Systematic Review

Int J Organ Transplant Med 2024;15(3):146-157
https://doi.org/10.61882/ijotm.2024.15.1151

Bibliometric Analysis of Kidney Transplantation-related Cell Therapy: Platelet-rich Plasma, Mesenchymal Stromal/Stem Cells, and Hematopoietic Stem Cells

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ABSTRACT

Background: This bibliometric analysis systematically examines the global research landscape of cell therapy applications in kidney transplantation, with particular focus on platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs) over a 52-year period (1971-2023).

Objective: The study addresses three key research questions: (1) How has research output evolved temporally? (2) What are the dominant research themes and collaborative networks? (3) Which institutions and authors have made the most significant contributions?

Methods: We conducted a comprehensive analysis of English-language articles from Scopus and Web of Science databases using a systematic search strategy incorporating Boolean operators and wildcard terms. After applying strict inclusion criteria and removing duplicates, 1,196 relevant publications were analyzed using RStudio (v4.1.4) with the bibliometrix package and Biblioshiny web application. Analytical methods included publication trend analysis, citation metrics, co-authorship network mapping, and keyword co-occurrence visualization.

Results: Our results reveal a marked increase in annual publications, with peak output occurring in 2021-2022. Leiden University Medical Center emerged as the most productive institution (57 publications), while the United States dominated country-level contributions. Network analysis identified collaborative clusters among 2,237 research institutions worldwide. Keyword analysis highlighted three major research themes: immunomodulation mechanisms (particularly for MSCs), graft survival enhancement, and stem cell differentiation potential. The top-cited works predominantly focused on MSC applications for reducing graft rejection.

Conclusion: These findings provide valuable insights into the evolution of cell therapy research in kidney transplantation, demonstrating a growing scientific interest with clear translational potential. The identification of key contributors, collaborative networks, and research hotspots offers guidance for future investigations, particularly in understudied areas such as PRP applications and the development of standardized clinical protocols. This analysis serves as both a reference map of historical progress and a roadmap for future research directions in this promising therapeutic domain.

KEYWORDS: Kidney transplantation; Cell therapy; Platelet-rich plasma; Mesenchymal stromal/stem Cells; Hematopoietic stem cells

INTRODUCTION

Kidney transplantation stands as a pivotal therapeutic intervention for end-stage renal diseases, offering a transformative solution to enhance patients' quality of life [1]. In recent decades, the integration of cell therapy approaches has emerged as a promising frontier in the field, with a particular emphasis on platelet-rich plasma (PRP; a concentrated source of growth factors derived from autologous blood), mesenchymal stromal/stem cells (MSCs; multipotent cells with immunomodulatory and regenerative properties), and hematopoietic stem cells (HSCs; progenitor cells capable of reconstituting blood and immune lineages) [2]. To elucidate the multifaceted landscape of research in this do

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Table 1: Codes were used to merge Scopus and Web of Science exported data in RStudio.

```
library(bibliometrix)
library(openxlsx)
## importing web of science dataset
web_data<-convert2df("abs.txt")
## importing scopus dataset
scopus_data<-convert2df("abs.bib",dbsource="scopus",format="bibtex")
##combined both datasets
combined<-mergeDbSources(web_data,scopus_data,remove.duplicated=T)
##exporting file
write.xlsx(combined,"combinedabs.xlsx")
```

main, this comprehensive bibliometric analysis delves into the expansive body of literature spanning over 50 years.

Cell therapy has emerged as a transformative paradigm in the realm of kidney transplantation, signifying a groundbreaking approach to address the complex challenges associated with organ rejection and post-transplant complications [3]. The distinct properties of PRP, MSCs, and HSCs have been harnessed to modulate immune responses, mitigate inflammation, and promote tissue regeneration in the transplanted kidney [4]. In particular, MSCs demonstrate immunomodulatory capacities that can promote immune tolerance and decrease the potential of graft-versus-host reactions [5]. Additionally, HSCs contribute to hematopoietic reconstitution, crucial for sustaining long-term graft function [6]. The utilization of these cellular therapies holds the promise of improving overall transplant outcomes by addressing complications such as graft rejection, ischemia-reperfusion injury, and chronic allograft dysfunction [7]. By delving into the intricate interplay between cell therapy and kidney transplantation, this study seeks to underscore the pivotal role of regenerative medicine in shaping the future of organ transplantation, fostering a more nuanced understanding of the therapeutic potential of these cellular interventions and their implications for clinical practice [8].

