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# Citation Activity of *Journal of Korean Medical Science* in 2011–2020: Reflection on the Most and Least Cited Items

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## ABSTRACT

**Background:** The *Journal of Korean Medical Science* (JKMS) is a weekly periodical published by the Korean Academy of Medical Sciences. JKMS invites global researchers to submit articles covering various areas in general medicine. The present article's aim was to analyze citations of JKMS articles in 2011–2020 for updating editorial policies.

**Methods:** Citation records of JKMS articles were tracked in Web of Science (WoS), Clarivate® from August 2021 to June 2022.

**Results:** In 2011–2020, JKMS published 2,880 articles, including 2,757 (96.0%) ever cited. All reviews (57/57) and 96% of original research reports (2,184 out of 2,264) received at least one citation. Brief communications, opinions, and images were least cited items. Of 36 subject categories covered by JKMS, only biomedical engineering was significantly less advantageous citation-wise. Five articles published in 2012–2017 attracted more than 100 citations. Most other articles were cited less than 50 times. Article categories of nationwide epidemiology, disease or patient registries, clinical trials, and infectious diseases were distinguished as well cited. Of 378 articles published in 2020, 10 were cited at least 100 times; all these ten items were related to severe acute respiratory syndrome coronavirus 2 and coronavirus disease 2019. In the past 5 years, studies on health care laws, management, and some specific topics in clinical specialties were not cited. The citation trends in WoS, Crossref, and Scopus were similar while PubMed Central records were roughly twice less.

**Conclusion:** Most of JKMS articles are cited during 5 years post publication, with 1.4% non-citation rate. The obtained results suggest that inviting review articles in clinical sciences, research reports on hot medical topics, and nationwide database analyses may attract more author interest and related citations.

**Keywords:** *Journal of Korean Medical Science*; Citation; Web of Science; Crossref, Scopus

## INTRODUCTION

The *Journal of Korean Medical Science* (JKMS) is a globally recognized periodical published by the Korean Academy of Medical Sciences. Founded in 1986, it is now publishing its 37th volume.<sup>1</sup> The JKMS is a flagship journal in Korea covering all subjects in general medicine and serving a

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model of quality editing and publishing for other scholarly journals in the country and related region.<sup>2</sup> The Editor-in-Chief of *JKMS* has been a member of the International Committee of Medical Journal Editors (ICMJE) since 2016.

*JKMS* is a platform for publishing quality research reports and other scientific documents that contribute to the evidence-based data and scientific knowledge dissemination. It employs various open-access channels, including social-media platforms, to reach the global audience, maintain post publication communication, and attract scientific credits.<sup>3</sup> The most reliable scientific credit for scholarly articles and journals is perhaps citations which are often viewed as hard currency for the publishing enterprise.

While journal editors are responsible for most, if not all, aspects of their published contents, they should also employ all ethical strategies for attracting relevant citations and advantageously ranking their journals. One of the successful strategies is inviting great articles with potentially societal and citation impacts.

The tough publishing competition has led to selective and at times coercive citation practices across some journals which are widely known for their 'citation cartels.' Notably, citation activities in the 'Big Six' (B6) journals in general medicine were analyzed in a remarkable study that reported on low self-citations, with an exception of the *New England Journal of Medicine* where clinical trial reports had abundance of journal self-citations.<sup>4</sup> The share of self-citations in the B6 trial reports ranged from 14.9–23.1% with an average of 18.4% and the same in reviews ranged from 10.5–27.6% with an average of 11.9%. Such auto-citations in the B6 journals may be due to a selective approach to quality and prestige of high-impact sources, tempting all stakeholders in the publishing to cite the most impactful items.<sup>4</sup>

Citation analyses may visualize loopholes in the publishing enterprise and prompt the journal editors to upgrade their policies. Over the past decade, *JKMS* has been actively implementing the best standards in reviewing, editing, and publishing to contribute to the science growth globally. And it is essential to overview the accumulated citation data and highlight areas where citations are missing.<sup>5</sup>

There are several global databases and platforms that track and record citations: Web of Science (WoS, Clarivate®), Crossref, Scopus, and PubMed Central (PMC). We chose WoS as the most selective and prestigious platform to analyze citation activity and related trends for *JKMS* articles published in 2011–2020.

