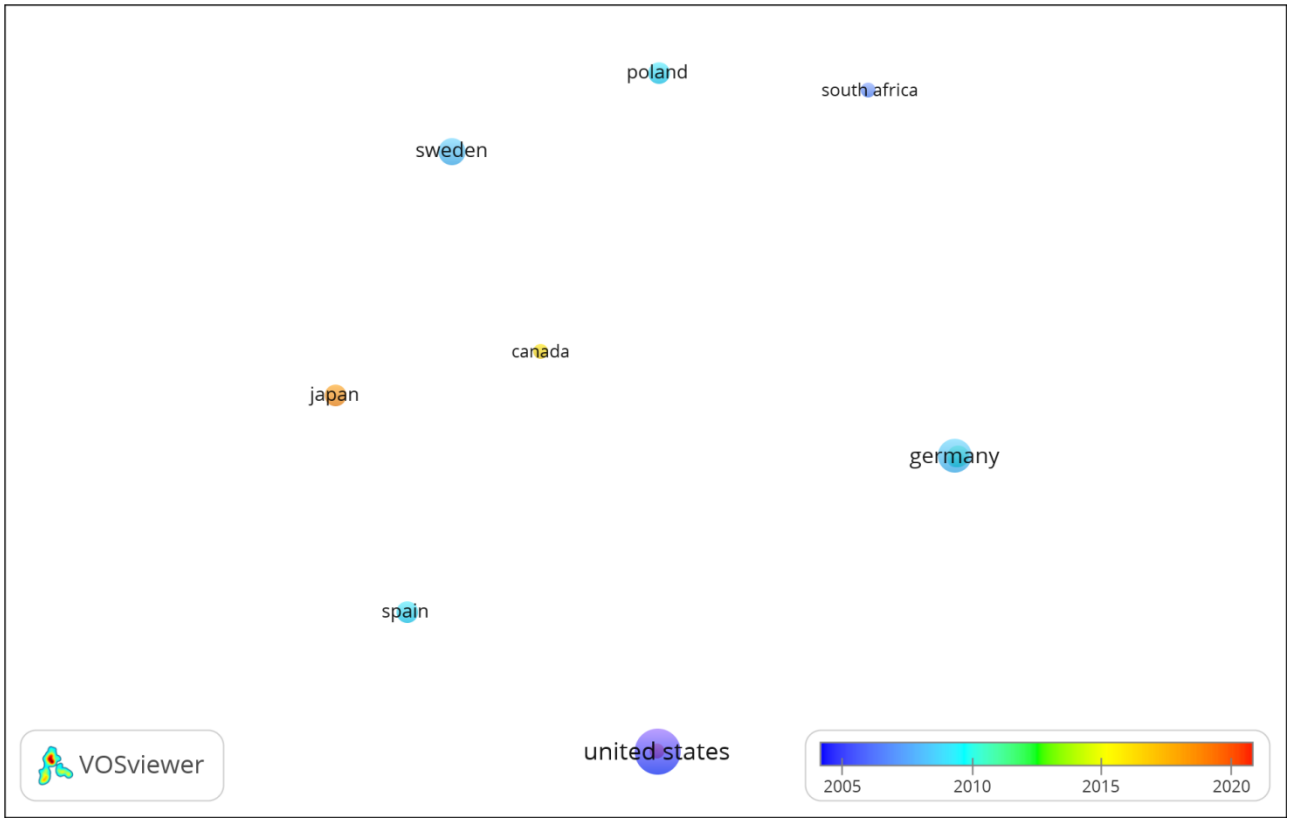

Figure 5: Co-authorship analysis on basis of countries

The citation analysis of top countries had been shown in table 3, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of acountry as one and the minimum citations of the country as one.

Table 3: Highlights of Active Countries

Description	Country	Documents	Citations	Link strength
The country with the highest publication,	United States of America	9	100	1
The country with the highest citations	Spain	2	257	0
The country with the highest co-authorship links	Germany	5	199	4

The most active countries in this research domain were the United States of America, Spain, and Germany, with the highest number ofpublications,citations, and co-authorship respectively.

Link analysis and citation analysis were used to identify the most active journal in this research domain. We have taken the parameters of the minimum number of documents of a journal as one and the minimum number of citations of a journal as one for the link analysis and citation analysis. Highlights of the most active and relevant journals related to “Implants and Allergy”are shown in table 4. Table 4shows the journal activity of this research domain through

parameters of publication volume, citations, and co-authorship linkages.

Table 4: Analysis of journal activity

Description	Journal details	Documents	Citations	Average citations per documents
Journal with the highest publications,	Contact Dermatitis	3	33	1
Journal with the highest citations	Clinical oral implants research	1	231	4

From the above discussion regarding the bibliometric patterns in the research regarding Implants and Allergy,this research had observed a gradual increase in research interest regarding Implants and Allergyfrom the starting of the millennium and the momentum is going on positively.This points out the relevance and potential of this research domain (Refer to Figure 2).The most active authors in this research domainThomas Pwith the highest publication, citation, and co-authorship links(Refer to table 1).The overlay analysis of top countries researching pacemaker batteriesindicates that the United States of America, Spain, and Germany were the leading countriesrelating tothe highest numberof publications, citations, and co-authorship links(Refer to figure 5). The top journals of this research domain were identified asContact Dermatitis and Clinical oral implants research.Fromthese wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Implants and Allergy.

CONCLUSION

Implants and Allergy was an interesting research domain and the most active journals related to this research domain wereContact Dermatitis and Clinical oral implants research.The most active countrieswere the United States of America, Spain, and Germany.The leading organization engaged in the research regarding Implants and Allergy was the Ludwig-Maximilian's University of Germany. The most active author who had made valuable contributions related toImplants and Allergy wasThomas Pwith the highest publication, citation, and co-authorship links.This research domain offers a new avenue for researchers and future research can be on innovations in Implants and Allergy.

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