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A bibliometric analysis of KSHV/HHV8 research

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A bibliometric analysis was conducted to evaluate the global scientific output of KSHV/HHV8 research in the Science Citation Index Expanded from 1991 to 2016. The publications were analysed in terms of document type, language of publication, trends in publication, journals, Web of Science categories, and publications of countries, institutions, and authors. The results showed that *Journal of* Virology led 610 journals. The researchers focused on the category of virology. The USA took the lead position among 92 countries with 58% of all the KSHV/HHV8 articles. Top ten productive institutions were all from the USA. National Cancer Institute, University of California, San Francisco, and Harvard University from the USA led top three the institutions. A comprehensive analysis of keywords revealed that HIV, lymphoma, and EBV were recent foci. The proportion of number of single institution articles : number of nationally collaborative articles : number of internationally collaborative articles (S : N : I) was used to compare performance of institutions. Y-index was also applied to evaluate authors' publication performance. Chang's group published the first in KSHV/HHV8 research field.

Keywords: *Scientometrics, Web of Science, KSHV/HHV8, SCI-EXPANDED.*

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1. Introduction

Kaposi's sarcoma is the leading neoplasm of AIDS patient and HIV infection is known to be a major risk factor for its development [1,2]. In 1994, an emerging virus referred to Kaposi's sarcoma-associated herpesvirus (KHSV), also known as human herpesvirus 8 (HHV8), has been identified in Kaposi's sarcoma [3]. The other limphoproliferative disorders, including primary effusion lymphoma and

multicentric Castleman's disease, have also been linked to KSHV/HHV8 infection [4,5]. Previous studies have suggested that KHSV/HHV8 infection can increase the risk for development of prostate cancer [6-8]. However, the controversial data have been postulated [9,10]. Besides to be considered as an oncogenic virus, KSHV/HHV8 has been associated with Diabetes Mellitus Type 2 based on the seroprevalence survey combined the data from basic research [11,12].

Similar to other herpesviruses, KSHV/HHV8 can establish two distinct phases of infection, latent infection and lytic replication, which are distinguished by their virtually distinct gene expression profiles. Latent HHV8 is characterized by a circularized, extrachromosomal viral genome (episome). No functional or infectious viral particles are produced during latency. Latency enables the virus to escape immune surveillance and to establish persistent infection. The latency associated viral products have been implicated to play a major role in the development of HHV8-associated malignancies because most tumor cells in KS, PEL, and MCD are latently infected by KSHV/HHV8. The lytic cycle is essential for production of progeny virus that can infect other cells and disseminate to other individuals [13,14]. In general, KSHV/HHV8 is transmitted by saliva or mother-to-child and also can be sexually transmitted [15-17]. Some evidences suggest that KHSV/HHV8 transmission may be via blood transfusion [18,19].

KSHV/HHV8-related research has been carried out for few decades and covers various topics including functions of KSHV/HHV8 individual genes, the interplay between KSHV/HHV8 and host cells, the therapy for KSHV/HHV8 related diseases and epidemiology study. Despite the KSHV/HHV8-related research has gained greater intension since the virus was identified, there have been few attempts to gather systematic data on the global scientific production of KSHV/HHV8 research. Bibliometric analysis has been widely applied for scientific production and research trends in many disciplines of science. The purpose of this research was to provide a bibliometric profile of scientific literatures of KSHV/HHV8, to explore the trend of KSHV/HHV8 research.

In this research, KSHV/HHV8 literature published in Science Citation Index EXPANDED from 1991 to 2016 were screened, and highly cited articles in total citations and citations in recent year were identified and compared for impact in literature. In addition, indicators $S : N : I$ and Y-index were used to compare performance of institutions and authors respectively.

2. Materials and methods

Data used in this study were retrieved from the Clarivate Analytics Web of Science, the online version of the Science Citation Index Expanded (SCI-EXPANDED) on 21 September 2017. The database was searched under the keywords "KSHV", "HHV8", "Kaposi's sarcoma-associated herpes virus", and "human herpesvirus 8" in terms of topic (title, abstract, author keywords, and *KeyWords Plus*) within the publication year with a limit of 1991 to 2016. *KeyWords Plus* supplied additional search terms extracted from the titles of articles cited by authors in their bibliographies and footnotes in the ISI (now Clarivate Analytics) database, and substantially augmented title-word and author-keyword indexing [20]. The final filter was the "front page", in which only the articles having the search keywords in

their "first page" including article title, abstract, and author keywords were retained [21]. The impact factor of a journal was based on the *Journal Citation Report* 2016. The number of citations of an article from Web of Science Core Collection in a single year, for example 2016, was referred to as the C_{2016} [22], and the total number of citations since publication to the end of 2016 was referred to as the TC_{2016} [23,24].

