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REVIEW ARTICLE

A bibliometric analysis of publications in *Renal Failure* in the last three decades

Yuh-Shan Ho[a], Mihály Tapolyai[b,c], Wisit Cheungpasitporn[d] and Tibor Fülöp[b,e]

[a]Trend Research Centre, Asia University, Taichung, Taiwan; [b]Department of Nephrology, Szent Margit Kórhaz, Budapest, Hungary; [c]Medicine Service, Ralph H. Johnson VA Medical Center, Charleston, SC, USA; [d]Department of Medicine, Division of Nephrology, Mayo Clinic, Rochester, MN, USA; [e]Department of Medicine, Division of Nephrology, Medical University of South Carolina, Charleston, SC, USA

ABSTRACT

Publications in *Renal Failure* in Science Citation Index Expanded (SCI-EXPANDED) between 1992 and 2021 were analyzed. Six publication indicators: total, independent, collaborative, first author, corresponding author, and single author publications as well as their related citation indicators, were used to compare performances of countries, institutes, and authors. Comparison of the highly cited papers and journal's impact factor (*IF*) contributors was discussed. In addition, the main research topics in the journal were presented. Results show that China published the most total articles and reviews, as well as the first-author papers and corresponding-author papers in the journal. The Chang Gung Memorial Hospital in Taiwan ranked the top in five publication indicators: total, single-institution, inter-institutionally collaborative, first author, and corresponding-author papers. A low percentage of productive authors emerged as a journal *IF* contributor. Similarly, only a limited relationship between highly cited papers and *IF* contributing papers was found. Publications related to hemodialysis, chronic kidney disease, and acute kidney injury were the most popular topic, while meta-analysis was new focus in the last decade in the journal.

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Bibliometric; SCI-EXPANDED; journal impact factor; impact factor contributing indicator

Preamble

Since this Editor took over the journal *Renal Failure* in January 2019, a significant increase in submissions has taken place with a commensurate rise in the Journal 's impact factor, downloads, and overall journal ranking. The emergence of COVID-19 epidemics also resulted in a further explosion of submissions dedicated to kidney diseases and critical illnesses, highly relevant to the journal's profile. All these events and the changing landscape of medicine and technology prompted us to critically examine publication trends as reflected in *Renal Failure*.

Introduction

The *Renal Failure* with ISO Abbreviation title *Ren. Fail.* has been indexed in the Science Citation Index Expanded (SCI-EXPANDED) and classified in Web of Science category of 'Urology and Nephrology' since 1987. Earlier, the journal has been published under the names of *Uremia Investigation* (1984–1986), *Clinical and Experimental Dialysis and Apheresis* (1981–1983), and *Journal of Dialysis* (1976–1980). Bibliometric analyses of medical-related journals were presented in the past, for example, the *Journal of Orthopaedic & Sports Physical Therapy* [1], the *International Orthopaedics* [2], and the *Spine* [3], and the *Knee* [4] as well as journals in category of 'Urology and Nephrology', for example, the *Clinical Kidney Journal* [5] and the *Korean Journal of Urology* [6]. Document types, languages, publication trends, and publications of country, institution, and author were generally revealed to provide basic information about a journal [7]. Six publication indicators: total, independent, collaborative, first author, corresponding author, and single author publications [8] as well as citation indicators: the total number of citations from Web of Science Core Collection since publication to the end of the most recent year [9] and the number of citations in the most recent year [10] were applied to evaluate journals [8]. In recent years, journal impact factor (*IF*) contributing indicator was also proposed to discuss publications in a journal [11,12].

The bibliometric method was applied to obtain an overview of *Renal Failure* in the last three decades. The aim of this study was to analyze including publication characteristics and trends over this period. Furthermore, relationship between journal's *IF* contributors and highly cited publications were to be discussed.

CONTACT Tibor Fülöp tiborfulop.nephro@gmail.com; fulopt@musc.edu Department of Medicine, Division of Nephrology, Medical University of South Carolina, 96 Jonathan Lucas Street, Charleston, SC 29525, USA

Methods

The documents used in this study were derived from the SCI-EXPANDED of the Web of Science Core Collection, Clarivate Analytics. The searching keyword phrase 'Renal Failure' was searched as publication titles (SO) from 1992 to 2021 (updated on 27 January 2023). All document information from SCI-EXPANDED and each year's citation times for every paper sorting from the Web of Science Core Collection was checked and downloaded into Excel Microsoft 365 [13]. The functions in Excel Microsoft 365, for example, Concatenate, Counta, Filter, Freeze Panes, Len, Match, Proper, Rank, Replace, Sort, Sum, and Vlookup were applied. The SCI-EXPANDED database cannot be directly used for bibliometric research [14]. The data format is processed uniformly by functions in the EXCEL. Additional coding was manually performed.

The collaboration type, country, and institution were determined by the authors' affiliation. In the SCI-EXPANDED database, the corresponding author is designated as the 'reprint author'. This study uses the term 'corresponding author' instead [15]. In a single author, a single institution, and a single country paper where the authorship is unspecified, the single author, the single institution, and the single country were considered both as first and corresponding author, institution, and country. In multi-corresponding author articles, all the corresponding authors, institutions, and countries were considered. Papers with corresponding authors in SCI-EXPANDED, that had only address but not affiliation names were checked out, and the addresses were changed to affiliation names.

The affiliations that originated in England, Scotland, North Ireland (Northern Ireland), and Wales were reclassified as UK (United Kingdom) [16]. Affiliations in Hong Kong before 1997 were reclassified as being from China [17]. Affiliations in Yugoslavia and Serbia Monteneg (Serbia and Montenegro) were checked and reclassified as being in Serbia.

Results and discussion

Characteristics of document type

In the last three decades, *Renal Failure* published 4354 documents in 11 Web of Science document types. Table 1 shows the characteristics of these 11 document types, including 3865 articles (89% of 4354 documents) with an average number of authors per paper (*APP*) of 5.9 and 245 reviews (5.6%) with an *APP* of 4.2. It was reported that the documents in the Web of Science Core Collection could be divided into two document types [18]. For example, 241 proceedings papers and one publication with expression of concern are also classified as articles. Therefore, the total percentage is higher than 100% in Table 1. Document type of retractions with two documents had the greatest *APP* of 8.0 while document type of editorial materials with 17 documents had an *APP* of 2.1. In addition, one expression of concern had no author information in the SCI-EXPANDED. The *APP* in the journal was 5.8, and the maximum number of authors in a paper was 39. The article entitled 'Hypophosphatemia is an independent risk factor for AKI among hospitalized patients with COVID-19 infection' [19] was published by 39 authors from seven institutions in China and USA. The proceedings papers had the greatest CPP_{2021} with 14. CPP_{2021} of reviews was 1.1 times greater than articles.

Characteristics of the journal's impact factor

According to the 2021 Journal Citation Reports (JCR), JCR used 178 Web of Science categories in SCI-EXPANDED to index 9649 journals. The journal's *IF* is defined as the sum of all the citations coming from papers published by the journal in the previous two years in the selected JCR year, divided by the total number of papers published by the journal (including articles and reviews). Some categories of documents that are generally not cited, for example, letters, editorial materials, and other document types are not included in the denominator of the *IF*. Periodicals of the first two years have observed the following: (https://incites.help.clarivate.com/Content/Indicators-Handbook/ih-journal-impact-factor.htm?Highlight=impact%20factor). Due to the definition of the journal's *IF*, only the following document types were considered for further analysis: articles and reviews.

The journal's *IF* has the following formula:

$$IF_{year} = \frac{C_{year-2} - C_{year-1}}{TP_{year-2} - TP_{year-1}}$$

where IF_{year} is the journal's *IF* in a specific JCR year, $C_{year\text{-}2}$: citations from JCR year to items in 'year-2', $C_{year\text{-}1}$: citations from JCR year to items in 'year-1', $TP_{year\text{-}2}$: citable items in 'year-2', $TP_{year\text{-}1}$: citable items in 'year-1'. *CN*: the journal's *IF* contributing indicator: ($C_{year\text{-}1}$ + $C_{year\text{-}2}$) that means the citation numbers of $C_{year\text{-}1}$ + $C_{year\text{-}2}$. The denominator is made of two

Table 1. Citations and authors according to document type.