## METHODS

The *JKMS* publications in 2011–2020, excluding editorial and correspondence items, were analyzed in view of their citations on WoS from December 2021 to June 2022. Citations by year, individual article, article type, and scientific category were analyzed to demonstrate citation trends. Citations of same articles were also retrieved from Crossref, Scopus, and PMC on the same day to reveal any differences between them.

Statistical significance was analyzed using  $\chi^2$  test or Fisher's exact test.

## RESULTS

A total of 2,880 articles were published in JKMS from 2011 to 2020 and 2,757 (96%) of them were cited more than once (Table 1). A few research articles received no citations during 5 years post publication. All review articles have been cited. Brief communications (89/97) and images (20/31) were less cited than others (Table 1).

There are no criteria of waiting time duration to declare non-citation, but the cited half-life of 5.4 years by Journal Citation Report (JCR®) 2021 may suggest that articles in JKMS have much less possibility of citation after 5 years from publication. Based on the 5-year half-life, non-citation data of JKMS articles in 2010–2015 can be summarized in Table 2. The overall non-citation rate was 1.4% and that for research articles was 1%.

Articles in endocrinology, gastroenterology, human genetics, immunology, laboratory medicine, medical informatics, medical imaging, musculoskeletal disorders, and urology have been cited 97% or more. In contrast, articles in biomedical engineering showed 75% citation rate, the lowest by category ( $P = 0.020$ ). Articles in Obstetrics and Gynecology, Otorhinolaryngology, and Surgery were 89–90% less cited than those in other categories but not significant statistically (Table 3).

**Table 1.** Citation of articles by type in 2011–2020

Year	Article types							Total
	Research	Review	Special	Brief	Opinion	Case	Image	
2011	203/204	4/4	0/0	3/3	0/0	59/61	0/0	269/272
2012	203/204	0/0	1/1	6/6	0/0	62/62	0/0	272/273
2013	223/225	8/8	5/5	7/7	0/0	45/47	0/0	288/292
2014	202/206	10/10	10/10	7/7	0/0	25/27	0/0	254/260
2015	232/236	9/9	7/7	3/3	5/6	12/14	1/1	269/276
2016	258/259	5/5	5/5	3/3	5/5	16/16	5/7	297/300
2017	240/247	3/3	7/8	6/7	7/8	21/21	4/5	288/299
2018	219/229	6/6	5/5	15/15	8/9	21/24	6/8	280/296
2019	184/189	3/3	9/9	7/8	9/12	6/6	3/7	221/234
2020	220/265	9/9	9/9	32/38	26/28	22/26	1/3	319/378
Total	2,184/2,264	57/57	58/59	89/97	60/68	289/304	20/31	2,757/2,880
Citation rate, %	96	100	98	92	88	95	65	96
<i>P</i> value <sup>a</sup>	< 0.001	0.175	0.517	0.066	0.007	0.545	< 0.001	

Data are presented as number of cited publications/number of total publications.

<sup>a</sup>The  $\chi^2$  test or Fisher's exact test.

**Table 2.** Number and rate of non-citation by article type and year 2011–2016

Article types	Publication year						Total
	2011	2012	2013	2014	2015	2016	
Research	1/204	1/204 (0.5)	2/225 (0.9)	4/206 (1.9)	4/236 (1.7)	1/259 (0.4)	13/1,334 (1.0)
Review	0/4	0/0	0/8	0/10	0/9	0/5	0/36
Special	0/0	0/1	0/5	0/10	0/7	0/5	0/28
Brief	0/3	0/6	0/7	0/7	0/3	0/3	0/29
Opinion	0/0	0/0	0/0	0/0	1/6 (16.7)	0/5	1/11 (9.1)
Case	2/61 (3.3)	0/62	2/47	2/27 (7.4)	2/14 (14.3)	0/16	8/227 (3.5)
Image	0/0	0/0	0/0	0/0	0/1	2/7 (28.6)	2/8 (25)
Total	3/272 (1.1)	1/273 (0.4)	4/292 (1.4)	6/260 (2.3)	7/276 (2.5)	3/300 (1.0)	24/1,673 (1.4)
<i>P</i> value <sup>a</sup>	0.784	0.159	> 0.999	0.248	0.098	0.601	

Data are presented as number of non-citation/number of publication (%).