The records were downloaded and reorganized using Microsoft Excel 2013 [25,26]. In the SCI-EXPANDED database, the corresponding author was designated as the "reprint author"; this study instead used the term "corresponding author" [27]. In a single author article where authorship was unspecified, the single author was both first author and corresponding author. Similarly, for a single institution article, the institution was classified as both the first author's institution and the corresponding author's institution [28]. Only the first corresponding author was considered in this study. The collaboration type was determined by the addresses of the authors. Affiliations in England, Scotland, Northern Ireland, and Wales were reclassified as being from the United Kingdom (UK) [29]. Affiliations in Zaire were reclassified to be in Democratic Republic of the Congo (Dem Rep Congo) [30]. Affiliations in Hong Kong before 1997 were included with China [21].

3. Results and discussion

3.1 *Document type and language of publication*

Document types in a research field and their citations per publication were earlier proposed [31]. A total of 4,572 KSHV/HHV8 related publications in SCI-EXPANDED was found within 12 document types indexed in the Web of Science. The most used document type was the articles (75% of 4,572 publications) followed distantly by reviews (9.4%) and meeting abstracts (8.6%) (Table 1). Compare with studies in engineering and science, lower percentage of articles can be found in medical related studies [32,33]. Percentage of article was found to be lower than 60% in *Helicobacter pylori* (51%) and homeopathy (58%) studies respectively. The document type of notes with four documents and retracted publication with one document had the much higher CPP_{2016} of 454 and 102, respectively which can be attributed to the note entitled "Kaposi's sarcoma-associated herpesvirus-like DNA sequences in Multicentric Castleman's disease" [5] by Soulier et al. from France with TC_{2016} of 1,446 and the only one retracted publication entitled "Is Kaposi's-sarcoma-associated herpesvirus detectable in semen of HIV-infected homosexual men (Retracted article. See vol. 351, pg. 1365, 1998)" [34] by Lin et al. from USA with TC_{2016} of 102. It is not usual that reviews had lower of citations per publication (CPP_{2016}) than that of proceedings papers and articles respectively [26]. Number of authors per publication (*APP*) for reviews was also found less than that of articles. An article entitled "Inherited human OX40 deficiency underlying classic Kaposi sarcoma of childhood" [35] had the most number of authors with 29 authors from USA, Australia, Turkey, France, Germany, and Canada. Journal articles represented the majority of document type and including whole research ideas and results [36]; therefore 3,425 articles were analyzed in further study.

Language of publication is one of basic concerned in bibliometric studies as a big data analysis [23]. There were 3,425 KSHV/HHV8 articles that met the selection criteria

mentioned. Ninety-eight percent of the articles were published in English. Other languages also appeared, such as French (37 articles), German (7), Spanish (5), Turkish (3), and one for each in Polish and Russian respectively.

3.2 *Trends in KSHV/HHV8 Publication*

A relationship between number of articles (*TP*) and their citations per publication ($CPP_{year} = TC_{year}/TP$) by years in a research field was proposed as a figure. Figure 1 shows the distribution of the 3,425 KSHV/HHV8 articles over year and their citations per publication (CPP_{2016}). Before 1994, no KSHV/HHV8 articles were found in SCI-EXPANDED. From 1994 to 2001, it increased at a much quicker pace, and then reached a plateau after 2001 with an average number of 169 articles. In 1994, only one article had the highest CPP_{2016}, which was attributed to the article entitled "Identification of herpesvirus-like DNA sequences in AIDS-associated Kaposi's sarcoma" [3] by Chang and other six authors from Columbia University, DNAX Research Institute, and New York City Department of Health in USA with a TC_{2016} of 3,870. Similarly, in 2015 with seven articles had second high CPP_{2016}, which was attributed to the article entitled "Kaposi's sarcoma-associated herpesvirus-like DNA sequences in AIDS-related body-cavity-based lymphomas" [4] by Cesarman and other four authors from the New York Hospital–Cornell Medical Center, Columbia University, and Cedars–Sinai Medical Center in USA.

