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Effect of Self-Citation on H-Index: A Study of Top 1% Highly Cited Iranian Scientists in Medical Sciences

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Abstract

Background: H-index is one of the main bibliometric indicators for evaluating researchers. It has been criticized due to the effect of self-citation rate on its increase.

Aim: This study aimed at analyzing the state of top 1% highly-cited Iranian scientists in medical sciences in ESI for investigating the effect of their self-citations on their h-indices.

Methods: Iranian Medical Science Scientometric Information Database, Essential Science Indicators™ (ESI) and Scopus indexing/abstracting database were used for data extraction. Data analysis was conducted in Excel and SPSS..

Results: In total, 6.15% of citations were self-citations that resulted in increase in h-index by 2.49 units. After excluding self-citations, the h-indexes of 23.4% of the studied scientists did not change and the mean rate of h-index decreased by 2.49. A correlational test showed the strong correlation between self-citation count and h-index rate (r=.718).

Conclusion: Self-citation is present as a common phenomenon in all scientific communities and increases in h-index. If not used for manipulating bibliometric indicators, it can make the scientific works more visible for potential readers and consequently receiving more citations.

Conflicts of Interest: The Authors declare no conflicts of interest.
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Introduction

Since the health and medical sciences have wide scope and is closely related to human life quality, a considerable volume of research funds in most countries is dedicated to research on the field (1). The scientific production has been one of the main performances of research in the field(2). The number of papers a country publishes in internationally-known journals is one of the indicators for measuring its role in scientific development(3). Therefore, an increase in the scientific publications indexed in known databases is conceived as a main scientific indicator(4). Exploring the features of research made by academic researchers and research institutes can be done by measuring some bibliometric indicators (5), including among others, ones achieved and extracted from indexing / abstracting databases (6).

Many traditional bibliometric indicators such as the number of publications and citation counts have been used in research evaluation (7). Considering some limitations of the traditional indicators, J.E. Hirsch created a new indicator for measuring the impact of scientific research

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in 2005, named as h-index (8). Simultaneously regarding quantity (the number of publications) and quality (citation impact of publications), the index is a simple mathematical measure. An increase just in publication number cannot affect the indicator and neither can the highly-cited ones (9).

H-index is used for measuring the scientific influence of research agents, such as educational departments, universities and individual researchers(10). Based on the distribution of citations received by a researcher's publications, h-index is the largest number *h* such that h articles have at least *h* citations each (11). This indicator can be easily measured via accessible indexing /abstracting databases and is a good criterion for evaluating the researchers whose contributions have not been considered by traditional indicators despite their really considerable scientific influence (12).

However, the indicator has some limitations, including among others, the effect of some factors on it, such as self-citations, co-authorship counts and the nature of high-cited of review articles (9). As a time-dependent indicator, h-index increases by the years of an author's scientific activity and it is not reasonable to compare the newly-emerged researchers with experienced ones based on their h-indexes. Self-citation can significantly affect some indicators such as total citation count, citation speed and h-index (13).

As many researches have been conducted on h-index in national and international scope, the effect of self-citation on h-index remains one of considerable issues. As achieving higher ranks in international ranking systems, improving the quality of scientific publications and increasing in h-indexes are of main concerns of universities, this study aimed at analyzing the state of top 1% highly-cited Iranian scientists in medical sciences in Essential Science Indicators (ESI) and the effect of their self-citations on their h-indexes.

Methods

As an applied cross-sectional study, this study utilized from some bibliometric indicators such as total publication numbers and citation amounts as well as self-citation and h-index measures. Iranian Medical Science Scientometric Information Database (https://isid.research.ac.ir), Essential Science Indicators™ (ESI) database (https://clarivate.com/webofsciencegroup/solutions/essential-science-indicators) and Scopus indexing/abstracting database (https://www.scopus.com) were used for data extraction.