Document type	*TP*	%	*TP**	*AU*	*APP*	TC_{2021}	CPP_{2021}
Article	3865	89	3858	22,888	5.9	40,167	10
Review	245	5.6	245	1040	4.2	2845	12
Proceedings paper	241	5.5	241	1087	4.5	3314	14
Letter	178	4.1	178	655	3.7	414	2.3
Note	25	0.57	25	99	4.0	226	9.0
Correction	19	0.44	19	119	6.3	2	0.11
Editorial material	17	0.39	13	27	2.1	8	0.47
Item about an individual	2	0.046	2	8	4.0	5	2.5
Retraction	2	0.046	2	16	8.0	2	1.0
Expression of concern	1	0.023	0	0	N/A	0	0
Paper with expression of concern	1	0.023	1	5	5.0	12	12

TP: number of papers; *TP**: number of papers with author information in SCI-EXPANDED; *AU*: number of authors; *APP*: average number of authors per paper; TC_{2021}: the total number of citations from Web of Science Core Collection since paper to the end of 2021; CPP_{2021}: average number of citations per paper (TC_{2021}/TP); N/A: not available.

document types such as reviews and articles. A research product pertaining to any other document type is excluded from the denominator.

The top 22 journal's *IF* contributing papers with the *CN* of 18 or more are listed in Table 2. Ninety-five percent, and 4.5% of them were published in the 2010s and the 2000s, respectively. Articles entitled 'Neutrophil to lymphocyte ratio in evaluation of inflammation in patients with chronic kidney disease' [20] and 'Effects of uric acid-lowering therapy on the progression of chronic kidney disease: a systematic review and meta-analysis' [21] contributed the most to *Renal Failure IF* with a *CN* of 31, respectively, followed by a review entitled 'Review of the efficacy of AST-120 (KREMEZIN®) on renal function in chronic kidney disease patients' by Asai et al. [22] with a *CN* of 30. Six of the top 22 *IF* contributing papers (27% of the 22 papers) ranked within the top 22 in total citations with TC_{2021} as the most frequently cited papers in *Renal Failure*, including five articles by Chen et al. [33], Cheungpasitporn et al. [28], Okyay et al. [20], Turkmen et al. [27], and Adil et al. [40] with a TC_{2021} of 125, 101, 97, 91, and 81 respectively as well as a review by Filiopoulos et al. [31] with TC_{2021} of 91. Thirteen of the top 22 *IF* contributing papers (59% of the 22 papers) ranked within the top 22 in total citations with C_{2021} as the most impactful papers in the most recent year-2021, including 10 articles by Adil et al. [24], Adil et al. [41], Adil et al. [40], Cheungpasitporn et al. [28], Garcia-Canton et al. [36], Gong et al. [23], Okyay et al. [20], Turkmen et al. [27],

Table 2. Top 22 journal impact factor contributing papers with the *CN* of 18 or more in *Renal Failure*.

Title (reference)	Rank (*CN*)	Rank ($C_{year\text{-}2}$)	Rank ($C_{year\text{-}1}$)	Rank (TC_{2021})	Rank (C_{2021})
Neutrophil to lymphocyte ratio in evaluation of inflammation in patients with chronic kidney disease [20]	1 (31)	3 (20)	3 (11)	6 (101)	19 (12)
Effects of uric acid-lowering therapy on the progression of chronic kidney disease: a systematic review and meta-analysis [21]	1 (31)	1 (24)	30 (7)	89 (44)	19 (12)
Review of the efficacy of AST-120 (KREMEZIN®) on renal function in chronic kidney disease patients [22]	3 (30)	2 (21)	12 (9)	200 (34)	2 (21)
Diabetes aggravates renal ischemia and reperfusion injury in rats by exacerbating oxidative stress, inflammation, and apoptosis [23]	4 (26)	12 (13)	1 (13)	338 (26)	14 (13)
Ameliorative effect of naringin in acetaminophen-induced hepatic and renal toxicity in laboratory rats: role of FXR and KIM-1 [24]	5 (24)	6 (15)	12 (9)	33 (70)	9 (15)
The *miR-15a-5p-XIST-CUL3* regulatory axis is important for sepsis-induced acute kidney injury [25]	6 (23)	4 (16)	30 (7)	410 (23)	6 (16)
Exogenous hydrogen sulfide (H_2S) reduces blood pressure and prevents the progression of diabetic nephropathy in spontaneously hypertensive rats [26]	7 (22)	13 (12)	6 (10)	29 (72)	157 (5)
The relationship between neutrophil-to-lymphocyte ratio and inflammation in end-stage renal disease patients [27]	7 (22)	13 (12)	6 (10)	2 (125)	14 (13)
Proton pump inhibitors linked to hypomagnesemia: a systematic review and meta-analysis of observational studies [28]	7 (22)	13 (12)	6 (10)	12 (91)	14 (13)
Ameliorative effect of berberine against gentamicin-induced nephrotoxicity in rats *via* attenuation of oxidative stress, inflammation, apoptosis and mitochondrial dysfunction [24]	7 (22)	23 (10)	2 (12)	80 (46)	10 (14)
Acute toxic kidney injury [29]	7 (22)	7 (14)	19 (8)	410 (23)	10 (14)
Prevalence of coronary artery calcification and its association with mortality, cardiovascular events in patients with chronic kidney disease: a systematic review and meta-analysis [30]	7 (22)	7 (14)	19 (8)	453 (22)	10 (14)
New insights into uric acid effects on the progression and prognosis of chronic kidney disease [31]	13 (20)	19 (11)	12 (9)	12 (91)	51 (8)
Diabetic retinopathy may predict the renal outcomes of patients with diabetic nephropathy [32]	13 (20)	7 (14)	43 (6)	228 (32)	27 (10)
Urine neutrophil gelatinase-associated lipocalin and interleukin-18 predict acute kidney injury after cardiac surgery [33]	15 (19)	7 (14)	63 (5)	10 (97)	632 (2)
Quality of life, clinical outcome, personality and coping in chronic hemodialysis patients [34]	15 (19)	13 (12)	30 (7)	214 (33)	157 (5)
Cisplatin-induced oxidative stress stimulates renal Fas ligand shedding [35]	15 (19)	30 (9)	6 (10)	338 (26)	73 (7)
Frailty in hemodialysis and prediction of poor short-term outcome: mortality, hospitalization and visits to hospital emergency services [36]	15 (19)	4 (16)	176 (3)	579 (19)	6 (16)
Carotid intima-media thickness is an independent predictor of all-cause mortality and cardiovascular morbidity in patients with diabetes mellitus type 2 and chronic kidney disease [37]	15 (19)	30 (9)	6 (10)	490 (21)	36 (9)
Combination of biomarkers for diagnosis of acute kidney injury after cardiopulmonary bypass [38]	20 (18)	13 (12)	43 (6)	85 (45)	73 (7)
Non-diabetic renal disease with or without diabetic nephropathy in type 2 diabetes: clinical predictors and outcome [39]	20 (18)	7 (14)	103 (4)	54 (54)	73 (7)
Naringin ameliorates sodium arsenite-induced renal and hepatic toxicity in rats: decisive role of KIM-1, caspase-3, TGF-β, and TNF-α [40]	20 (18)	23 (10)	19 (8)	18 (81)	1 (24)

CN: journal impact factor contributing indicator ($C_{year\text{-}1}$ + $C_{year\text{-}2}$); $C_{year\text{-}2}$: number of citations from JCR year to paper in 'year-2'; $C_{year\text{-}1}$: number of citations from JCR year to paper in 'year-1'; TC_{2021}: total number of citations from Web of Science Core Collection since paper year to the end of 2021; C_{2021}: total number of citations from Web of Science Core Collection in 2021.