The evolution of cell therapy in kidney transplantation represents a dynamic intersection of regenerative medicine, immunology, and transplantation science [8]. As novel therapeutic modalities continue to emerge, a systematic examination of the scholarly output becomes imperative to identify trends, key contributors, and collaborative networks that shape the trajectory of this evolving field. This investigation navigates through the vast sea of scientific literature, utilizing advanced bibliometric methodologies to unravel quantitative insights. By scrutinizing publication trends, prolific authors, collaborative networks, and citation metrics, this study seeks to provide a nuanced understanding of the contributions of cell therapy to kidney transplantation. The inclusion of diverse parameters, such as keyword analysis, adds a qualitative dimension, unraveling the thematic intricacies that define this research domain.

While the analysis endeavors to offer a comprehensive view, it is essential to acknowledge the inherent limitations of bibliometric studies, including potential database biases and language restrictions [9]. Nevertheless, this study serves as a critical compass, guiding researchers, clinicians, and policymakers toward informed decision-making in the pursuit of advancing cell therapy for improved kidney transplantation outcomes.

In the subsequent sections, we delve into the detailed findings of this bibliometric analysis, exploring the nuances of publication trends, authorship dynamics, collaborative landscapes, and thematic concentrations. Through this scholarly expedition, we aim to contribute substantively to the collective understanding of cell therapy in kidney transplantation and stimulate further discourse and exploration in this rapidly advancing field.

Table 2: Scopus database.

Query
(TITLE-ABS-KEY ("Platelet-Rich Plasma" OR "Plasma, Platelet-Rich" OR "Platelet Rich Plasma" OR "Mesenchymal Stem Cells" OR "Stem Cell, Mesenchymal" OR "Mesenchymal Stem Cell" OR "Stem Cells, Mesenchymal" OR "Bone Marrow Mesenchymal Stem Cells" OR "Bone Marrow Mesenchymal Stem Cell" OR "Bone Marrow Stromal Cells" OR "Bone Marrow Stromal Cell" OR "Bone Marrow Stromal Cells, Multipotent" OR "Multipotent Bone Marrow Stromal Cell" OR "Multipotent Bone Marrow Stromal Cells" OR "Adipose-Derived Mesenchymal Stem Cells" OR "Adipose Derived Mesenchymal Stem Cells" OR "Adipose-Derived Mesenchymal Stromal Cells" OR "Adipose Derived Mesenchymal Stromal Cells" OR "Mesenchymal Stem Cells, Adipose-Derived" OR "Mesenchymal Stem Cells, Adipose Derived" OR "Adipose-Derived Mesenchymal Stem Cell" OR "Adipose Derived Mesenchymal Stem Cell" OR "Adipose Tissue-Derived Mesenchymal Stem Cell" OR "Adipose Tissue Derived Mesenchymal Stem Cell" OR "Adipose Tissue-Derived Mesenchymal Stem Cells" OR "Adipose Tissue Derived Mesenchymal Stem Cells" OR "Adipose Tissue-Derived Mesenchymal Stromal Cells" OR "Adipose Tissue Derived Mesenchymal Stromal Cells" OR "Adipose Tissue-Derived Mesenchymal Stromal Cell" OR "Adipose Tissue Derived Mesenchymal Stromal Cell" OR "Mesenchymal Stromal Cells" OR "Mesenchymal Stromal Cell" OR "Stromal Cell, Mesenchymal" OR "Stromal Cells, Mesenchymal" OR "Multipotent Mesenchymal Stromal Cells" OR "Multipotent Mesenchymal Stromal Cell" OR "Mesenchymal Stromal Cells, Multipotent" OR "Mesenchymal Progenitor Cell" OR "Mesenchymal Progenitor Cells" OR "Progenitor Cell, Mesenchymal" OR "Progenitor Cells, Mesenchymal" OR "Wharton Jelly Cells" OR "Wharton's Jelly Cells" OR "Wharton's Jelly Cell" OR "Whartons Jelly Cells" OR "Bone Marrow Stromal Stem Cells" Or "Cell, Hematopoietic Stem" OR "Cells, Hematopoietic Stem" OR "Hematopoietic Stem Cell" OR "Stem Cell, Hematopoietic" OR "Hematopoietic Progenitor Cells" OR "Cell, Hematopoietic Progenitor" OR "Cells, Hematopoietic Progenitor" OR "Hematopoietic Progenitor Cell" OR "Progenitor Cells, Hematopoietic" OR "Stem Cells, Hematopoietic" OR "Hematopoietic Colony-Forming Unit" OR "Hematopoietic Colony-Forming Units") AND TITLE-ABS-KEY ("Renal Transplantation" OR "Renal Transplantations" OR "transplantations renal" OR "transplantation renal" OR "grafting kidney" OR "Kidney Grafting" OR "transplantation kidney" OR "Kidney Transplantations" OR "transplantations kidney" OR "Kidney Transplantation"))

MATERIALS AND METHODS

Eligibility Criteria and Data Source

This bibliometric investigation seeks to assess the contributions of cell therapy in the context of kidney transplantation, specifically emphasizing PRP, MSCs, and HSCs. The study exclusively incorporates research and review English-language articles sourced from the Scopus and Web of Science databases.