3.3 *Journals and Web of Science Categories*

In total, 3,425 articles were published in 610 journals and were listed in 76 Web of Science categories in SCI-EXPANDED in 2016. According to Bradford's Law of Scattering [37], the journals were sorted in descending order in terms of number of articles, and then divided into three "zones". Zone one represents the most productive one-third of the total articles, with six journals (0.98% of 610 journals). Zone two represents the next most productive one-third of total articles, with 57 (9.3%) journals, and Zone three represents the least productive one-third of total articles with 547 (90%) journals. The number of journals was approximately $1 : n : n^2$ (1 : 9.5 : 91), following Bradford's law. It was reported that publications in medical related topics such as pluripotent stem cell [28] and Ebola [33] also followed the Bradford's law. The six most productive of Bradford's core journals were *Journal of Virology* with 658 articles (19% of 3,425 articles) with IF_{2016} of 4.663, *PLoS Pathogens* (118 articles; IF_{2016} = 6.608), *Virology* (110 articles; IF_{2016} = 3.353), *Blood* (101 articles; IF_{2016} = 13.164), *Journal of Infectious Diseases* (90 articles; IF_{2016} = 6.273), and *Journal of Medical Virology* (79 articles; IF_{2016} = 1.935). The impact factor is used to evaluate a journal's relative importance, especially when compared to others in the same field. KSHV/HHV8 research has been a newly expanded research topic since 1994 with more articles published in journals in virology field with higher *IF*s. It was also reported that articles in pluripotent stem cell-related research were published in journals with higher *IF*s [28].

The five leading Web of Science categories published at least 10% of all articles were virology with 1,278 articles (37% of 3,423 articles), followed distantly by immunology with 386 (11%) articles, microbiology with 384 (11%) articles, oncology with 372 (11%) articles, and infectious diseases 326 (10%) articles.

3.4 *Publication of Countries*

Five indicators such as the total (*TP*), single-country (*SP*), internationally collaborative (*ICP*), first author (*FP*), and corresponding author (*RP*) articles were used to examine the research performances for different countries. The contributions provided by different countries were estimated by the affiliation of at least one author connected to the articles. Five of the 3,425 articles without any researcher address information on the SCI-EXPANDED. Of the 3,420 articles with researcher addresses published by authors from 92 countries, 2,543 articles (74% of 3,420 articles) were single-country articles from 50 countries and 877 (26%) articles were internationally collaborative articles from 89 countries. Table 2 shows the top 20 countries with $TP > 30$. Two North American countries, ten European countries, five Asian countries, two Africa countries, and one South American country were ranked in the top 20. Five of the seven major industrialized countries of the world (G7) such as USA, the UK, Italy, France, and Germany were the top five countries to publish. The G7 had high productivity in articles, which included 2,916 articles (85% of 3,420 articles) with affiliations. Domination in publication is not surprising from mainstream countries, since this pattern has occurred in many medical-related topics, such as patent ductus arteriosus [31], *Helicobacter pylori* [38], human papillomavirus [32], and pluripotent stem cell [28].

3.5 *Publication of Institutions*

Seven indicators such as the total (*TP*), single-institute (*SP*), internationally collaborative (*ICP*), nationally collaborative (*NCP*), first author (*FP*), corresponding author (*RP*), and single-author (*IP*) articles were used to compare institution publications. Of the 3,420 articles with researcher address information in the SCI-EXPANDED, 1,201 (35% of the 3,420 articles) were single-institute articles and 2,219 (65%) articles were inter-institutional collaborations including 877 articles (26% of the 2,219 articles) were internationally collaborative articles and 1,342 articles (39%) were nationally collaborative articles. Table 3 shows that among the top 20 institutions, 15 (75%) were in USA and one in each of China, Germany, Japan, and France. National Cancer Institute (NCI) in USA ranked top in six indicators such as *TP*, *SP*, *ICP*, *FP*, *RP*, and *IP*. However, NCI ranked 2nd on nationally collaborative articles while Harvard University in USA published the most nationally collaborative articles.

In recent years, a proportion (*SNI*) of number of single-institute articles (*S*), nationally collaborative articles (*N*), and internationally collaborative articles (*I*) was proposed to compare different institutions' publication characteristics [26,39]. In KSHV/HHV8 research field, the proportion of $S : N : I$ was 35 : 39 : 26. Results in Table 3 shows that the top institute, National Cancer Institute's proportion of $S : N : I$ was 30 : 31 : 39. It indicated that National Cancer Institute's research in KSHV/HHV8 field had more international collaborations among different institutions in other countries than national collaborations among different institutions in the same country. Rosalind Franklin University of Medicine and Science in USA was more able to conduct research independently with $S : N : I = 76: 16 : 8.2$. National Institute of Infectious Diseases in Japan had more national collaborations with $S : N : I = 16: 59 : 25$ while University of Nebraska in USA had more international collaborations with $S : N : I = 24: 4.1 : 71$.