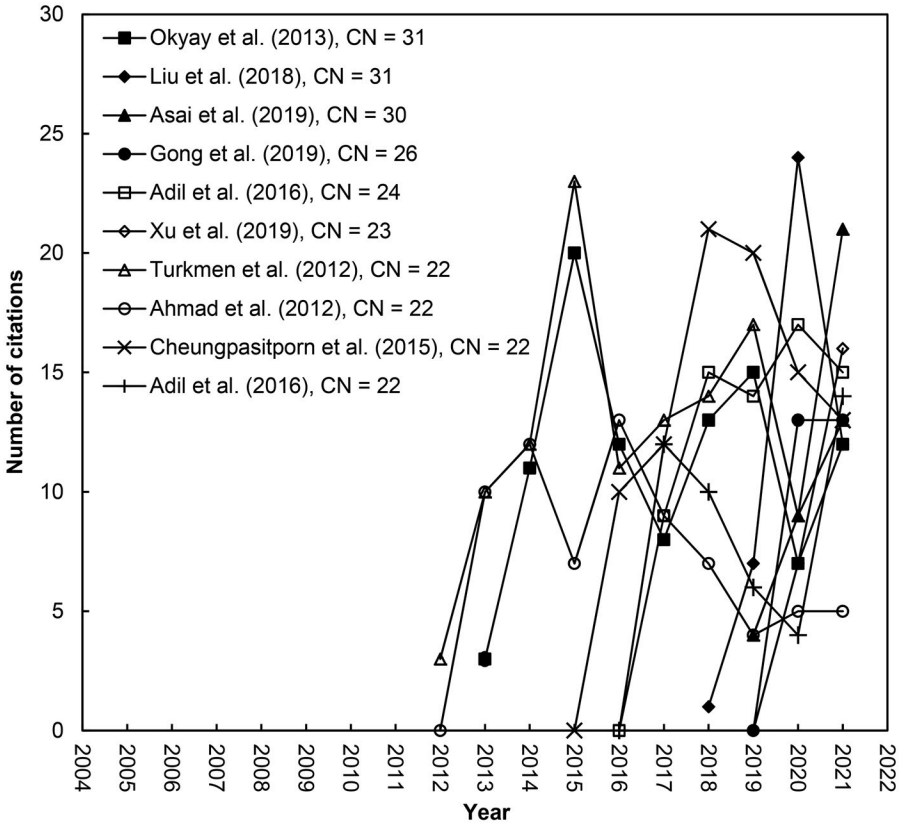

Figure 1. Citation histories of the top 10 journal's *IF* contributing papers.

Xu et al. [25], and Liu et al. [21] with a C_{2021} of 24, 16, 16, 15, 14, 13, 13, 13, 12, and 12, respectively as well as three reviews by Asai et al. [22], Petejova et al. [29], and Wang et al. [30] with a C_{2021} of 21, 14, and 14, respectively. Furthermore, 31% and 36% of the top 100 *IF* contributing papers in terms of *CN* were found in the top 100 papers in terms of TC_{2021} and C_{2021}, respectively; and only 16% of the top 100 *IF* contributing papers were found in both the top 100 C_{2021} and TC_{2021}. It can be concluded that the *IF* of a journal is used to evaluate a journal's relative importance, especially when compared to others in the same field. However, it is not an appropriate metric when compared to individual research performance. It was also reported in the Web of Science that the journal's *IF* is a journal-level metric. It does not apply to individual papers or subgroups of papers that appeared in the journal. Furthermore, it is not appropriate to use a journal's *IF* to evaluate paper performance of authors, institutions, or countries. Figure 1 shows the citation histories of the top 10 journal *IF* contributing papers. Most of them had citation decreasing trends after a couple of years of publication. Only papers by Asai et al. [22] and Xu et al. [25] are keeping an increased trend of citations. The *Renal Failure* has been indexed in the Web of Science category of 'urology and nephrology' since 1987. Figure 2 shows its *IF* and ranking from 1997 to 2021. The journal's *IF* fluctuated and slightly increased from 1997 to 2016 and then sharply increased to reach 3.222 in 2021. The ranking of *Renal Failure* in the Web of Science subject category of urology and nephrology was changed obviously in the last six years (Figure 2).

Figure 3 shows the average number of citations per paper for each year of paper life. In general, citations per publication for papers in a journal would have a sharp increase after publication and would reach a peak in a specific year [7]. The peak year of citations per paper with 1.3 was found to be in the 2nd full year since its publication. That differed from the *Journal of Membrane Science* in the 4th year [7]; the *Journal of Orthopaedic Research* in the 5th year [11]; and the *Revista de Biología Tropical* with the peak year in the 7th year [8]. However, it shows an increasing trend without a peak after the 9th year for the *Polish Journal of Environmental Studies* [42]. In recent years, an alternative calculation of *IF*, considering citations within five years after publication was also proposed by the JCR. The *IF* of *Renal Failure* can be reputed as acceptable to the typical *IF*, which only considers citations within two years after publication rather than 5-year *IF*s. However, it has been pointed out that the *IF* is not an unbiased criterion for all journals, since peak year citations per paper of each journal can differ from others [42].

Trends of annual papers and average number of citations per paper

Ho's research group proposed a figure with the number of annual papers (*TP*) and their average number of citations per paper ($CPP_{2021} = TC_{2021}/TP$) to discover the development trend of a journal [7,8,11]. The 4110 papers, including 3865 articles

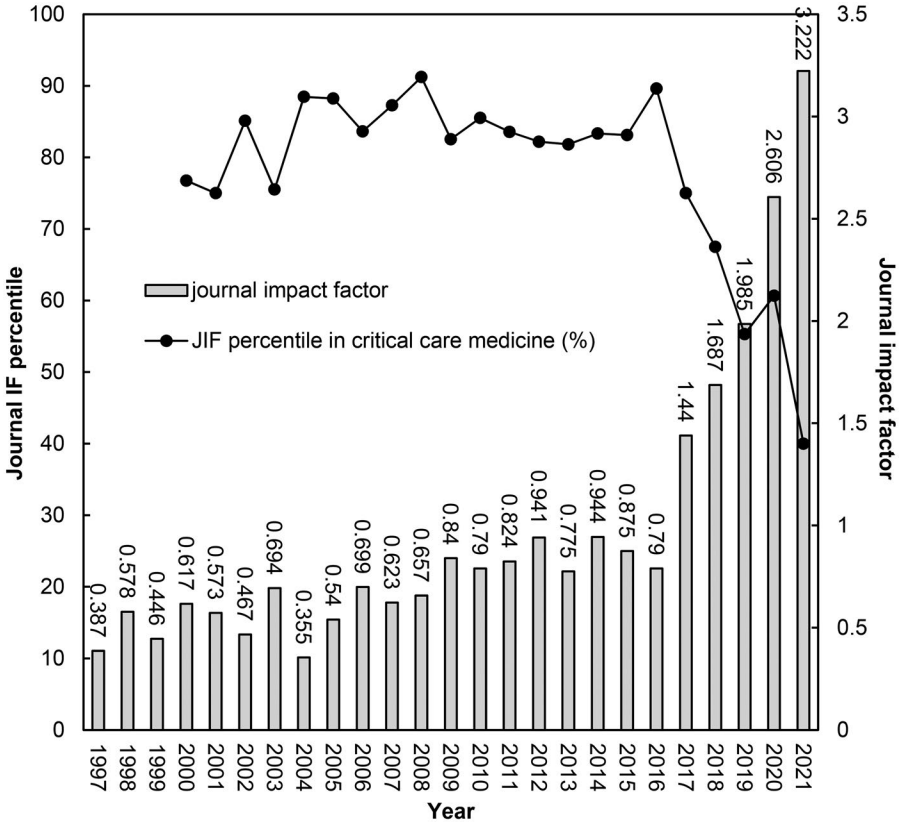

Figure 2. Rankings of the *Renal Failure* by journal's *IF* in the Web of Science categories of urology and nephrology from 1997 to 2021.