Inclusion criteria:

1. Original research articles and review papers

2. Focused on at least one cell therapy type (PRP, MSCs, or HSCs) in kidney transplantation

3. Contained complete bibliometric metadata (title, authors, affiliations, references etc.)

Exclusion criteria:

1. Non-English publications

2. Editorials, letters, conference abstracts

3. Studies not relevant to both cell therapy AND kidney transplantation

4. Duplicate publications

Comprehensive metadata retrieval in BibTeX and text formats was undertaken, and subsequent consolidation of data occurred in RStudio, resulting in an Excel file (Table 1).

Search Strategy

In the course of this scientific inquiry, an exhaustive exploration was carried out within the Scopus and Web of Science databases utilizing sophisticated search functionalities. Our approach involved the utilization of Boolean

Table 3: Web of Science database.

No.	Queries
#1	"Platelet-Rich Plasma" OR "Plasma, Platelet-Rich" OR "Platelet Rich Plasma" OR "Mesenchymal Stem Cells" OR "Stem Cell, Mesenchymal" OR "Mesenchymal Stem Cell" OR "Stem Cells, Mesenchymal" OR "Bone Marrow Mesenchymal Stem Cells" OR "Bone Marrow Mesenchymal Stem Cell" OR "Bone Marrow Stromal Cells" OR "Bone Marrow Stromal Cell" OR "Bone Marrow Stromal Cells, Multipotent" OR "Multipotent Bone Marrow Stromal Cell" OR "Multipotent Bone Marrow Stromal Cells" OR "Adipose-Derived Mesenchymal Stem Cells" OR "Adipose Derived Mesenchymal Stem Cells" OR "Adipose-Derived Mesenchymal Stromal Cells" OR "Adipose Derived Mesenchymal Stromal Cells" OR "Mesenchymal Stem Cells, Adipose-Derived" OR "Mesenchymal Stem Cells, Adipose Derived" OR "Adipose-Derived Mesenchymal Stem Cell" OR "Adipose Derived Mesenchymal Stem Cell" OR "Adipose Tissue-Derived Mesenchymal Stem Cell" OR "Adipose Tissue Derived Mesenchymal Stem Cell" OR "Adipose Tissue-Derived Mesenchymal Stem Cells" OR "Adipose Tissue Derived Mesenchymal Stem Cells" OR "Adipose Tissue-Derived Mesenchymal Stromal Cells" OR "Adipose Tissue Derived Mesenchymal Stromal Cells" OR "Adipose Tissue-Derived Mesenchymal Stromal Cell" OR "Adipose Tissue Derived Mesenchymal Stromal Cell" OR "Mesenchymal Stromal Cells" OR "Mesenchymal Stromal Cell" OR "Stromal Cell, Mesenchymal" OR "Stromal Cells, Mesenchymal" OR "Multipotent Mesenchymal Stromal Cells" OR "Multipotent Mesenchymal Stromal Cell" OR "Mesenchymal Stromal Cells, Multipotent" OR "Mesenchymal Progenitor Cell" OR "Mesenchymal Progenitor Cells" OR "Progenitor Cell, Mesenchymal" OR "Progenitor Cells, Mesenchymal" OR "Wharton Jelly Cells" OR "Wharton's Jelly Cells" OR "Wharton's Jelly Cell" OR "Whartons Jelly Cells" OR "Bone Marrow Stromal Stem Cells" Or "Cell, Hematopoietic Stem" OR "Cells, Hematopoietic Stem" OR "Hematopoietic Stem Cell" OR "Stem Cell, Hematopoietic" OR "Hematopoietic Progenitor Cells" OR "Cell, Hematopoietic Progenitor" OR "Cells, Hematopoietic Progenitor" OR "Hematopoietic Progenitor Cell" OR "Progenitor Cells, Hematopoietic" OR "Stem Cells, Hematopoietic" OR "Hematopoietic Colony-Forming Unit" OR "Hematopoietic Colony-Forming Units" (TITLE-ABS-KEY)
#2	"Renal Transplantation" OR "Renal Transplantations" OR "transplantations renal" OR "transplantation renal" OR "grafting kidney" OR "Kidney Grafting" OR "transplantation kidney" OR "Kidney Transplantations" OR "transplantations kidney" OR "Kidney Transplantation" (TITLE-ABS-KEY)
#3	#1 and #2

and Wildcard search operators to meticulously identify pertinent keywords for the study, as illustrated in Tables 2 and 3. The search was executed in December 2023, with the complete search strategy delineated in Fig. 1. Articles deemed irrelevant based on title, abstract, and full-text examination were methodically eliminated. Subsequently, 1195 articles were imported for comprehensive bibliometric analyses.