Research population included all top 1% highly-cited Iranian scientists in medical science declared in ESI. 209 researchers were present in ESI till 2022/03/01. Data were analyzed by Excel for descriptive statistics and by SPSS for inferential statistics.

Results

Out of 23,520 faculty members in Iran's medical universities, 209 were of top 1% highly cited ones. Table 1 shows the number of publications, citations per publication, total citation counts, % of self-citations, and citation counts without self-citations, h-indexes and h-indexes after excluding self-citations of these scientists. In total, 6.15% of citations were self-citations that resulted in increase in h-index by 2.49 units.

Top 1% highly cited Iranian scientists in medical sciences by their affiliations

The first to third ranks in the affiliated universities of top 1% highly cited Iranian scientists in medical sciences belonged to Tehran UMS (57), Kermanshah UMS (19) and Mashhad UMS (18), respectively (Figure 1).

Top 1% highly cited Iranian scientists in medical sciences by their professions

Among top 1% highly cited Iranian scientists in medical sciences by their professions, the first to three professional fields belonged to epidemiology (26), pharmaceutics (14) and toxicology (10), respectively (Figure 2).

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Table 1. Some bibliometric indicators of top 1% highly-cited Iranian scientists in medical sciences in ESI

Index	Number of scientists	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
Publication number	209	240.56	15.50	194	58[a]	224.12	50230.72	1408	17	1425	50276
Citations per Publication	209	595.55	285.94	61.44	14.22[a]	4133.75	17087877.56	35720.78	14.22	35735	124468.96
Total citation count in Scopus	209	14383.90	1096.19	9979	1673[a]	15847.50	251143207.48	114324.00	1673.00	115997	3006235.00
% of self-citations	209	6.15%	0.49%	2.00%	1.00%	7.09%	0.50%	34.00%	1.00%	35.00%	1285.00%
Self-citation count	209	643.48	66.61	326	89	962.92	927209.84	7277	9	7286	1344844
Citation count without self-citations	209	13773.83	1080.54	9265.41	1573[a]	15621.25	244023335.19	112104.44	1572.62	113677.06	2878730.55
h-index	209	36.23	1.134	34.00	27[a]	16.391	268.671	105	6	111	7573
h-index after excluding self-citations	209	33.77	1.033	31.00	28	14.927	222.812	99	6	105	7058