3.6 *Publications of Authors*

In recent years, Ho's group proposed an indicator, the Y-index is related to the number of first author articles (*FP*) and corresponding author articles (*RP*). The Y-index combines two parameters (*j*, *h*), to assess both the publication potential and characteristics of the contribution as a single index. This indicator has been used to compare highly cited authors [40-43] and classic authors [44,45] in a specific field.

The *Y*-index is defined as [22,44,45]

$$j = FP + RP \tag{1}$$

$$h = \tan^{-1}\left(\frac{RP}{FP}\right) \tag{2}$$

Where *j* is the publication potential which is a constant related to publication quantity, and *h* is publication characteristics which can describe the proportion of *RP* to *FP*. The greater the value of *j*, the more the contribution of the first author and corresponding author articles. Different values of *h* represent different proportions of corresponding author articles from first author articles. $h > 0.7854$ indicates more corresponding author articles; $h = 0.7854$ indicates the same number of first author and corresponding author articles; and $h < 0.7854$ indicates more first author articles. When $h = 0$, *j* is the number of first author articles, and $h = \pi/2$, *j* is the number of corresponding author articles.

Altogether, 3,316 (97%) of 3,425 KSHV/HHV8 articles had both first and corresponding author information in the SCI-EXPANDED. A total of 3,316 articles by 10,920 authors were analyzed by *Y*-index. Only 926 authors (8.5% of the 10,920 authors) had both first author and corresponding author articles while 8,083 (74%) authors had no any first author and corresponding author articles. 125 of the 926 the authors had $\pi/2 > h > 0.7854$ and 96 authors had $0 < h < 0.7854$ while 621 had the same numbers of first author and corresponding author articles. In addition, 1,287 authors published only first author articles and 624 authors published only corresponding author articles.

The *Y*-index is useful, especially in an era of increasing multiple-authorship when the contribution of authors is diluted [40]. Figure 2 shows the *Y*-index (*j*, *h*) distribution of the top 19 authors with $j > 20$ ($j \cos h$ and $j \sin h$ are chosen as the *x* and *y* coordinate axes). *j* is a publication intensity constant: an author with a high *j* has more articles as the first or corresponding author, and takes the leadership role in more articles. Each dot represents one value that could be one author or many authors. The author who contributed the most KSHV/HHV8 articles was S.J. Gao ($j = 50$), followed by B. Chandran and D. Ganem with $j = 49$ respectively. C. Wood (30, $\pi/2$), D.P. Dittmer (30, 1.418), and H. Katano (30, 1.046) had the same value of *j*. It is clear that all of these authors are located on the same curve ($j = 30$) in Fig. 2, indicating that they have the same publication potential but different publication characteristics. Wood ($h = \pi/2$) has only corresponding author articles, Dittmer ($h = 1.418$) had a higher ratio of corresponding author articles to first author articles, whereas Katano ($h = 1.046$) had a lower one. E.S. Robertson (42, $\pi/2$), J.U. Jung (34, $\pi/2$), and C. Wood (30, $\pi/2$) published only corresponding author articles. However, Robertson had a higher publication potential with $j = 42$ than Jung with $j = 34$ and Wood with $j = 30$. The Y-index shows that B. Chandran and D. Ganem had the same publication potential and publication characteristics with the same Y-index (49, 1.528). A possible bias may occur when calculat-

ing the *Y*-index in that authors are sometimes listed in alphabetical order. In such a case, the first author may not always be the major contributor to an article.