Bibliometric Analyses

The management and analysis of data were executed employing the bibliometric package (version 4.1.4) [10] and the Biblioshiny web applications within RStudio (RStudio 2023.09.1+494, PBC, Boston, MA). The analytical scope encompassed a span of 52 years, centering on metrics related to publication and citation, as well as trends in citation [11, 12]. Institutions demonstrating prolific output were discerned based on the quantity of articles pertaining to the impact of ultra-processed foods on the gut microbiota within this timeframe.

Moreover, collaborative networks were established among 2237 leading research institutes utilizing clustering algorithms and data normalization from 1195 articles, with guidance from an association parameter. Recognition of authors with notable contributions was contingent on the frequency of their published articles. The evaluation also encompassed the

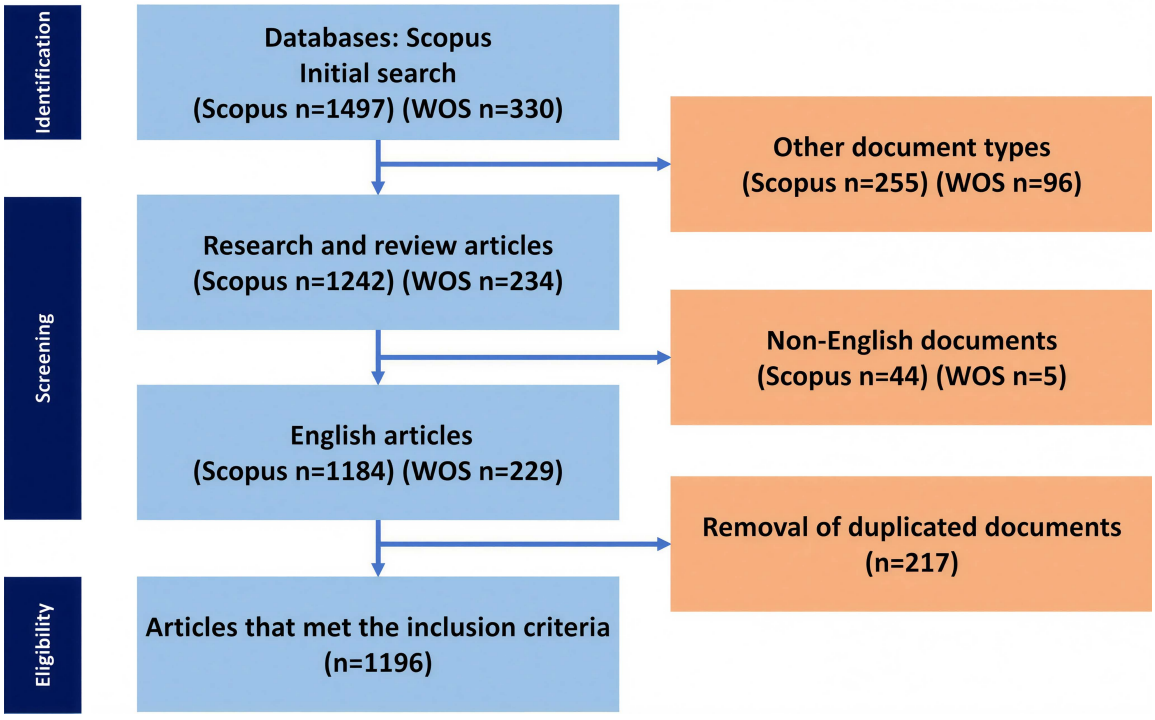

Figure 1: PRISMA-style flowchart illustrating the systematic selection process for English-language articles included in the bibliometric analysis of cell therapy (PRP, MSCs, HSCs) in kidney transplantation. Key steps: (1) Initial identification of records from Scopus and Web of Science (n= [total initial hits]); (2) Removal of duplicates (n= [duplicates removed]); (3) Title/abstract screening for relevance to cell therapy and kidney transplantation (n= [excluded at this stage]); (4) Full-text assessment for eligibility based on inclusion criteria (n= [excluded with reasons, e.g., wrong study type, insufficient data]); (5) Final corpus of articles included in bibliometric analysis (n= 1,195). Exclusion criteria: non-English papers, editorials/letters, and studies lacking focus on both cell therapy and transplantation.

identification of the top 10 most frequently cited documents and preeminent journals.

This investigation explored the interrelations among ten notable journals, fields of study, and countries contributing to the examination of the roles of cell therapy in kidney transplantation, with an emphasis on PRP, MSCs, and HSCs over the preceding 52-year period. Global research collaboration was visually represented on a world map to illustrate interactions. A TreeMap visualization outlined the ten most frequently utilized keywords in articles related to this subject.