a. Multiple modes exist. The smallest value is shown

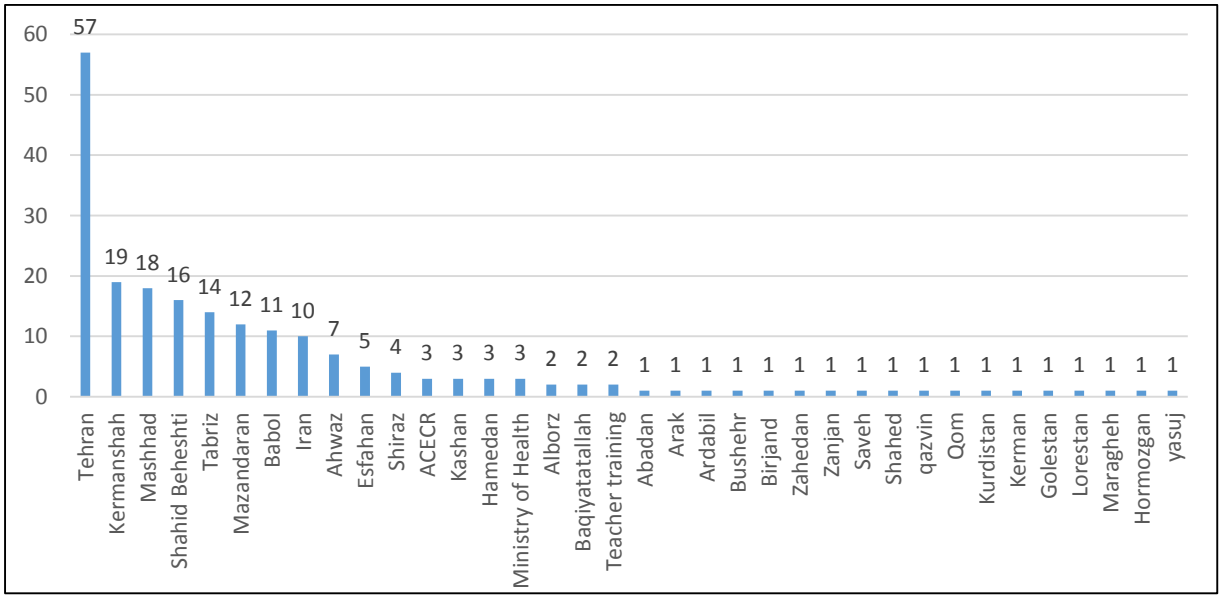

Figure 1. The frequency distribution of top 1% highly-cited Iranian scientists in medical sciences by their affiliations

Papers of top 1% highly cited Iranian scientists in medical sciences by their gender

Out of top 1% highly cited Iranian scientists in medical sciences, 164 and 44 scientists were male and female, respectively (Table 2).

Males published 43553 papers (with mean rate of 263.96 and females published 6723 papers with the mean rate of 152.80.

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Papers of top 1% highly cited Iranian scientists in medical sciences by their academic rankings

Among top 1% highly cited Iranian scientists in medical sciences by their academic rankings, the first to three ranks belonged to professors (106), assistant professors (50) and associate professors (30), respectively.

As Table 3 shows, professors with publishing 29249 papers ranked first in publishing papers, followed by associated professors by publishing 8320 papers and distinguished professors by publishing 6864 papers, respectively.

Self-citation counts of top 1% highly cited Iranian scientists in medical sciences by gender

As Table 4 shows, the mean self-citation count made by males (711.83) is as 18 times as more than that of females (387.18).