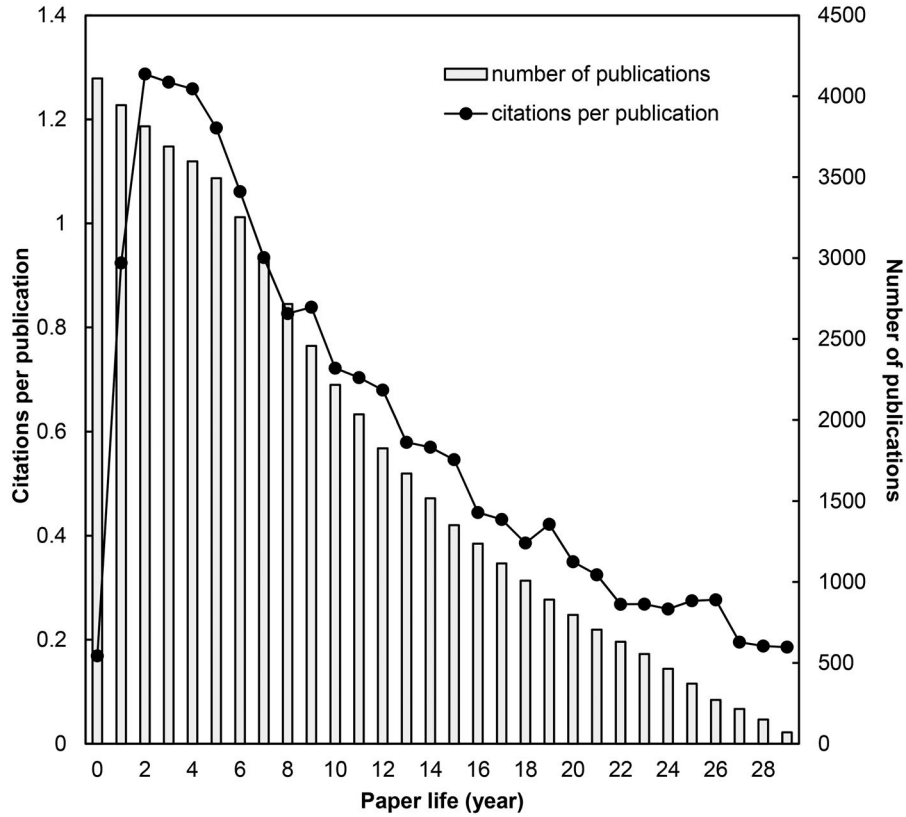

Figure 3. Trend of average number of citations per paper.

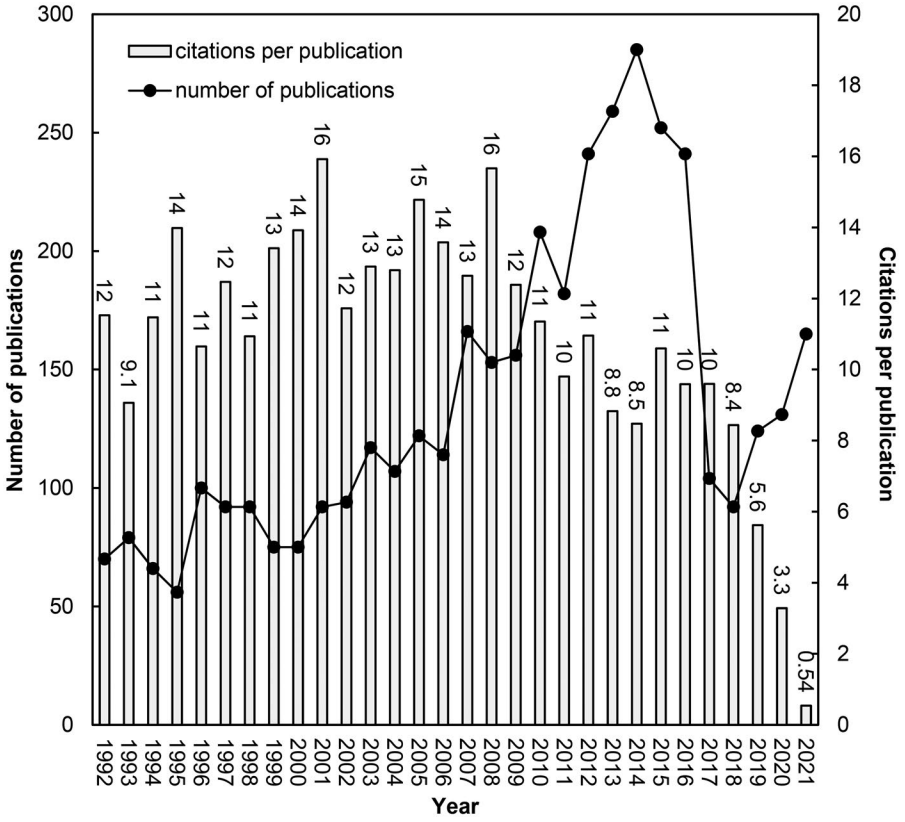

Figure 4. Number of annual papers and average number of citations per paper versus year for *Renal Failure*.

and 245 reviews published in the *Renal Failure* were analyzed. Figure 4 shows that the number of annual papers increased from 75 papers in 2000 to 285 papers in 2014. However, a sharp decrease was found after 2014 to reach 92 papers in 2018. This drop has coincided with the journal being converted to Open Access model of publication, whereas publication fee is levied against the authors or the authors' institutions. In the last three years, the annual number of papers increased to 165 papers published in 2021. In general, about 10 years are necessary to accumulate citations to reach a plateau [7]. It took shorter period to reach a plateau in the *Renal Failure*.

Countries, institutions, and authors of the published papers

Excluding 11 papers (0.53% of 4110 papers) without the author's affiliation information on SCI-EXPANDED, the remaining 4099 papers with a CPP_{2021} of 10 originated from 89 different countries. Among them, 3858 (94% of the 4099 papers) were single-country papers with a CPP_{2021}, while 241 (5.9%) were internationally collaborative papers with a CPP_{2021} of 10 from 70 countries. Six publication indicators: number total of papers (*TP*), single-country papers (IP_C), internationally collaborative papers (CP_C), first-author papers (*FP*), corresponding-author papers (*RP*), and single-author papers (*SP*) [43], as well as their related citation indicators [44] have been applied as criteria to compare the publication's performance of countries and institutions in a research topic. Table 3 shows the top 10 most contributing countries with the six publication indicators. Three of the top 10 countries were in Asia, three in Europe, and two in the Americas. The most productive African country was Egypt with 53 papers (ranked 18th). China ranked the top in three of the six publication indicators with a *TP* of 777 papers (19% of 4099 papers), an *FP* of 774 papers (19% of 4099 first-author papers), and an *RP* of 773 papers (19% of 4099 corresponding-author papers). The USA ranked first in two indicators with a CP_C of 106 papers (44% of 241 internationally collaborative papers) and an *SP* of 49 papers (35% of 141 single-author papers). Turkey ranked at the top with an IP_C of 748 papers (19% of 3858 single-country papers). Compared to the top 10 productive countries, India had a *TP* of 204 papers, an IP_C of 196 papers, an *FP* of 199 papers, and an *RP* of 199 papers with the greatest $TP\text{-}CPP_{2021}$, $IP_C\text{-}CPP_{2021}$, $FP\text{-}CPP_{2021}$, and $RP\text{-}CPP_{2021}$ of 15, respectively. Greece had a CP_C of 13 papers with the greatest $TP\text{-}CPP_{2021}$ of 14. China had an *SP* of one paper with the greatest $SP\text{-}CPP_{2021}$ of 21.

A total of 2279 papers (56% of 4099 papers) came from independent institutions with a CPP_{2021} of 11 and 1820 papers (44%) from inter-institutional collaborations with a CPP_{2021} of 9.9. The percentage of the inter-institutional collaboration rate of the *Renal Failure* (56%) was found higher than that of non-medical journals, for example, *J. Membr. Sci.* (38%) [7], and *Pol. J. Environ. Stud.* (31%) [42], but lower than medical-related journal: *J. Orthop. Res.* (63%) [11]. The characteristics of the top 10 productive institutions with the six publication indicators and their related citation indicators

Table 3. Top 10 productive countries.