3.7 *Citation Life Cycles of Articles*

Table 4 presents the top most frequently cited articles in TC_{2016}. Out of these 10 articles, five were published in 1996, two in 1995, and one in 1994, 1997, and 2005, respectively. Among the 10 articles, two were published in *Science* (IF_{2016} = 37.205), two in *Nature Medicine* (IF_{2016} = 29.886), and *New England Journal of Medicine* (IF_{2016} = 72.406), *Lancet* (IF_{2016} = 47.831), *Nature* (IF_{2016} = 40.137), *Nature Methods* (IF_{2016} = 25.062), *Blood* (IF_{2016} = 13.164), and *Proceedings of the National Academy of Sciences of the United States of America* (IF_{2016} = 9.661). It was widely expected that papers published in journals with a high *IF* would probably have high citations. P.S. Moore and Y. Chang published five of the 10 most frequently cited articles together with affiliation of Columbia University in. In the 2017 Clarivate Citation Laureates, Yuan Chang and Patrick S. Moore were selected among possible Nobel Prize winners in physiology or medicine for their discovery of the Kaposi's sarcoma-associated herpes virus, or human herpesvirus 8 (KSHV/HHV8) (https://clarivate.com/2017-citation-laureates/).

After checking of the top ten most frequently cited articles from hard copies. Only eight articles had corresponding author information. It was found that Y. Chang was the only highly cited author who published two of the top ten highly cited articles. Four first authors of the top ten articles were from Columbia University in USA, two from Cornell University in USA, and one from each of Institute of Cancer Research in the UK, University of Basel in Switzerland, University of California, San Francisco in USA, and University of Lausanne in Switzerland. Four corresponding authors of the eight top ten articles were from Columbia University in USA, two from Cornell University in USA, and one from each of Institute of Cancer Research in the UK and University of Basel in Switzerland.

The citation lives of the top ten articles are shown in Fig. 3. The articles with the highest TC_{2016} can be considered the most popular articles in the last two decades. In general, the trends of the top ten articles sharply increased since their publication years and then decreased. The articles with the highest C_{2016} were considered the most impactful articles in the recent year. Recently published articles, for example, "PD-L1 expression is characteristic of a subset of aggressive B-cell lymphomas and virus-associated malignancies" [46] influenced a great number of scientists with data comprising C_{2016} of 83 (rank 2nd) but TC_{2016} of 159 (rank 129th). It did not have enough time to accumulate citations data, but has had a steep increase of citations since its publication. Articles by Chang et al. [3], Cesarman et al. [4], Pfeffer et al. [47], and Nador et al. [48] ranked in 1st, 3rd, 6th, and 8th of C_{2016} respectively. These four articles were the only articles ranked in the top ten for the indicators of TC_{2016} and C_{2016}.

3.8 *Research Tendencies and Hotspots*

The distribution of words in article titles, abstracts, author keywords, and *KeyWords Plus* can be informative when evaluating trends in research topics [49,50]. The results of

our keyword analyses provide information about the main and possible research foci as each word cluster comprised several supporting words.

Thus the possible main research foci in KSHV/HHV8 research are HIV, lymphoma, and EBV. "HIV" (HIV, human immunodeficiency virus, and AIDS), "lymphoma" (lymphoma), and "EBV" (EBV, and Epstein Barr virus) grouped respectively. Figure 4 compares the distributions of these three main focuses in KSHV/HHV8 research. Article by Chang et al. [3] with the most cited article (TC_{2016} rank 1st) and the most impact article in recent year (C_{2016} rank 1st), was the earliest article related to HIV and EBV (Table 4). The earliest article of lymphoma was found in 1995 by Cesarman et al. [4] with C_{2016} rank 3rd and TC_{2016} rank 2nd.

4. Conclusions

This study used a vigorous "front page" screening methodology, excluding articles that would had little or no relevance to KSHV/HHV8 research, to download KSHV/HHV8 related research publications from the SCI-EXPANDED database. In total, 4,572 KSHV/HHV8 documents including 3,425 articles were published in SCI-EXPANDED. Twelve document types were used in KSHV/HHV8 publications. Reviews had lower of citations per publication than that of articles. English was the dominant language. KSHV/HHV8 publications increased sharply from 1994 to 2001. Articles published in 1994 had the highest annual citations per publication. There were 3,425 articles published in 610 journals listed in the 76 Web of Science subject categories. The highest number of articles was in Journal of Virology and in the subject category of virology. The USA ranked top in all five studied indicators. National Cancer Institute in the USA had the highest production including independent, internationally collaborative, first author, corresponding author, and single author articles while Harvard University in the USA was the most frequent national partner. In KSHV/HHV8 research field, the proportion of number of single institution articles : number of nationally collaborative articles : number of internationally collaborative articles ($S : N : I$) was found to be 35 : 39 : 26. Chang's group published the first article which was the most frequently cited and most impact in 2016 in KSHV/HHV8 research field.