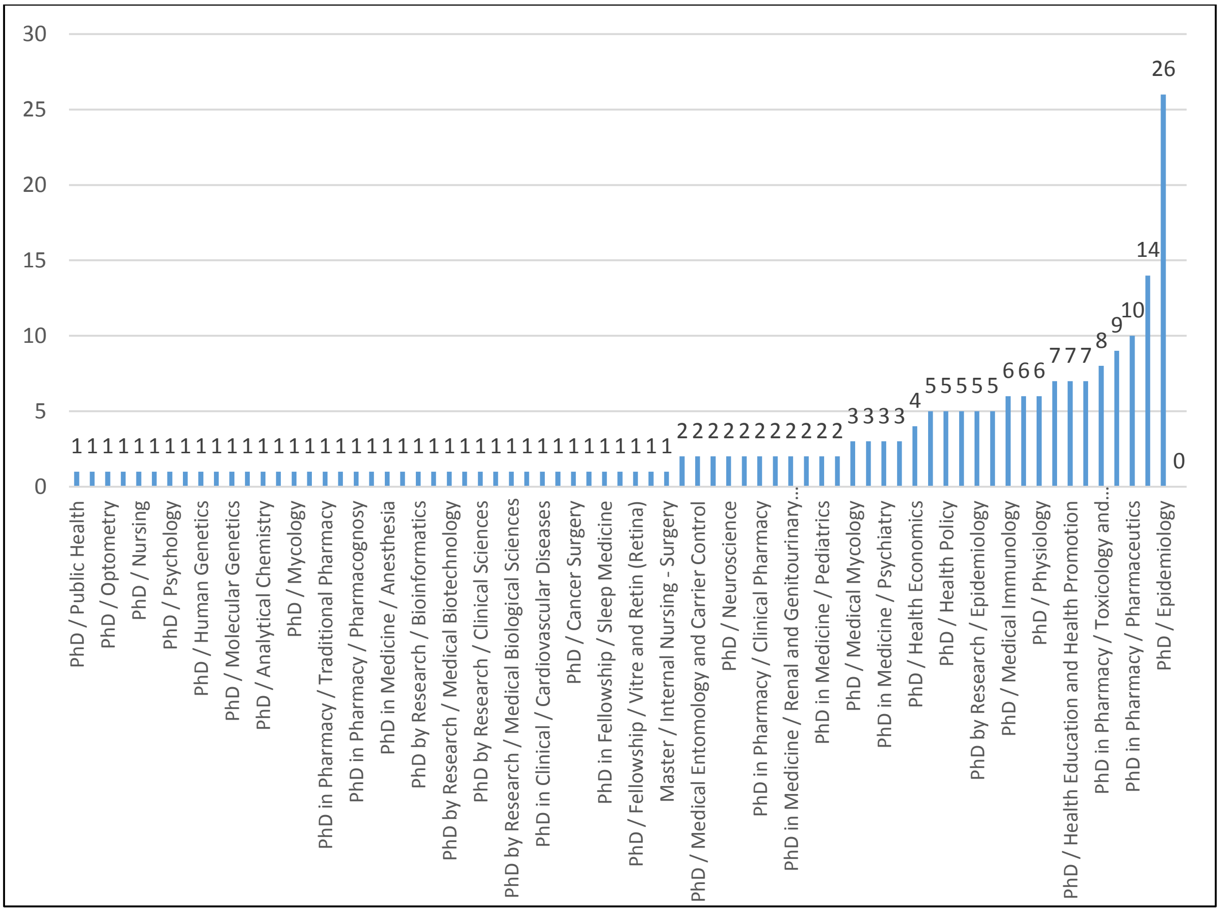

Figure 2. The frequency distribution of top 1% highly-cited Iranian scientists in medical sciences by their professional fields

Table 2. Statistics for the papers published by top 1% highly-cited Iranian scientists in medical sciences by gender

Index	Gender	N	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
Number of publications	Man	165	263.96	18.29	205	90[a]	234.92	55185.93	1397	28	1425	43553
	Woman	44	152.80	22.62	97	58	150.06	22517.52	716	17	733	6723

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Table 3. Statistics for the papers published by top 1% highly-cited Iranian scientists in medical sciences by academic rankings

Academic ranking	N	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
Distinguished Professor	11	624	121.29	455	222[a]	402.29	161835.60	1203	222	1425	6864
Professor	106	275.93	18.05	238	70[a]	185.83	34532.61	1057	33	1090	29249
Associate Professor	40	208	37.31	143	58.00	235.98	55686.31	1322	17	1339	8320
Assistant Professor	50	111.24	12.41	90.5	28[a]	87.72	7694.23	418	24	442	5562
Instructor	2	140.5	56.50	140.5	84[a]	79.90	6384.5	113	84	197	281

a. Multiple modes exist. The smallest value is shown

Table 4. Statistics for the self-citation counts of top 1% highly-cited Iranian scientists in medical sciences by gender

Index	Gender	N	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
Self-citations	Man	165	711.83	81.23	351.00	60	1043.4	1088681.19	7262	24	7286	117452
	Woman	44	387.18	75.04	200.50	89	497.78	247785.69	2364	9	2373	17036

Self-citation counts of top 1% highly cited Iranian scientists in medical sciences by academic rankings

As Table 5 shows, the highest and lowest mean rates of self-citations were made by distinguished professors (1976.91) and assistant professors (250.78), respectively.

H-indexes of top 1% highly cited Iranian scientists in medical sciences by gender

As can be seen in Table 6, the mean rate of h-index of male scientists (37.52) was more than that of female scientists (31.41). *H-indexes of* **Top 1% highly cited Iranian scientists in medical sciences by academic rankings**

Table 7 shows that distinguished professors ranked highest in mean h-index rate (59.64). The lowest rank belonged to assistant professors with 26.96.