<sup>a</sup>The  $\chi^2$  test or Fisher's exact test.

**Table 3.** Number of cited articles by scientific category in JKMS 2011–2020

Scientific category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Citation rate, %
Alternative Medicine	0/0	0/0	0/0	0/0	1/1	0/0	0/0	0/0	0/0	0/0	1/1	100
Anesthesiology & Pain Medicine	4/4	7/7	6/6	4/4	6/6	4/4	1/1	4/4	4/4	4/4	44/44	100
Basic Medical Science	3/3	4/4	0/0	3/3	3/3	4/4	3/3	0/0	9/9	4/6	33/35	94
Biomedical Engineering	0/0	0/0	0/0	0/0	0/0	0/0	5/7	2/3	6/7	2/3	15/20*	75*
Cardiovascular Disorders	26/27	26/27	36/37	24/26	21/24	9/9	9/9	8/9	11/13	13/17	183/198	92
Cell Therapy & Organ Transplantation	7/7	7/7	6/6	9/10	6/7	5/5	6/6	7/7	3/3	3/5	59/63	94
Dentistry	0/0	1/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	1/1	100
Dermatology	5/5	8/8	5/5	3/3	1/1	5/5	3/4	1/1	3/3	0/0	34/35	97
Editing, Writing & Publishing	0/0	0/0	0/0	6/6	8/8	7/7	13/15	9/9	10/10	10/11	63/66	95
Emergency & Critical Care Medicine	3/3	8/8	7/7	9/9	11/11	15/16	14/14	5/5	9/9	9/10	90/92	98
Endocrinology, Nutrition & Metabolism	20/21	23/23	18/19	12/12	10/10	13/13	15/15	8/9	4/4	3/4	126/130	97
Gastroenterology & Hepatology	19/19	13/13	16/16	17/17	14/14	14/14	11/12	9/9	9/9	11/13	133/136	98
Global Health	0/0	0/0	0/0	0/0	0/0	2/2	2/2	0/1	4/4	4/4	12/13	92
Humanities & Forensic Medicine	0/0	0/0	0/0	0/0	1/1	1/1	0/0	5/5	4/4	4/5	15/16	94
Human Genetics & Genomics	1/1	4/4	5/5	1/1	4/4	1/1	2/2	0/0	3/3	1/1	22/22	100
Immunology, Allergic Disorders & Rheumatology	14/14	14/14	15/15	20/20	12/12	17/17	10/10	8/8	8/8	13/15	131/133	98
Infectious Diseases, Microbiology & Parasitology	25/25	22/22	21/21	11/11	13/13	20/20	22/24	35/37	21/23	78/89	268/285	94
Laboratory Medicine	1/1	2/2	0/0	0/0	1/1	2/2	1/1	1/1	1/1	0/0	9/9	100
Medicine General	3/3	5/5	10/10	7/7	13/14	11/11	7/8	16/18	21/22	20/22	113/120	94
Medical Imaging	3/3	0/0	1/1	2/2	8/8	3/3	3/3	3/3	1/1	4/5	28/29	97
Medical Informatics	0/0	0/0	0/0	0/0	2/2	4/4	1/1	2/2	2/2	4/4	15/15	100
Musculoskeletal Disorders, Rehabilitation & Sports Medicine	8/8	4/4	14/14	10/10	9/9	20/20	7/7	12/12	2/2	13/14	99/100	99
Nephrology	11/11	19/19	15/15	11/11	3/4	10/10	15/15	7/9	2/2	9/12	102/108	94
Neurology & Neuroscience	15/15	12/12	11/12	16/17	12/12	5/5	8/8	11/11	11/12	12/15	113/119	95
Nursing Science	0/0	0/0	0/0	0/0	1/1	0/0	0/0	0/0	0/0	0/0	1/1	100
Obstetrics & Gynecology	2/2	5/5	1/1	4/4	5/5	6/6	9/11	9/9	7/9	7/8	55/60	92
Oncology & Hematology	42/42	26/26	35/35	28/29	22/23	28/29	11/11	10/10	8/8	9/10	219/223	98
Ophthalmology	4/4	4/4	4/4	3/4	5/5	6/6	5/5	7/8	7/7	3/3	48/50	96
Otorhinolaryngology	0/0	1/1	2/2	0/0	4/4	2/2	2/2	1/1	2/2	6/7	20/21	95
Pediatrics	16/16	33/33	31/31	11/11	19/19	22/22	44/44	23/27	21/22	23/29	243/254	96
Pharmacology, Drug Therapy & Toxicology	2/2	3/3	2/2	2/2	2/2	2/2	2/2	5/5	0/0	2/3	22/23	96
Preventive & Social Medicine	6/6	3/3	6/6	8/8	7/7	14/14	13/13	29/29	9/10	18/22	113/118	96
Psychiatry & Psychology	6/6	1/1	10/10	11/11	11/11	17/18	15/15	20/20	10/11	15/17	116/120	97
Respiratory Diseases	13/13	11/11	8/8	9/9	14/14	7/7	10/10	5/6	3/4	8/12	88/94	94
Surgery	2/2	4/4	1/1	6/6	5/5	6/6	4/4	4/4	2/2	3/4	37/38	97
Urology	8/9	2/2	2/3	7/7	15/15	15/15	15/15	14/14	4/4	4/4	86/88	98
Total	269/272	272/273	288/292	254/260	269/276	297/300	288/299	280/296	221/234	319/378	2,757/2,880	96