Table 1

Citations and authors according to document type.

Document type	*TP*	%	*AU*	*APP*	TC_{2016}	CPP_{2016}
Article	3,425	75	22,124	6.5	130,609	38
Review	428	9.4	1,412	3.3	13,269	31
Meeting abstract	394	8.6	2420	6.2	59	0.15
Letter	202	4.4	1,038	5.1	1,641	8.1
Proceedings paper	117	2.6	818	7.0	3,863	33
Editorial material	86	1.9	225	2.6	768	8.9
Book chapter	28	0.61	65	2.3	892	32

Contd...

Correction	22	0.48	136	6.2	26	1.2
News item	7	0.15	8	1.3	1	0.14
Addition correction	4	0.087	16	4.0	32	8.0
Note	4	0.087	34	8.5	1,816	454
Retracted publication	1	0.022	7	7.0	102	102

TP: number of articles; *AU*: number of authors; *APP*: number of authors per publication (*AU*/*TP*); TC_{2016}: total citations since publication to the end of 2016; CPP_{2016} citations per paper (TC_{2016}/*TP*).

Table 2

Top 20 countries with *TP* > 70.

Country	*TP*	*TPR* (%)	*SPR* (%)	*CPR* (%)	*FPR* (%)	*RPR* (%)
USA	1970	1 (58)	1 (55)	1 (64)	1 (51)	1 (51)
UK	364	2 (11)	3 (5.4)	2 (26)	3 (6.6)	3 (6.3)
Italy	303	3 (8.9)	2 (6.7)	4 (15)	2 (6.6)	2 (6.5)
France	243	4 (7.1)	4 (5.2)	6 (13)	4 (5.2)	4 (5.2)
Germany	242	5 (7.1)	6 (3.4)	3 (18)	5 (4.3)	5 (4.3)
China	189	6 (5.5)	8 (2.4)	5 (14)	7 (3.6)	7 (3.6)
Japan	168	7 (4.9)	5 (5.0)	8 (4.7)	6 (4.2)	6 (4.3)
South Korea	99	8 (2.9)	7 (2.6)	11 (3.8)	8 (2.1)	8 (2.1)
Spain	72	9 (2.1)	10 (1.4)	10 (4.2)	9 (1.6)	9 (1.7)
Sweden	70	10 (2.0)	21 (0.47)	7 (6.6)	12 (1.3)	12 (1.4)
Brazil	60	11 (1.8)	11 (1.2)	13 (3.3)	11 (1.3)	11 (1.4)
Taiwan	57	12 (1.7)	9 (1.7)	22 (1.6)	10 (1.4)	10 (1.4)
Switzerland	52	13 (1.5)	12 (0.83)	12 (3.5)	13 (0.91)	14 (0.84)
Canada	47	14 (1.4)	13 (0.79)	15 (3.1)	15 (0.76)	15 (0.75)
Uganda	42	15 (1.2)	37 (0.039)	8 (4.7)	28 (0.18)	29 (0.15)
South Africa	41	16 (1.2)	19 (0.51)	14 (3.2)	16 (0.73)	17 (0.72)
Israel	40	17 (1.2)	13 (0.79)	18 (2.3)	14 (0.88)	13 (0.90)
Netherlands	35	18 (1.0)	17 (0.55)	17 (2.4)	19 (0.67)	19 (0.69)
Belgium	33	19 (1.0)	16 (0.67)	20 (1.8)	18 (0.70)	15 (0.75)
Greece	31	20 (0.91)	13 (0.79)	27 (1.3)	16 (0.73)	17 (0.72)

TP: total number of articles; *TPR* (%), *SPR* (%), *CPR* (%), *FPR* (%), and *RPR* (%): the rank and percentage of total articles, single-country articles, internationally collaborative articles, first-author articles, and corresponding-author articles among their total articles, respectively.