As the low number of instructors, only two scientists, their mean rate of h-index is higher than that of assistant professors.

Table 5. Statistics for self-citation counts of top 1% highly-cited Iranian scientists in medical sciences by academic rankings

Ranking	N	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
Distinguished Professor	11	1976.91	488.57	1296	258[a]	1620.40	2625709.89	5783	258	6041	21746
Professor	106	723.33	84.88	458.5	60[a]	873.838	763593.61	5431	25	5456	76673
Associate Professor	40	575.63	186.5	259.5	89	1179.51	1391243.47	7277	9	7286	23025
Assistant Professor	50	250.78	38.97	128.5	29a	275.63	75970.29	1140	24	1164	12539
Instructor	2	252.50	68.50	252.5	184[a]	96.87	9384.50	137	184	321	505

a. Multiple modes exist. The smallest value is shown.

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Table 6. Statistics for h-indexes of top 1% highly-cited Iranian scientists in medical sciences by gender

Index	Gender	N	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
h-index	Man	165	37.52	1.261	35.00	27[a]	16.198	262.373	98	13	111	6191
	Woman	44	31.41	2.471	26.50	19[a]	16.394	268.759	70	6	76	1382

a. Multiple modes exist. The smallest value is shown.

Table 7. Statistics for h-indexes of top 1% highly cited Iranian scientists in medical sciences by academic rankings

Ranking	N	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum	Sum
Distinguished Professor	11	59.64	6.270	56.00	35[a]	20.796	432.455	76	35	111	656
Professor	106	38.33	1.270	38.50	28[a]	13.071	170.852	66	15	81	4063
Associate Professor	40	35.83	3.196	31.00	20	20.214	408.610	95	6	101	1433
Assistant Professor	50	26.96	1.669	26.50	27	11.803	139.304	52	9	61	1348
Instructor	2	36.50	5.500	36.50	31[a]	7.778	60.500	11	31	42	73

a. Multiple modes exist. The smallest value is shown.

For better depiction and comparison of h-index rates before and after excluding self-citation, some measures were needed. Figure 3 depicts that after excluding self-citations, the rate of h-indexes of 23/4% of the scientists did not change and total mean rate of h-indexes decreased by 2.49. Figures 4 and 5 depicted the h-indexes after excluding self-citations by gender and by academic rankings, respectively. The highest change in h-indexes belonged to male scientists (-2.727) and distinguished professors (-4.727).