Data are presented as cited publication/total publication.

\* P = 0.020 by  $\chi^2$  test.

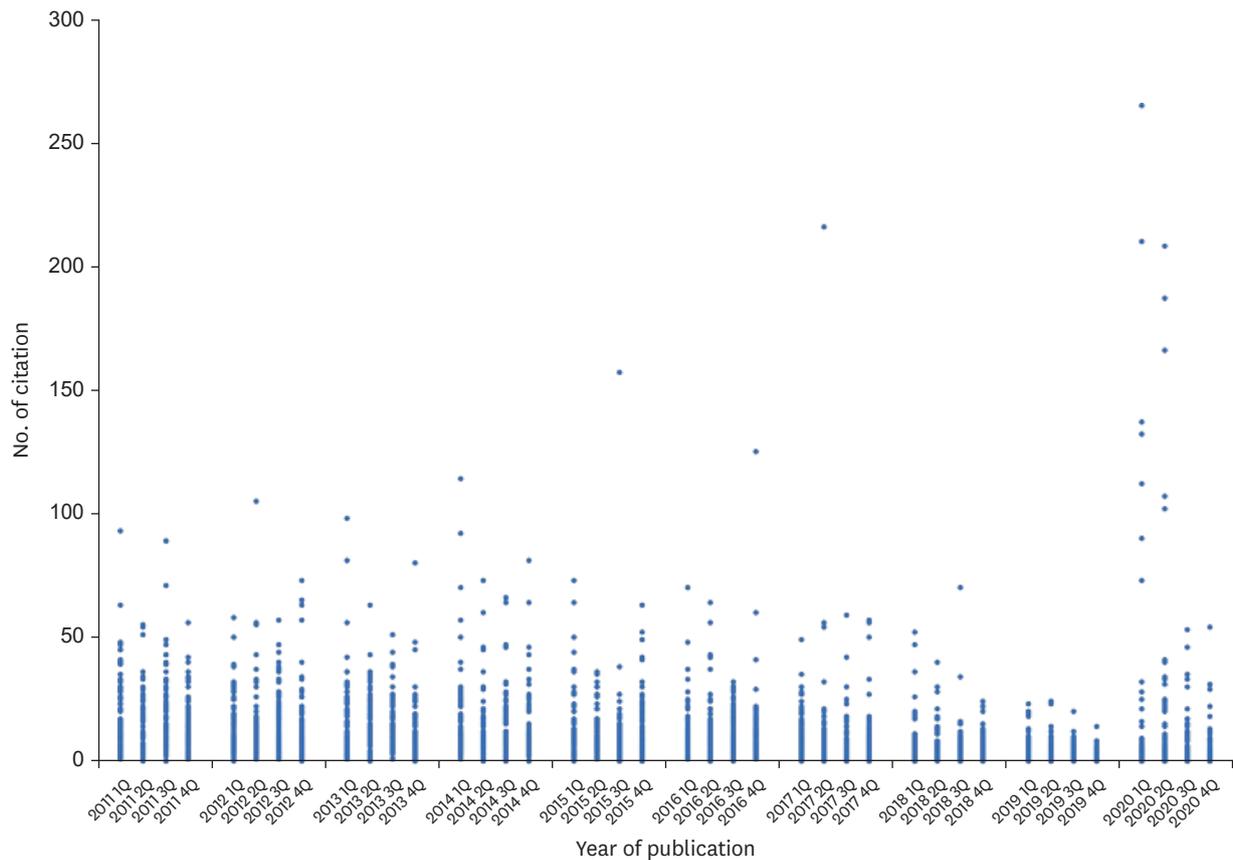


Fig. 1. Cumulative numbers of total citations plotted by publication dates.

The numbers of cumulative citations were depicted chronologically by dates of publication in **Fig. 1**. Articles cited more than 100 times were published from 2012 onward, with citation numbers steadily increasing from the same year. Importantly, 10 articles attracted more than 100 citations in 2020.