		TP		IP_C		CP_C		*FP*		*RP*		*SP*	
Country	*TP*	*R* (%)	CPP_{2021}	*R* (%)	CPP_{2021}	*R* (%)	CPP_{2021}	*R* (%)	CPP_{2021}	*R* (%)	CPP_{2021}	*R* (%)	CPP_{2021}
China	777	1 (19)	7.2	2 (19)	7.3	2 (20)	6.4	1 (19)	7.2	1 (19)	7.3	17 (0.71)	21
Turkey	763	2 (19)	11	1 (19)	11	9 (6.2)	10	2 (18)	11	2 (18)	11	7 (2.8)	9.0
USA	450	3 (11)	12	3 (8.9)	13	1 (44)	9.4	3 (9.2)	13	3 (9.3)	13	1 (35)	13
Taiwan	217	4 (5.3)	8.7	4 (5.5)	8.7	24 (1.7)	10	4 (5.2)	8.7	4 (5.2)	8.7	10 (2.1)	7.0
Japan	207	5 (5.1)	9.0	6 (50)	9.0	11 (5.4)	8.8	5 (4.9)	8.8	5 (4.9)	8.8	4 (4.3)	17
India	204	6 (5.0)	15	5 (5.1)	15	18 (3.3)	13	5 (4.9)	15	5 (4.9)	15	7 (2.8)	20
Brazil	169	7 (4.1)	10	7 (4.2)	10	18 (3.3)	11	7 (4.1)	10	7 (4.1)	10	7 (2.8)	6.5
Greece	141	8 (3.4)	11	8 (3.3)	11	11 (5.4)	14	8 (3.4)	11	8 (3.4)	11	5 (3.5)	12
Italy	130	9 (3.2)	11	9 (3.1)	12	13 (4.6)	8.4	9 (3.0)	12	9 (3.0)	12	N/A	N/A
UK	95	10 (2.3)	11	12 (1.9)	11	3 (10)	12	10 (2.0)	11	10 (2.0)	11	2 (11)	6.1

TP: number of total articles; R, ranking; *TP R* (%): total number of articles ranking and the percentage of total articles; IP_C *R* (%): rank and percentage of single-country articles in all single-country articles; CP_C *R* (%): rank and percentage of internationally collaborative articles in all internationally collaborative articles; *FP R* (%): rank and the percentage of first-author articles in all first-author articles; *RP R* (%): rank and the percentage of corresponding-author articles in all corresponding-author articles; *SP R* (%): rank and the percentage of first-author articles in all first-author articles; CPP_{2021}: average number of citations per publication ($CPP_{2021} = TC_{2021}/TP$); N/A: not available.

Table 4. Top 15 productive institutions.

		TP		IP_C		CP_C		*FP*		*RP*		*SP*	
Institution	*TP*	*R* (%)	*CPP*	*R* (%)	*CPP*	*R* (%)	*CPP*	*R* (%)	*R* (%)	*CPP*	*R* (%)	*CPP*	*R* (%)
Chang Gung Mem Hosp, Taiwan	104	1 (2.5)	8.8	1 (2.3)	10	1 (2.9)	7.3	1 (2.1)	9.3	1 (2.2)	9.2	N/A	N/A
Chang Gung Univ, Taiwan	65	2 (1.6)	7.2	16 (0.66)	7.8	2 (2.7)	7.1	13 (0.63)	6.8	15 (0.56)	7.4	N/A	N/A
Baskent Univ, Turkey	57	3 (1.4)	13	2 (1.7)	12	13 (1.0)	14	2 (1.0)	11	3 (1.0)	12	21 (0.71)	3.0
Shanghai Jiao Tong Univ, China	50	4 (1.2)	7.2	4 (1.1)	9.5	7 (1.3)	4.8	3 (1.0)	8.1	4 (0.93)	7.4	21 (0.71)	21
Univ Sao Paulo, Brazil	49	5 (1.2)	13	8 (1.0)	11	4 (1.5)	15	3 (1.0)	13	5 (0.9)	13	6 (2.1)	6.0
Cent S Univ, China	47	6 (1.1)	10	7 (1.1)	13	8 (1.3)	6.0	5 (1.0)	10	2 (1.1)	10	N/A	N/A
Gazi Univ, Turkey	46	7 (1.1)	13	18 (0.61)	13	3 (1.8)	12	15 (0.56)	13	17 (0.49)	14	N/A	N/A
Peking Univ, China	46	7 (1.1)	6.8	10 (0.88)	9.1	6 (1.4)	5.1	6 (0.83)	6.8	6 (0.88)	6.8	N/A	N/A
Fudan Univ, China	43	9 (1.0)	5.6	13 (0.70)	9.1	4 (1.5)	3.5	9 (0.71)	7.3	7 (0.83)	6.6	N/A	N/A
Nanjing Med Univ, China	41	10 (1.0)	9.1	9 (0.92)	12	11 (1.1)	5.9	6 (0.83)	10	8 (0.81)	10	N/A	N/A

TP: total number of articles; *TP R* (%): rank and percentage of total articles; IP_I *R* (%): rank and percentage of single-institute articles in all single-institute articles; CP_I *R* (%): rank and percentage of inter-institutionally collaborative articles in all inter-institutionally collaborative articles; *FP R* (%): rank and percentage of first-author articles in all first-author articles; *RP R* (%): rank and percentage of corresponding-author articles in all corresponding-author articles; *SP R* (%): rank and percentage of single-author articles in all single-author articles; *CPP*: average number of citations per publication ($CPP = TC_{2021}/TP$); N/A: not available.

are listed in Table 4. Five of the top 10 productive institutions were in China, two in Taiwan, two in Turkey, and one in Brazil. The Chang Gung Memorial Hospital in Taiwan dominated five of the six publication indicators with a *TP* of 104 papers (2.5% of 4099 papers), an IP_I of 52 papers (2.3% of 2279 single-institution papers), a CP_I of 52 papers (2.9% of 1820 inter-institutionally collaborative papers), an *FP* of 88 papers (2.1% of 4099 first-author papers), and an *RP* of 91 papers (2.2% of 4090 corresponding-author papers). Chulalongkorn University in Thailand had a *TP* of 21 papers (ranked 32nd) including the most six single-author papers (4.3% of 141 single-author articles). A total of 42 inter-institutionally collaborative papers were conducted by the Chang Gung Memorial Hospital (81% of 52 inter-institutionally collaborative papers) and the Chang Gung University (84% of 50 inter-institutionally collaborative papers) in Taiwan. In addition, 65% of total number of papers by the Chang Gung University were collaborations with the Chang Gung Memorial Hospital. Compared to the top 10 productive institutions in Table 4, the University of Sao Paulo in Brazil had a *TP* of 49 articles, a CP_C of 27 articles, *FP* of 41 articles, with the greatest *TP*-CPP_{2021} of 13, CP_C-CPP_{2021} of 15, and *FP*-CPP_{2021} of 13. The Central South University in China had an IP_C of 24 articles with the greatest IP_C-CPP_{2021} of 13. The Shanghai Jiao Tong University in China had an *SP* of one article with the greatest *SP*-CPP_{2021} of 21.

Four publication indicators: total number of papers (*TP*), first-author papers (*FP*), and corresponding-author papers (*RP*) were used for the analysis of authors' characteristics for papers in a research field [10]. Table 5 lists the top 17 productive authors with 22 papers or more on *Renal Failure*. The top 24 productive authors had no single-author paper. C.C. Huang published the most of 43 papers including 41 articles with a CPP_{2021} of 11 and two reviews with a CPP_{2021} of 21 but no first-author paper. N. Futrakul published 22 papers including the most first-author articles (21 manuscripts) and was correspondent for 18 articles (ranked 2nd). J.T. Fang published 35 papers including the most corresponding-author articles, 29 manuscripts altogether. Furthermore, J. Malyszko with 15 papers (ranked 56th) and J.B. Chen with 13 papers (ranked 77th) were sitting in the editorial board of the journal. The current Editor-in-Chief, T. Fülöp [45] also contributed 10 papers to the journal. Comparing the top 17 most productive

Table 5. Characteristics of the top 17 productive authors with $TP \geq 22$.