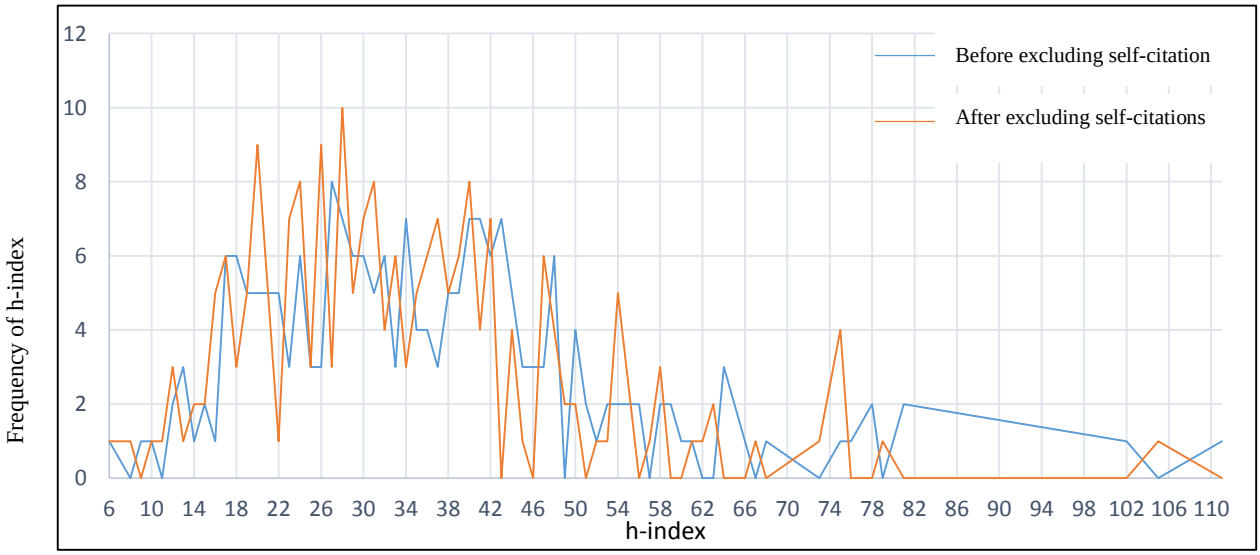

Figure 3. Distribution of h-index rates of top 1% highly-cited Iranian scientists in medical sciences before and after excluding self-citations

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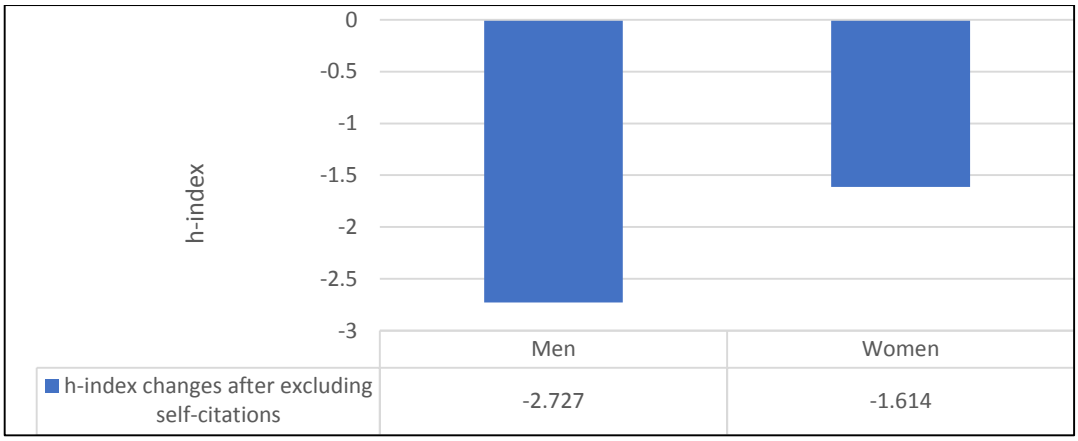

Figure 4. The change in mean rate of h-indexes of top 1% highly-cited Iranian scientists in medical sciences after excluding self-citations by gender

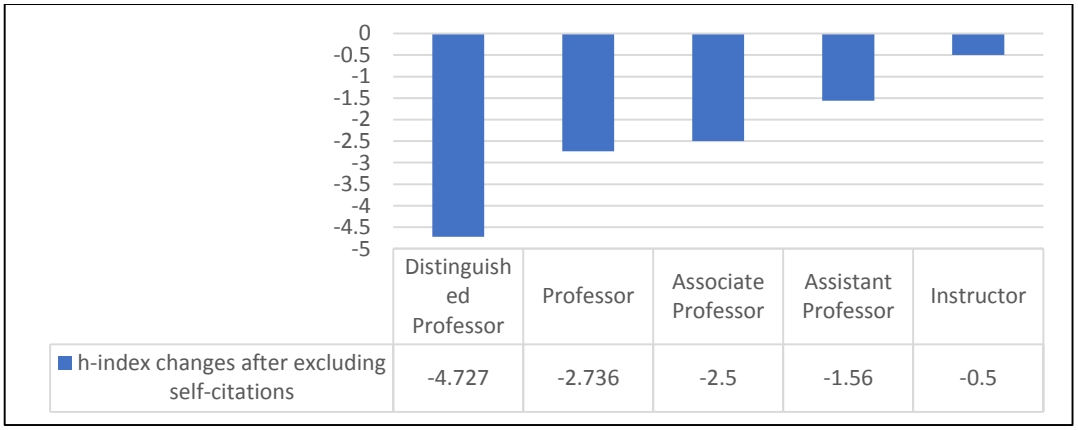

Figure 5. The change in mean rate of h-indexes of top 1% highly-cited Iranian scientists in medical sciences after excluding self-citations by academic rankings