RESULTS

Search Results

An initial retrieval yielded 1497 and 330 papers from the Scopus and Web of Science databases, respectively. Following the application of eligibility criteria and the exclusion of 370 studies deemed ineligible, a total of 1196 papers were deemed suitable for inclusion in this bibliometric analysis (Fig. 1). Of the 370 excluded studies, primary reasons included: (1) 321 were non-research articles, and (4) 49 had non-English language.

Key Attributes of the Encompassed Studies

Within the articles, all contributions were deemed original, constituting 100% of the overall content. These articles exhibited an average citation rate of 26.77 per document. The 10 most highly cited articles, appraising the contributions of cell therapy in kidney transplantation and emphasizing PRP, MSCs, and HSCs, are enumerated in Table 4. Notably, articles authored by scholars from the United States garnered the highest average citation rate, with 11756 citations per article. The analysis encompassed 1196 studies, involving a total of 6401 authors from 55 countries.

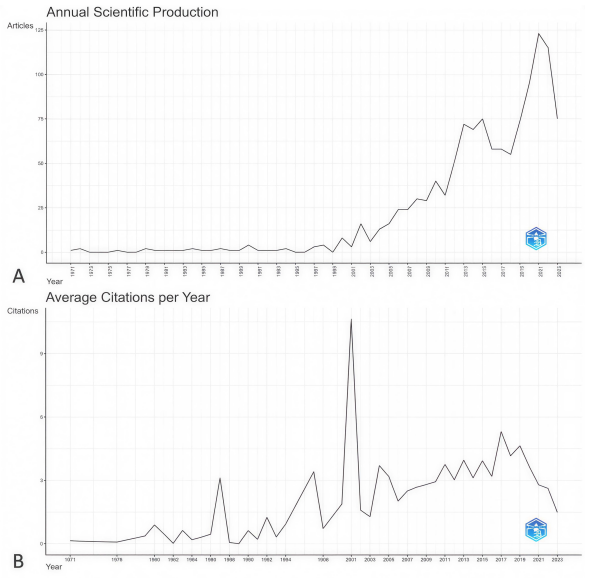

Figure 2: Worldwide annual patterns in (**A**) publication frequencies and (**B**) citations, analyzing the contributions of cell therapy in kidney transplantation, with a focus on platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

Trend of Publication and Citation

The bibliometrix R package (v4.1.4) was selected for its specialized capacity to handle large bibliographic datasets and generate network metrics. While powerful for citation analysis, its limitation lies in requiring standardized metadata - we addressed this through manual verification of 10% randomly selected records to ensure data integrity.

Throughout the 52-year span from 1971 to 2023, a discernible surge in article publications evaluating the contributions of cell therapy in kidney transplantation, with an emphasis on PRP, MSCs, and HSCs, has been observed. The lowest incidence of research publications transpired between 1971 and 1999, constituting a mere 34 studies during this interval. Conversely, the zenith in publications occurred in 2021 and 2022, registering totals of 123 and 115, respectively (Fig. 2A). In contrast, the trajectory of average annual citations exhibited gradual and erratic growth over the same timeframe, reaching its pinnacle in 2001 at 10.6 (Fig. 2B)

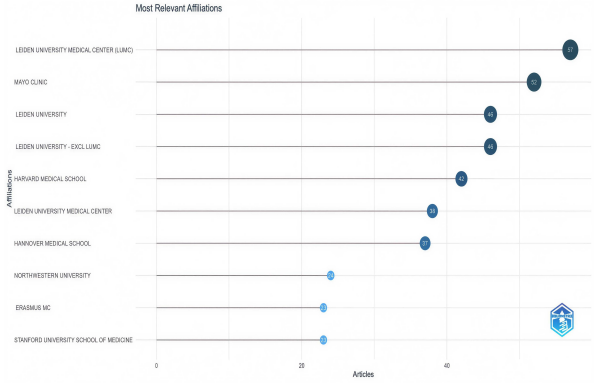

Figure 3: Ranking of the top 10 affiliations publishing articles analyzing the contributions of cell therapy in kidney transplantation, emphasizing platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

Most Relevant Affiliations

In the examination of the impact of cell therapy in kidney transplantation, with a focus on PRP, MSCs, and HSCs, the Leiden University Medical Center emerged as the most prolific institution, providing a contribution of 57 papers on the subject (Fig. 3).

Most Contributing Authors and Their Collaboration Network

In our examination of cell therapy in kidney transplantation, emphasizing PRP, MSCs, and HSCs, we conducted an analysis of document counts authored by various researchers. As depicted in Fig. 4, Reinders M emerged as the most prolific author of research articles, contributing the highest number of articles, with n= 31.