Author	R (TP)	$TP\text{-}CPP_{2021}$	R (FP)	$FP\text{-}CPP_{2021}$	R (RP)	$RP\text{-}CPP_{2021}$	R (CN)
C.C. Huang	1 (43)	11	N/A	N/A	98 (4)	13	33 (44)
L. Zhang	2 (36)	6.3	32 (5)	5.2	32 (7)	7.6	6 (75)
J.T. Fang	3 (35)	10	9 (9)	7.1	1 (29)	10	83 (31)
L. Wang	3 (35)	8.5	32 (5)	4.8	162 (3)	17	1 (130)
Y. Li	5 (30)	5.5	12 (8)	7.4	64 (5)	5.8	17 (54)
Y.C. Chen	6 (29)	10	22 (6)	11	N/A	N/A	139 (27)
C.L. Lin	7 (26)	10	18 (7)	21	5 (15)	10	123 (28)
H. Liu	8 (25)	7.8	196 (2)	7.0	98 (4)	9.3	42 (41)
C.T. Chang	9 (23)	12	96 (3)	15	32 (7)	3.6	197 (23)
M. Haberal	9 (23)	14	N/A	N/A	683 (1)	39	47 (39)
V. Sakhuja	9 (23)	17	196 (2)	39	12 (11)	18	149 (26)
M.S. Wu	9 (23)	9.0	N/A	N/A	9 (14)	8.9	70 (33)
L. Djukanovic	13 (22)	8.1	196 (2)	6.5	40 (6)	6.3	162 (25)
N. Futrakul	13 (22)	14	1 (21)	14	2 (18)	14	8 (70)
F.N. Ozdemir	13 (22)	16	584 (1)	14	N/A	N/A	18 (53)
S. Sezer	13 (22)	13	55 (4)	17	683 (1)	40	28 (47)
C.W. Yang	13 (22)	11	96 (3)	8.0	40 (6)	16	110 (29)

R, ranking; *TP*: total number of papers; *FP*: first-author papers; *RP*: corresponding-author papers; CPP_{2021}: average number of citations per paper ($CPP_{2021} = TC_{2021}/TP$); TC_{2021}: the total number of citations from Web of Science Core Collection since paper year to the end of 2021; *CN*: journal impact factor contributing indicator ($C_{year\text{-}1} + C_{year\text{-}2}$); N/A: not available.

Table 6. Six highly cited papers with TC_{2021} of 100 or more in *Renal Failure*.

Rank (TC_{2021})	Rank (C_{2021})	Rank (CN)	Titles	References
1 (162)	387 (3)	93 (9)	Oxidant mechanisms in gentamicin nephrotoxicity	[47]
2 (125)	14 (13)	7 (22)	The relationship between neutrophil-to-lymphocyte ratio and inflammation in end-stage renal disease patients	[27]
3 (115)	73 (7)	23 (17)	C reactive protein in patients with chronic renal diseases	[48]
4 (104)	157 (5)	28 (16)	Evaluation of toxic metals in blood and urine samples of chronic renal failure patients, before and after dialysis	[49]
4 (104)	36 (9)	351 (5)	Imaging modalities for renal artery stenosis in suspected renovascular hypertension: prospective intraindividual comparison of color Doppler US, CT angiography, GD-enhanced MR angiography, and digital subtraction angiography	[50]
6 (101)	19 (12)	1 (31)	Neutrophil to lymphocyte ratio in evaluation of inflammation in patients with chronic kidney disease	[20]

TC_{2021}: total number of citations from Web of Science Core Collection since paper year to the end of 2021; C_{2021}: total number of citations from Web of Science Core Collection in 2021; *CN*: journal impact factor contributing indicator.

authors in Table 5, V. Sakhuja with 23 papers, had the greatest $TP\text{-}CPP_{2021}$ of 17, followed by F.N. Ozdemir (22 papers; $CPP_{2021} = 16$). V. Sakhuja with two first-author papers, had the greatest $FP\text{-}CPP_{2021}$ of 39. S. Sezer with one single-author articles, had the greatest $SP\text{-}CPP_{2021}$ of 40. Only four of the top 17 productive authors: L. Wang, L. Zhang, N. Futrakul, and Y. Li ranked top 17 on journal's *IF* contributor. Wang was the best journal's *IF* contributor with the greatest *CN* of 130, followed by Zhang, Futrakul, and Li with a *CN* of 75, 70, and 54, respectively. Furthermore, only 47%, 28%, and 31% of the top 100 authors in terms of *CN* were ranked in the top 100 in terms of *TP*, *FP*, and *RP*, respectively, and 1.8%, 8.3%, and 7.3% of the top 100 authors in terms of *CN* were ranked in the top 100 in terms of $TP\text{-}CPP_{2021}$, $FP\text{-}CPP_{2021}$, and $RP\text{-}CPP_{2021}$, respectively. A potential bias in analysis of authorship might occur when different authors have the same name [43].

Highly cited papers

The total number of citations was obtained from the Web of Science Core Collection from publication year to the end of 2021 as the citation indicator, TC_{2021}. Articles with a TC_{year} of 100 or more, were generally named highly cited articles [46]. The main research focuses in a research topic might be reflected by highly cited papers. In *Renal Failure*, six articles (0.15% of 4110 papers) were highly cited papers with TC_{2021} of 100 or more. Table 6 shows the six highly cited papers in *Renal Failure* were published by 41 highly cited authors from 10 institutions in six countries, including USA, Turkey, Italy, Pakistan, Greece, and Turkey. These highly cited papers were published in 1999 [47], 2001 [48], 2007 [50], 2008 [49], 2012 [27] and 2013 [20] respectively. One of the six most frequently cited papers by Okyay et al. [20] ranked in the top six most *IF* contributing papers with a *CN* of 31.

Citation histories of the six highly cited papers in *Renal Failure* are shown in Figure 5. The highly cited article by Turkmen et al. [27] had a TC_{2021} of 125 (ranked 2nd), a C_{2021} of 13 (ranked 14th), and a *CN* of 22 (ranked 7th). Article by Rountas et al. [50] had a TC_{2021} of 104 (ranked 4th) but a *CN* of 5 (ranked 351st). Highly cited papers would not always have a high impact or visibility after publication. Article by Walker et al. [47] had a TC_{2021} of 162 (ranked 1st) but a C_{2021} of 3 (ranked 387th). Furthermore, only 28% of the top 100 papers in terms of C_{2021} were found in the top 100 in terms of TC_{2021} and 31% of the top 100 papers in terms of *CN* were found in the top 100 in terms of TC_{2021} in *Renal Failure*.