Table 3

Top 20 institutions with at least 36 articles

Institute	*TP*	*TPR* (%)	*SPR* (%)	*ICPR* (%)	*NCPR* (%)	*FPR* (%)	*RPR* (%)	*IPR* (%)	*%SP* (%)	*%NCP* (%)	*%ICP* (%)
National Cancer Institute (NCI), USA	191	1 (5.6)	1 (4.7)	1 (8.4)	2 (4.5)	1 (3.6)	1 (3.3)	1 (7.1)	30	31	39
University of California, San Francisco, USA	144	2 (4.2)	1 (4.7)	14 (3.1)	2 (4.5)	2 (2.7)	2 (2.4)	2 (5.7)	40	42	19
Harvard University, USA	129	3 (3.8)	7 (2.5)	7 (3.9)	1 (4.8)	4 (1.9)	5 (1.9)	4 (2.9)	23	50	26
Johns Hopkins University, USA	102	4 (3.0)	6 (3.0)	19 (2.5)	4 (3.3)	6 (1.8)	8 (1.5)	12 (1.4)	35	43	22
University of Pennsylvania, USA	100	5 (2.9)	4 (3.8)	12 (3.3)	13 (1.9)	5 (1.9)	4 (2.0)	N/A	46	25	29
University of California, Los Angeles, USA	94	6 (2.7)	8 (2.1)	13 (3.2)	7 (3.1)	8 (1.6)	9 (1.5)	3 (4.3)	27	44	30
University of North Carolina, USA	90	7 (2.6)	3 (3.9)	45 (1.3)	9 (2.4)	3 (2.1)	3 (2.1)	12 (1.4)	52	36	12
University of Southern California, USA	89	8 (2.6)	14 (1.2)	3 (4.4)	8 (2.7)	9 (1.4)	7 (1.5)	N/A	16	40	44
University of Washington, USA	86	9 (2.5)	10 (2.0)	26 (2.2)	5 (3.2)	10 (1.3)	12 (1.3)	12 (1.4)	28	50	22
University of Texas, USA	78	10 (2.3)	8 (2.1)	45 (1.3)	6 (3.1)	7 (1.7)	6 (1.6)	N/A	32	54	14
University College London (UCL), UK	77	11 (2.3)	22 (0.83)	2 (5.1)	18 (1.6)	14 (1.1)	13 (1.2)	12 (1.4)	13	29	58
University of Pittsburgh, USA	73	12 (2.1)	11 (1.7)	16 (3.0)	12 (1.9)	10 (1.3)	10 (1.4)	N/A	29	36	36
Cornell University, USA	64	13 (1.9)	14 (1.2)	21 (2.4)	11 (2.2)	13 (1.2)	15 (1.1)	N/A	22	45	33
Centers for Disease Control and Prevention, USA	63	14 (1.8)	26 (0.75)	11 (3.4)	15 (1.8)	24 (0.64)	23 (0.63)	N/A	14	38	48
Chinese Academy of Sciences, China	60	15 (1.8)	21 (0.92)	3 (4.4)	53 (0.75)	18 (0.82)	19 (0.78)	N/A	18	17	65
Hannover Medical School, Germany	53	16 (1.5)	43 (0.42)	7 (3.9)	37 (1.0)	18 (0.82)	16 (0.87)	N/A	9.4	26	64
National Institute of Infectious Diseases, Japan	51	17 (1.5)	27 (0.67)	39 (1.5)	10 (2.2)	20 (0.76)	19 (0.78)	N/A	16	59	25
Rosalind Franklin University of Medicine and Science, USA	49	18 (1.4)	5 (3.1)	145 (0.46)	72 (0.60)	10 (1.3)	11 (1.3)	N/A	76	16	8.2
University of Nebraska, USA	49	18 (1.4)	20 (1.0)	6 (4.0)	292 (0.15)	15 (1.1)	14 (1.1)	N/A	24	4.1	71
Institut Pasteur, France	48	20 (1.4)	43 (0.42)	10 (3.5)	41 (0.89)	17 (0.85)	16 (0.87)	4 (2.9)	10	25	65

TP: total number of articles; *TPR* (%), *SPR* (%), *ICPR* (%), *NCPR* (%), *FPR* (%), *RPR* (%), *IPR* (%): the rank and percentage of total articles, single-institution articles, internationally collaborative articles, nationally collaborative articles, first-author articles, corresponding-author articles, and single author articles among their total articles, respectively; N/A: not applicable; *%SP*: the percentage of single institution articles in total articles of each institution; *%NCP*: the percentage of nationally collaborative articles in total articles of each institution; *%ICP*: the percentage of internationally collaborative articles in total articles of each institution.