Most Productive Journals

Within the scope of our focus, the journal 'Transplantation' prominently featured 66 articles, while the journal 'Frontiers in Immunology' presented 56 articles, as illustrated in Fig. 5, among the published articles in the pertinent field. Among the top 10 relevant lists, the Journal of Transplantation ranked first in the top 10 most relevant journals (n= 66), it also has the impact factor (IF= 6.2). The journal with the highest IF in the most relevant source list was the *American Journal of Transplantation* (IF= 7.3), followed by the *Frontiers*

Table 4: Classification of the top 10 most cited articles assessing the contributions of cell therapy in kidney transplantation, with emphasis on platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

Ranking	Study References	Title of the Document	Journal Name	Total Citations	DOI
1	[13]	C3a modulates IL-1β secretion in human monocytes by regulating ATP efflux and subsequent NLRP3 inflammasome activation	New Engl J Med	643	10.1056/NEJMoa1611391
2	[14]	Bone marrow contributes to renal parenchymal turnover and regeneration	J Pathol	599	10.1002/path.976
3	[15]	Tolerance and chimerism after renal and hematopoietic-cell transplantation	New Engl J Med	421	10.1056/NEJMoa074191
4	[16]	Chimerism and tolerance without GVHD or engraftment syndrome in HLA-mismatched combined kidney and hematopoietic stem cell transplantation	Sci Transl Med	337	10.1126/scitranslmed.3003509
5	[17]	Incidence of invasive aspergillosis following hematopoietic stem cell and solid organ transplantation: interim results of a prospective multicenter surveillance program	Med Mycol	310	10.1080/13693780400020113
6	[18]	The BAFF/APRIL system: emerging functions beyond B cell biology and autoimmunity	Cytokine Growth Factor Rev	309	10.1016/j.cytogfr.2013.04.003
7	[19]	Pulmonary complications of solid organ and hematopoietic stem cell transplantation	Am J Respir Crit Care Med	294	10.1164/rccm.200309-1322so
8	[20]	Regulatory T-cell generation and kidney allograft tolerance induced by mesenchymal stem cells associated with indoleamine 2,3-dioxygenase expression	Transplantation	268	10.1097/TP.0b013e3181fed001
9	[21]	Human polyomaviruses in disease and cancer	Virology	251	10.1016/j.virol.2012.12.015
10	[22]	Autologous bone marrow-derived mesenchymal stromal cells for the treatment of allograft rejection after renal transplantation: results of a phase I study	Stem Cell Transl Med	240	10.5966/sctm.2012-0114

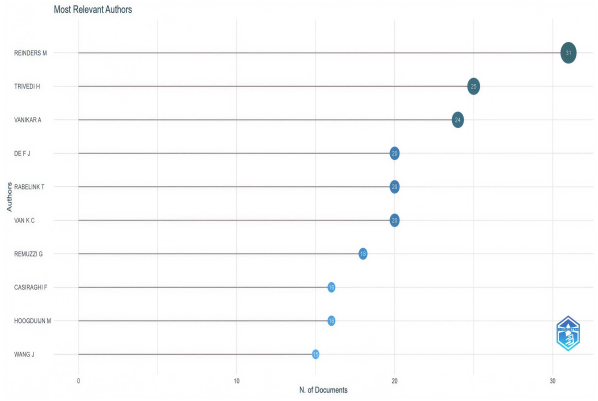

Figure 4: Ranking of the ten most prolific authors in the domain of kidney transplantation, with a focus on platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

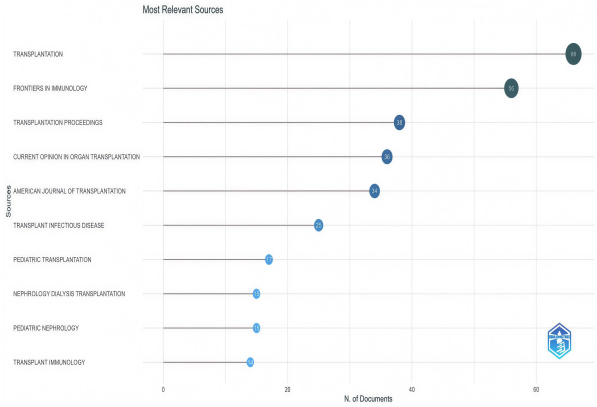

Figure 5: Ranking of the ten preeminent journals publishing research papers in the field of kidney transplantation, emphasizing platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

in Immunology (IF= 7.3). Moreover, it could be seen that five journals are in both the most relevant list, namely, *Transplantation Journal*, *Frontiers in Immunology*, *Transplantation Proceedings*, *Current Opinion in Organ Transplantation*, *American Journal of Transplantation* (Table 5).

World Research Production and Collaborations

Fig. 6 depicts the leading scholarly productivity pertaining to kidney transplantation, with a focus on PRP, MSCs, and HSCs, where the United States emerges as the foremost contributor among the top 10 nations. The illustration further underscores 95 noteworthy international collaborations within this research domain. The most prevalent collaborative endeavors transpired between the United States and China, totaling 5 instances. The United States recorded the highest citations at 11,766 in comparison to other nations on this topic, as indicated in Fig. 7.