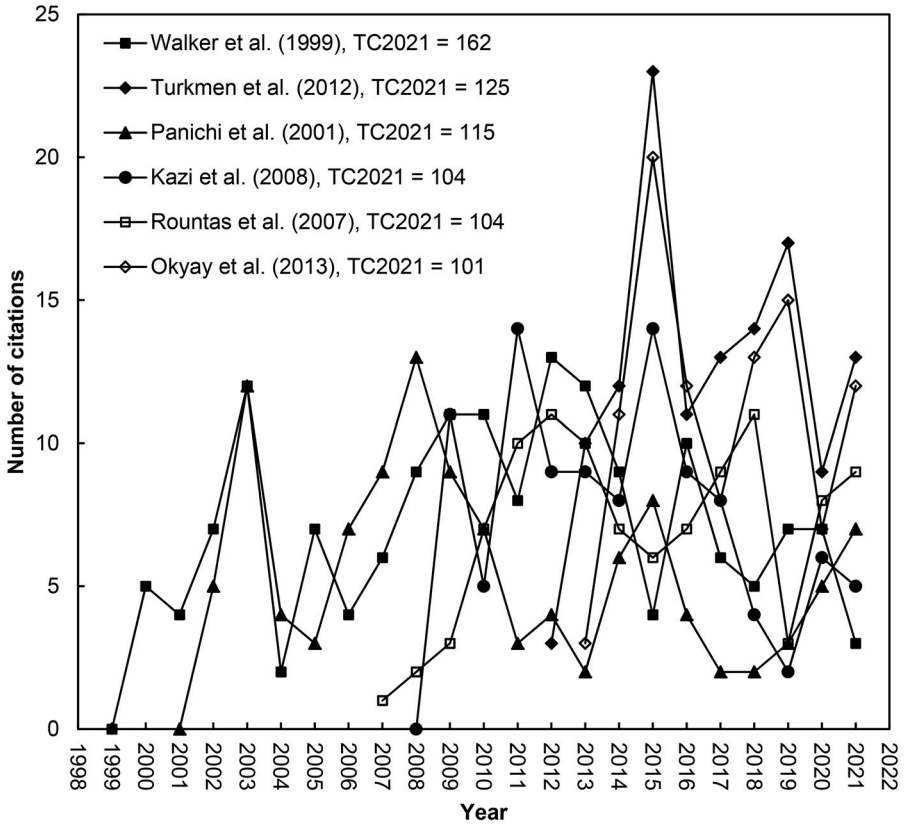

Figure 5. Citation histories of the six highly cited papers.

Table 7. Top 20 most frequently used author keywords.

Author keywords	*TP*	92-21 *R* (%)	92-01 *R* (%)	02-11 *R* (%)	12-21 *R* (%)
Hemodialysis	546	1 (15)	2 (11)	1 (19)	1 (13)
Chronic kidney disease	254	2 (6.9)	N/A	3 (4.7)	3 (10)
Acute kidney injury	234	3 (6.3)	N/A	10 (2.6)	2 (10)
Acute renal failure	227	4 (6.1)	1 (18)	2 (9.1)	33 (1.2)
Peritoneal dialysis	177	5 (4.8)	33 (1.2)	5 (4.4)	4 (5.9)
Oxidative stress	145	6 (3.9)	63 (0.71)	8 (3.7)	5 (4.8)
Renal failure	141	7 (3.8)	6 (4.2)	4 (4.6)	13 (3.2)
Dialysis	135	8 (3.7)	13 (2.4)	7 (4.2)	9 (3.5)
Nephrotoxicity	121	9 (3.3)	3 (8.3)	12 (2.5)	14 (2.7)
Chronic renal failure	117	10 (3.2)	4 (5.4)	6 (4.4)	22 (1.8)
End-stage renal disease	107	11 (2.9)	33 (1.2)	13 (2.4)	8 (3.6)
Kidney	106	12 (2.9)	10 (2.6)	14 (2.2)	11 (3.4)
Mortality	104	13 (2.8)	21 (1.4)	14 (2.2)	9 (3.5)
Diabetic nephropathy	99	14 (2.7)	33 (1.2)	14 (2.2)	12 (3.3)
Inflammation	99	14 (2.7)	230 (0.24)	20 (1.7)	7 (3.9)
Hypertension	94	16 (2.5)	14 (1.9)	9 (3.0)	16 (2.3)
Proteinuria	92	17 (2.5)	5 (4.5)	18 (2.1)	16 (2.3)
Meta-analysis	88	18 (2.4)	N/A	106 (0.44)	6 (4.3)
Renal transplantation	81	19 (2.2)	47 (0.94)	14 (2.2)	15 (2.4)
Nephrotic syndrome	73	20 (2.0)	16 (1.7)	19 (1.8)	20 (2.2)

TP: number of papers containing the author keywords; *R*: rank in a decade; N/A: not available.

Words in title and author keywords

The distribution of words in article titles, abstracts, author keywords, and *Keywords Plus* in different periods as information to evaluate main research focuses and find their development trends in research topics were proposed [51,52]. A total of 3695 papers (90% of 4110 papers) with information on author keywords in SCI-EXPANDED were analyzed. The distribution of the words in three decades is presented in Table 7. 'Hemodialysis' was the most used word by authors, used in 546 papers (15% of 3695 papers), followed by 'chronic kidney disease', 'acute kidney injury', and 'acute renal failure'. However, 'chronic kidney disease' and 'acute kidney injury' were not applied as author keywords in the decade of 1992–2001. 'Acute renal failure' was the most popular author keyword in the decade of 1992–2001 but

not in the most recent decade (ranked 33rd), reflecting a contemporary change of the nomenclature and terminology. Authors also published 'meta-analysis' and original studies investigating 'inflammation' in kidney diseases in the recent years in *Renal Failure*.

Trends and hot topics

Articles contain supporting words in their title, abstract, or author keywords were counted. The publication trends of each main topic in *Renal Failure* are summarized in Figure 6.

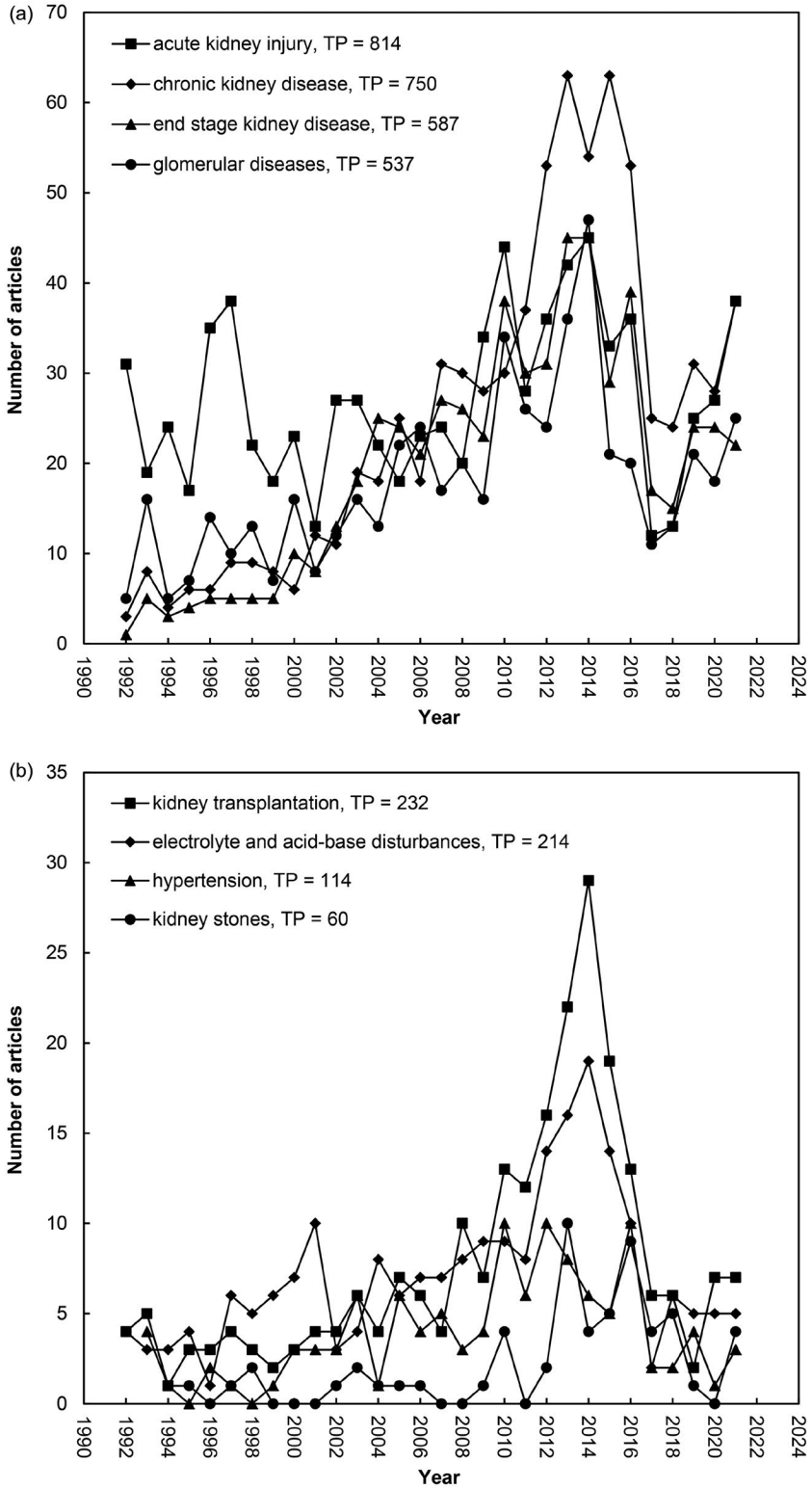

Figure 6. (a) Publication trends of the main research topics in the *Renal Failure* – part I. (b) Publication trends of the main research topics in the *Renal Failure* – part II.