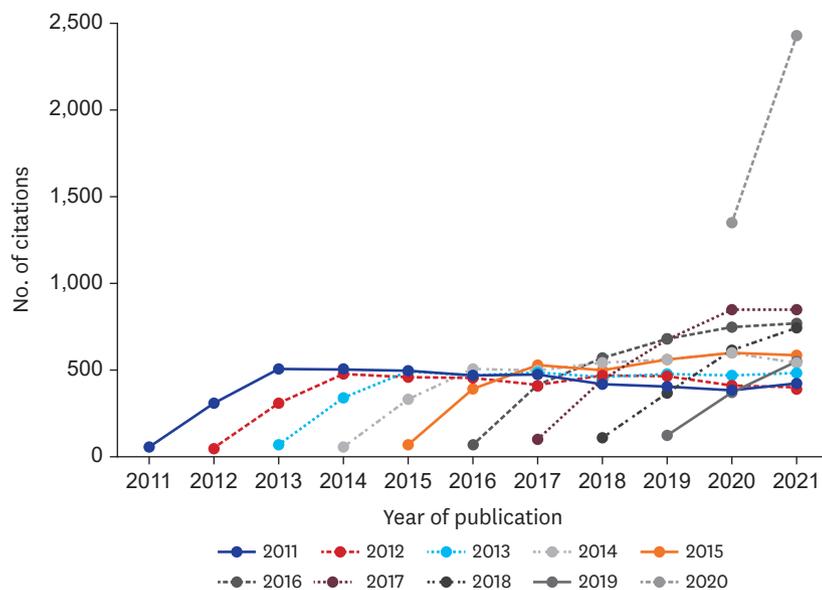
Citation counts were analyzed in connection to period post publication (**Fig. 2**). Articles in 2011–2014 showed similar level and pattern of citation during 2–5 years whereas those in 2015–2018 rapidly received more citations during 1–5 years post publication. Citations to articles in 2020, mostly related to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease 2019 (COVID-19) skyrocketed in 2020 and 2021 (**Figs. 1 and 2**).