TreeMap and Thematic Map

Fig. 8 presents a TreeMap visualization delineating the primary 20 keywords extensively utilized by authors in articles concerning kidney transplantation, emphasizing PRP, MSCs, and HSCs. Of particular significance, two keywords associated with kidney transplantation (constituting 40%) and cell therapy (comprising 25%) emerge as recurrently utilized within this research domain.

DISCUSSION

The comprehensive exploration conducted in this study aimed to assess the landscape of research on the contributions of cell therapy in kidney transplantation, with a particular emphasis on PRP, MSCs, and HSCs 1971 to 2023. The full record and cited references of 1196 articles were included in our study from the WOS-CC and Scopus databases.

The bibliometric analyses provided insights into various facets of this evolving field, including publication trends, citation patterns, influential authors, collaborating institutions, and global contributions [11]. The steady increase in annual publications indicates the growing interest and recognition of Cell Therapy in Kidney Transplantation.

The United States was the most cited (n= 11,756), following by Italy (n= 2324, the second) and the United Kingdom (n= 967, the third). Among the top 10 countries, all countries are developed countries. The Leiden University Medical Center (Netherlands) institutions ranked first with 57 papers, the following institution was from the United States, Mayo clinic— nonprofit American academic medical center with a 52 of publications. Moreover, four of the top 10 active institutions were from the United States. Between all universities the universities United States dominated in this

Table 5: Most relevant journals in the field of stem cell in kidney disease (1971-2023).

Most Relevant Sources	Articles	IF	JCR Category (Quartile)
Transplantation	66	6.2	Immunology-SCIE (Q2); Surgery-SCIE (Q1)
Frontiers in Immunology	56	7.3	Immunology-SCIE (Q1)
Transplantation Proceedings	38	0.9	Immunology-SCIE (Q4); Surgery-SCIE (Q4)
Current Opinion in Organ Transplantation	36	2.2	Transplantation-SCIE (Q3)
American Journal of Transplantation	34	8.7	Surgery-SCIE (Q1); Transplantation-SCIE (Q1)
Transplant Infectious Disease	25	2.6	Immunology-SCIE (Q4); Infectious Diseases-SCIE (Q3)
Pediatric Transplantation	17	1.3	Pediatric-SCIE (Q4); Transplantation-SCIE (Q4)
Nephrology Dialysis Transplantation	15	6.1	Transplantation-SCIE (Q1); Urology & Nephrology-SCIE (Q1)
Pediatric Nephrology	15	3.0	Pediatric-SCIE (Q2); Urology & Nephrology-SCIE (Q2)
Transplant Immunology	14	1.5	Immunology-SCIE (Q4); Transplantation-SCIE (Q4)

field. In developed nations, institutions typically possess ample financial resources and effective administration and there are capable of coordinating extensive clinical trial initiatives. Furthermore, the majority of advanced clinical practices in stem cell therapy have emerged within developed nations [23, 24].

Extracting keywords such as "kidney transplantation," "transplantation," and "hemopoietic stem cell transplantation" allows us to observe the dynamics and evolution of academic works in the field of transplantation and stem cell therapy. These keywords serve as vital indicators of changes in activity and research directions within this field. Terms related to organ transplantation, such as "kidney trans