Topic 1: end stage kidney disease

Supporting words: end stage kidney disease, end stage renal disease, ESKD, ESRD, ('hemodialyzed' and 'peritoneal dialysis'), ('hemodialysis' and 'peritoneal dialysis'), ('hemodialytic' and 'peritoneal dialysis'), or ('hemodialyzed' and 'peritoneal dialysis').

Topic 2: acute kidney injury

Supporting words: acute kidney injury, acute renal failure, and AKI.

Topic 3: chronic kidney disease

Supporting words: chronic kidney disease, chronic kidney diseases, chronic renal failure, and CKD.

Topic 4: glomerular diseases

Supporting words: AAV, Alport syndrome, amyloidosis, ANCA, anti-GBM, C3, complement, Fabry disease, FSGS, Glomerular disease, glomerular diseases, glomerulonephritis, IgA nephropathy, IgA vasculitis, infection-related glomerulonephritis, light-chain cast nephropathy, lupus nephritis, membranoproliferative glomerulonephritis, membranous nephropathy, minimal change disease, MPGN, nephrotic syndrome, and thin basement membrane disease.

Topic 5: kidney transplantation

Supporting words: kidney transplantation, kidney transplantations, renal transplantation, and renal transplantations.

Topic 6: electrolyte and acid–base disturbances

Supporting words: acidosis, alkalosis, buffer, buffered, buffering, buffers, dysmagnesemia, hypercalcemia, hyperkalemia, hypermagnesemia, hypernatremia, hyperphosphatemia, hypocalcemia, hypokalemia, hypomagnesemia, hyponatremia, and hypophosphatemia.

Topic 7: kidney stones

Supporting words: kidney stone, kidney stones, nephrolithiasis, renal calculi, renal stone, renal stones, and urolithiasis.

Topic 8: hypertension

Supporting words: ('hypertension' and 'blood pressure') and ('hypertension' and 'blood pressures').

We have also explored three recent hot topics. These included 'inflammation', the methodical approach of meta-analysis, and recent emergence of COVID-19 epidemics. The results are shown in Figure 7. (Topic 1. Inflammation: Supporting words: inflammation and microinflammation; Topic 2. meta-analysis: Supporting words: meta analysis, meta analyses, meta analysis, and metaanalysis; Topic 3. COVID-19: Supporting words: COVID-19, SARS Cov 2, and coronavirus 2). Publication with the subject meta-analysis has increased dramatically since 2012. This included the most cited paper on COVID-19 with an early meta-analysis by Ali et al. [53], evaluating survival rate in acute kidney injury superimposed COVID-19 patients. Multiple other papers have been published

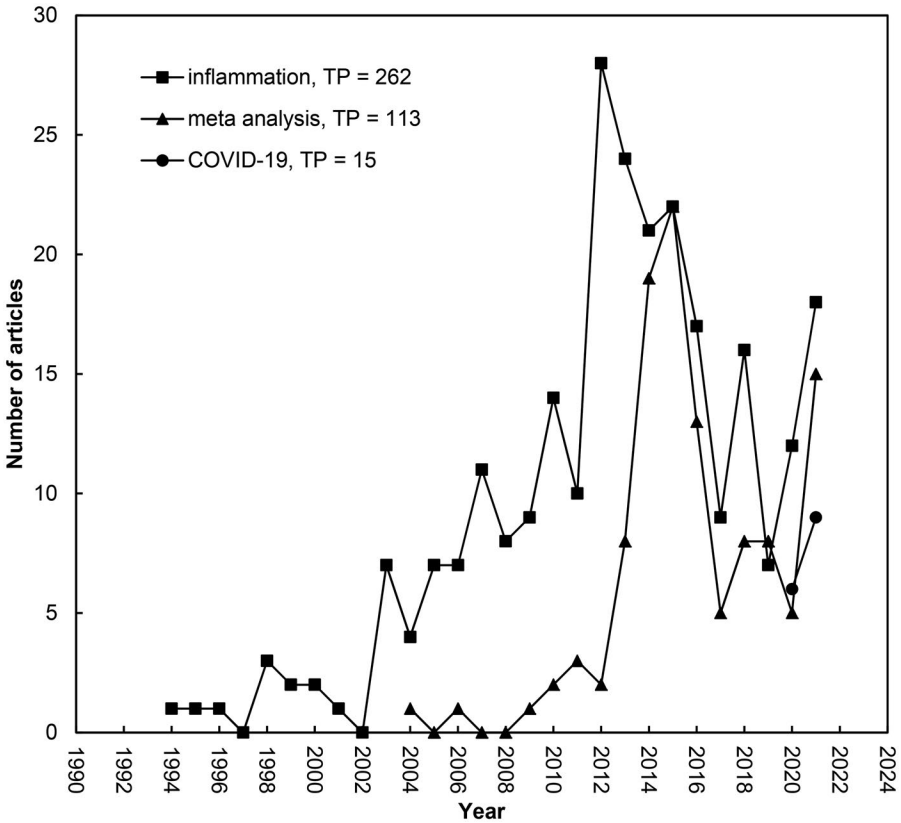

Figure 7. Publication trends of the three new research topics in *Renal Failure*.

in the journal elated to the COVID-19 epidemics, including review papers [54,55], clinical studies [56,57] and high-value single-case descriptions [58–60]. These findings support the research priorities of the *Renal Failure* journal during COVID-19 epidemics that helped improve understanding and management of COVID-19 infection related kidney diseases.

Summary and limitations

The journal publication profile has undergone significant changes over the last three decades, partly reflecting on the changing profile of medical practice, emphasis on specific research topics and methods, as well as reflecting changes from the source countries and institutions of research publications. We are also to recognize several limitations of this current project. Predefined key word searches likely to afford less granular resolution for basic sciences paper than of clinical ones. Citation was not analyzed according to mechanistic key words, such as: 'axis', 'pathway', 'nomogram', 'prediction', and 'network'. Funding and role of funding contributing to papers' success was not analyzed in general.

Conclusions

A total of 4354 publications in 11 Web of Science document types were published in *Renal Failure* from 1992 to 2021. Review papers had a slightly greater average number of citations per publication than those of original articles. The peak year of citations per publication was found to be in the 2nd full year since its publication year. While China and Turkey were the main contributors, India had higher average number of citations per publication. The Chang Gung Memorial Hospital in Taiwan contributed the most articles and reviews in the journal. Publications by the University of Sao Paulo in Brazil had higher citations. Highly cited articles in a journal might not contribute much to the journal's *IF* and highly cited authors do not represent the journal's key *IF* contributors to *Renal Failure*. Publications related to hemodialysis, chronic kidney disease, and acute kidney injury were the most common topics while meta-analysis was new focus in the last decade in the journal.

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ORCID

Yuh-Shan Ho http://orcid.org/0000-0002-2557-8736
Mihály Tapolyai http://orcid.org/0000-0002-2915-3962
Tibor Fülöp http://orcid.org/0000-0002-3346-7040

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