As table 8 shows, self-citation count had positive correlation with all variables in the matrix. Self-citation count had a strong correlation with both h-index and total citation count. This was weak in case of publication number. The correlation was moderate between self-citation rate and h-index after excluding self-citations. The correlation of h-index after excluding self-citations with number of publications and total h-index were strong. H-index had a moderately positive correlation with other variables at hand.

Table 8. Correlation matrix of the number of papers, h-index rates and self-citation counts of top 1% highly-cited Iranian scientists in medical science

	Self-citation count	H-index	Total citation count	H-index after excluding self-citations	Citation count after excluding self-citations	Number of publications
Self-citation count	1	.718**	.699**	.609**	.874**	.243**
H-index		1	.630**	.986**	.762**	.597**
Total citation count			1	.685**	.327**	.998**
H-index after excluding self-citations				1	.712**	.657**
Total citation count after excluding self-citations					1	.278**
Number of publications						1

**. Correlation is significant at the 0.01 level (2-tailed).

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Discussion

Self-citation rates heavily depend on several variables, which need to be taken into consideration. In addition, several factors may lead to self-citation, including cumulative research progress and one's own continuous research. It can be the result of avoiding self-plagiarism, gratifying personal desires, gaining more visibility and scientific status or even improving citation-based research performance (14).

Self-citation is present as a fact in citation analysis. Both the lack of self-citation in a certain long period and the presence of high percentage of self-citation are unreasonable (15). Besides, the bibliometric indicators based on the self-citation can be very helpful in getting an insight into scientific communication patterns as well as in making the works of citing authors more visible (16). It may be needed in reporting continuous researches (17). However, self-citation is biased when used for manipulating bibliometric indicators.

We found that the mean rate of self-citations of top 1% highly cited Iranian scientists in medical sciences was 6.15%, H-indexes ranged from 1% to 35% (with 95.7% of them with having less than 20% of self-citations compared to their total citations). As the self-citation count in the range of 10-20% of total citation count is acceptable (18), it can be said the self-citation rate of top 1% highly-cited Iranian scientists in medical sciences is reasonable. Males had more self-citations than females. However, the self-citation rates of these scientists are proportional to their academic rankings and increase by promotion in their academic rankings.

The mean rate of h-index of top 1% highly cited Iranian scientists in medical sciences were 36.23, which decreased 2.49 units after excluding self-citations and amounted to 33.74. The current results are in line with previous studies (8, 19-23) that found self-citation increases h-index. This increase is proportional to the academic rankings and h-index of male scientists decreased more than that of female scientists when removing self-citations.

We found that self-citation counts are positively correlated with h-index, total citation count, h-index after excluding self-citations, citation count after excluding self-citations and number of publications. In other words, increase in number of publications resulted in an increase in received citations, self-citations and h-indexes.

Conclusion

As the research population in this study were of world's top scientists, it can be concluded that self-citation is a phenomenon in all scientific communities and not limited to certain groups. The reasons behind self-citation can be studied in further qualitative research and using data of other indexing and abstracting database for expanding the results of this study will be helpful.

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Conflicts of Interest

The authors declare no conflicts of interest.

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The Ethics Committee of Hamadan University of Medical Sciences has ethically approved this study with code number: IR.UMSHA.REC.1397.469.

Ethics

This study has been ethically approved by the Ethics Committee of Hamadan University of Medical Sciences with code number: IR.UMSHA.REC.1397.469.

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