Total citations to 2,880 *JKMS* articles in 2011–2020 were 33,254, 31,512, and 33,129 by WoS, Crossref, and Scopus, respectively (**Table 4**). The same record by PMC was 18,984. Annual citation activity recorded by all databases demonstrated similar patterns for a period between 2011 and 2020. The decreasing average count per article in 2011 was 17.54 by WoS, 16.31 by Crossref, and 17.48 by Scopus, and the counts slowly decreased later year by year until 2019 (**Table 4**).

**Table 4.** Comparison of citation numbers by indexing database 2011–2020

Year	No. of publications	WoS		Crossref		Scopus		PMC	
		Total citation	Average						
2011	272	4,771	17.54	4,437	16.31	4,754	17.48	2,381	8.75
2012	273	4,262	15.61	3,828	14.02	4,145	15.18	2,066	7.57
2013	292	3,997	13.69	3,717	12.73	4,006	13.72	2,074	7.10
2014	260	3,944	15.17	3,480	13.38	3,737	14.37	1,976	7.60
2015	276	3,415	12.37	3,138	11.37	3,310	11.99	1,847	6.69
2016	300	3,432	11.44	3,260	10.87	3,366	11.22	1,918	6.39
2017	299	3,005	10.05	2,922	9.77	2,942	9.84	1,745	5.84
2018	296	1,856	6.27	1,928	6.51	1,983	6.70	1,139	3.85
2019	234	1,042	4.45	1,090	4.66	1,104	4.72	645	2.76
2020	378	3,530	9.34	3,712	9.82	3,782	10.01	3,193	8.45
Total	2,880	33,254	11.55	31,512	10.94	33,129	11.50	18,984	6.59

WoS = Web of Science, PMC = PubMed Central.



**Fig. 2.** Number of citations by duration of year after publication.

## DISCUSSION

The current citation analysis demonstrated that the overall citation rate of *JKMS* articles published in 2011–2020 was 96% (as of December 2021; **Table 1**). The aggregation of citations to *JKMS* articles requires some time post publication, with an initial citation growth and a decline over time. Due to the current rapid development trends in clinical research, the initial citation activity is more informative and suggestive of ‘hot’ topics than the delayed activity. This is why cited half-life by JCR® may help reveal trendy topics and their attractiveness over time. As a prime example, the cited half-life of *JKMS* articles was reported 5.4 years by JCR® 2021. Supposedly, *JKMS* articles are less likely to attract new citations after 5 years post publication. If the cited half-life is known for a journal, it may be used as time lag duration to estimate non-citation rate after publication.

Only one to four research articles published annually in 2010–2016 did not receive citations. The same figure increased from 2017 onward, with 11 articles (7 research articles) remaining without citations by 2021 (**Tables 1 and 2**). The non-citation rate is one of the proxy

parameters of journal quality which is negatively correlated with the Journal Impact Factor (JIF) by JCR®.<sup>5</sup> Skewed citations and non-citation are well-known patterns of all journals, but high-impact sources often escape non-citation.<sup>5,6</sup> Given the cited half-life 5.4 years recorded by JCR®, the time lag for estimation of non-citation rate of *JKMS* can be 5 years post publication. The non-citation rate of all 2011–2016 *JKMS* articles stands at 1.4% and the same for research articles at 1%.

By article type, all review articles, including those in 2020, received citations, but only 96% of research articles were cited. Interestingly, 10, 5, and 45 research articles published in 2018, 2019, and 2020, respectively, received no citations by December 2021. With the cited half-life of 5.4 years, non-cited articles may still receive citations in the foreseeable future.

While brief communications and opinion pieces in *JKMS* attracted low citations, image articles (images in this issue) showed the lowest citation rate of 65%. Clinical trial reports were cited as actively as other research articles in *JKMS*, something in contrast to the B6 journals where trials had blockbuster effect.<sup>4</sup> Importantly, *JKMS* reviews and special articles demonstrated high citability, pointing to the necessity to actively solicit, edit, and publish these articles to boost *JKMS* citation rates.