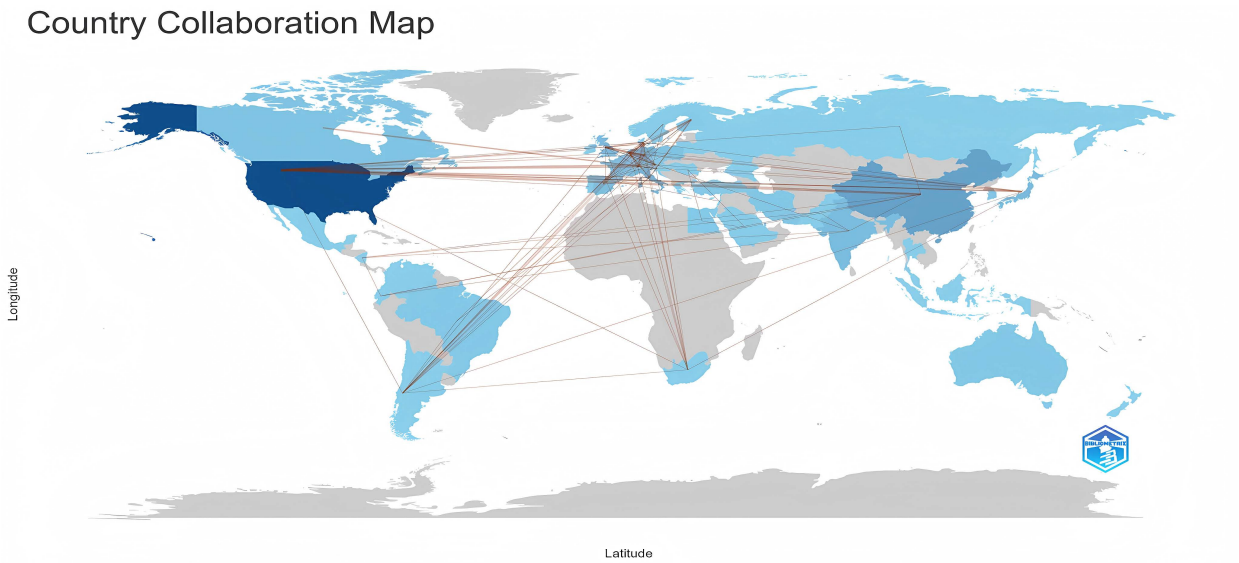

Figure 6: Visualization of collaborative networks among countries in the publication of articles concentrating on the domain of kidney transplantation, with an emphasis on platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

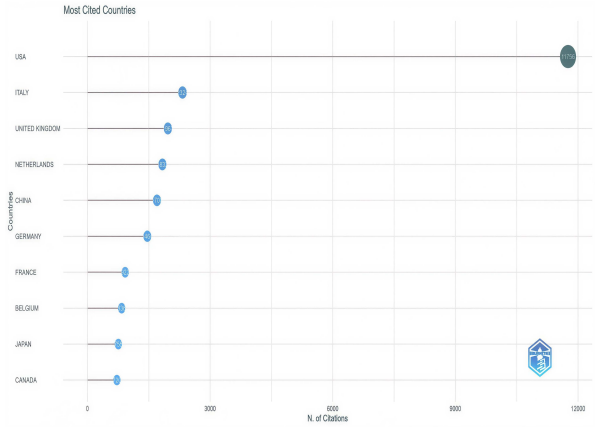

Figure 7: Ranking of the ten most highly cited countries in the domain of kidney transplantation, with emphasis on platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

plantation" and "hematopoietic stem cell transplantation," indicate enduring interest and the importance of progressing methods in organ transplantation and hematopoietic stem cells in the field of medicine. This also indicates ongoing enhancements in procedures and technologies related to these types of transplantations. Changes in the use of these key words may reflect the evolution of methods, technologies, and new approaches in the field of transplantation. This is distinctly evident in both the publication activity and research within this sphere. The majority of articles listed in Table 4 are dedicated to research in the field of hematopoietic stem cells [15-17, 19].

Chronic kidney disease is a progressive condition that affects >10% of the general population worldwide, amounting to >800 million individuals [25]. According to the Pan American Health Organization and World Health Organization data, the cumulative number of fatalities attributed to kidney diseases in 2019 was 254,028 [26]. The rising prevalence of kidney diseases [25] underscores the significance of exploring novel treatment modalities, establishing them as a crucial aspect of medical research. Klinkhammer BM et al. administered healthy MSCs to rats with acute anti-Thy1.1-nephritis in an in vitro setting, and the results demonstrated an accelerated healing process of glomerular lesions [27]. At present, investigations focused on stem cell-based treatment approaches for kidney diseases are being conducted in vitro [27, 28].

Increasing evidence suggests that stem cell-based therapy enhances the regeneration of renal tissue, reducing kidney damage while concurrently improving renal function [27]. There are certain challenges and complications, but science is advancing. Stem cells could potentially become the next regenerative medicine for treating kidney diseases.

Despite the comprehensive nature of this study, certain limitations must be acknowledged. The reliance on specific databases, such as Scopus and Web of Science, may introduce selection bias. Additionally, the exclusion of

Figure 8: TreeMap visualization emphasizing the primary ten author-generated keywords frequently encountered in articles related to platelet-rich plasma (PRP), mesenchymal stromal/stem cells (MSCs), and hematopoietic stem cells (HSCs).

non-English articles may limit the inclusivity of the analysis. Furthermore, while bibliometric analyses provide quantitative insights, they may not capture the qualitative nuances of individual studies.

In conclusion, this study offers a thorough examination of the evolving landscape of cell therapy in kidney transplantation. The identified trends, key contributors, and collaborative networks underscore the global significance of this research area. The results lay the groundwork for future research directions, underscoring the necessity for ongoing exploration and collaboration to deepen our comprehension of the impact of cell therapy on improving kidney transplantation outcomes. Despite the acknowledged limitations, the insights gained from this study contribute valuable knowledge to the broader scientific community.

FINANCIAL SUPPORT: None.

CONFLICTS OF INTEREST: None declared.

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