*JKMS* articles cover 36 scientific specialties. Most of the article categories demonstrated 90% and more citation rates. Only biomedical engineering articles resulted in the significantly least cited proportion (75%). The biomedical engineering section was introduced at *JKMS* in 2017, and this section may require more time to mature and attract healthy flow of citations. Possibly, there is still not enough readers and citers for this section, pointing to the need for more active post publication promotion.

Articles in obstetrics and gynecology, otorhinolaryngology, and surgery demonstrated 89–90% citation rates but without statistical significance. Articles with too specific (narrow) topics were less likely to be cited which might be due to the small pool of interested researchers. Most submissions with too narrow scope are usually rejected outright at *JKMS*; and only handful of these submissions pass peer review and get published. Examples of non-cited articles in *JKMS* include those on health-related laws or compensation strategy in connection to industrial hazards, and some clinical studies with narrow topics. Apparently, the current citation analysis suggests that *JKMS* editors should prioritize submission, publication, and post publication promotion of items within this journal's general medical scope.

Total citations to *JKMS* articles in 2011–2014 were around 300 one year post publication and 500 after two years post publication. Compared to this, articles in 2015–2019 received 400–500 and 600–800 citations, respectively (Fig. 2). This trend can be viewed as a boost in citation activity. As a whole, total citations increased slowly and steadily from 2011 to 2019. The transition of the journal from monthly to weekly publication schedule in 2018 had a negligible immediate influence citation-wise.

Understandably, articles in 2020 were quite different from previous sets. The articles published in 2020 were cited 1,421 times in 2020, and 2,470 times in 2021. In 2020, *JKMS* published 378 influential articles, including 126 on SARS-CoV-2 or COVID-19 pandemic. The pandemic articles had a booster effect on citation counts. Thanks to these, *JKMS* recorded its highest JIF 2021 by JCR® at 5.354 (2.153 in 2020). The big jump was partly due to the weekly publication schedule since 2018 which allowed rapidly publishing numerous Korean articles

on SARS-CoV-2 or COVID-19 and timely exposing them to the global scientific community. The current achievement needs to be nurtured to raise *JKMS* standards and scope further to the level of a global general medical journal.

**Table 4** data demonstrated similar level of citations to *JKMS* articles recorded by WoS, Crossref, and Scopus. We can rely on any convenient data from these platforms to estimate citations of *JKMS* articles. Only the numbers from PMC were twice less than those from either WoS, Crossref, or Scopus. Such a difference is possibly due to the small total number of journals archived by PMC (i.e., 2,636 full participating journals and 307 National Institute of Health portfolio journals).<sup>7</sup> Although PMC covers 8,668 selective deposit journals, these are only for selective open-access articles. Compared to this, WoS and Scopus cover substantively more active sources. One of the previous reports recorded less citations for *JAMA*, *Lancet*, and *New England Journal of Medicine* in WoS than in Scopus and Google Scholar.<sup>8</sup> The difference could be due to the selectiveness of WoS. Google Scholar tracks all scientific information in the Internet without any selectiveness and thus its recorded citation numbers could be much higher than those by citation-tracking bibliographic databases. As such, Google Scholar counts were not analyzed in the current study.

The current analysis did not reflect on social media metrics. *JKMS* launched its Twitter channel in May 2019 and started actively promoting selected articles. It is hoped that dissemination of information via the official channels may enable attracting more interested readers and those who consider our precious articles for citations. Dissemination of research findings via social media has been found beneficial for raising citations across some disciplines.<sup>3,9</sup> Related social-media analyses are warranted for further updating *JKMS* editorial policies.

In conclusion, articles in *JKMS* have accrued citations similarly between scientific categories except for those in biomedical engineering. Articles have been cited continuously during 5 years post publication, and those from 2016 received citations more than those before 2015. Review articles are usually well cited. Non-citable articles are often those with narrow scope and specific focus. Articles on SARS-CoV-2 or COVID-19 in 2020 enabled *JKMS* to boost its citation metrics, particularly the JIF 2021. It is hoped that the current citation analysis will guide the journal editors for adjusting their daily practices and upgrading the publishing standards.

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