Table 4

Ten most frequently cited KSHV/HHV8 research articles in Science Citation Index Expanded

Rank (TC_{2016})	Rank (C_{2016})	Article	Reference
1 (3870)	1 (123)	Identification of herpesvirus-like DNA sequences in AIDS-associated Kaposi's sarcoma	Chang et al. (1994)
2 (1964)	3 (59)	Kaposi's sarcoma-associated herpesvirus-like DNA sequences in AIDS-related body-cavity-based lymphomas	Cesarman et al. (1995)
3 (1093)	24 (19)	Nucleotide sequence of the Kaposi sarcoma-associated herpesvirus (HHV8)	Russo et al. (1996)
4 (795)	36 (15)	Viral FLICE-inhibitory proteins (FLIPs) prevent apoptosis induced by death receptors	Thome et al. (1997)
5 (783)	29 (18)	Lytic growth of Kaposi's sarcoma-associated herpesvirus (human herpesvirus 8) in culture	Renne et al. (1996)
6 (738)	6 (35)	Identification of microRNAs of the herpesvirus family	Pfeffer et al. (2005)
7 (717)	44 (14)	Detection of Kaposi sarcoma associated herpesvirus in peripheral blood of HIV-infected individuals and progression to Kaposi's sarcoma	Whitby et al. (1995)
8 (700)	24 (19)	Molecular mimicry of human cytokine and cytokine response pathway genes by KSHV	Moore et al. (1996)
9 (664)	8 (27)	Primary effusion lymphoma: A distinct clinicopathologic entity associated with the Kaposi's sarcoma-associated herpes virus	Nador et al. (1996)
10 (639)	182 (8)	KSHV antibodies among Americans, Italians and Ugandans with and without Kaposi's sarcoma	Gao et al. (1996)

TC_{2016}: number of citations from Web of Science Core Collection from its publication to the end of 2016; C_{2016}: number of citations in 2016

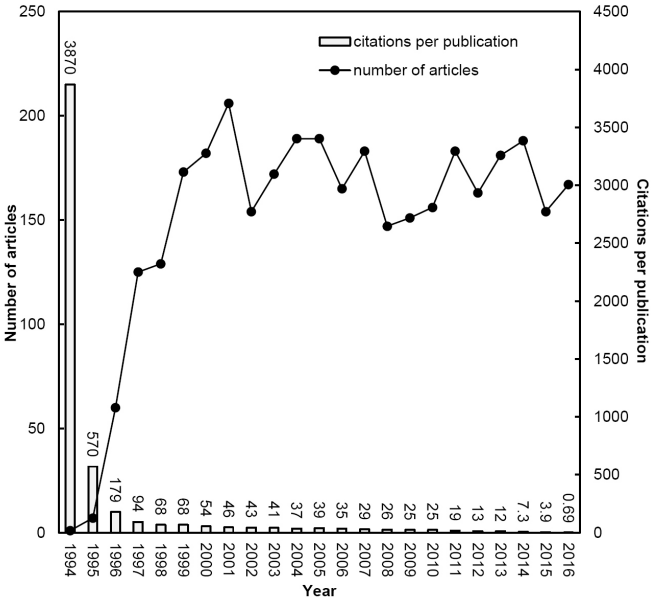

Figure 1

Trends of KSHV/HHV8 articles and citations per publication from 1994 to 2016.

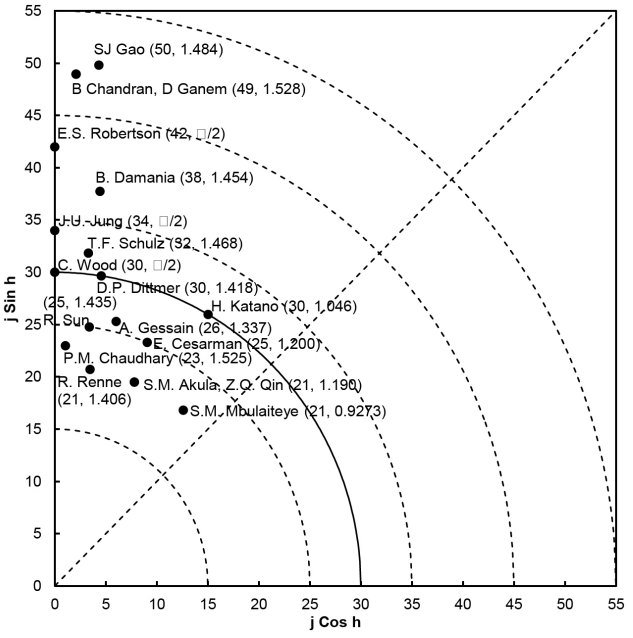

Figure 2

Distribution of the top 18 authors with their Y-index values (*j* > 20)

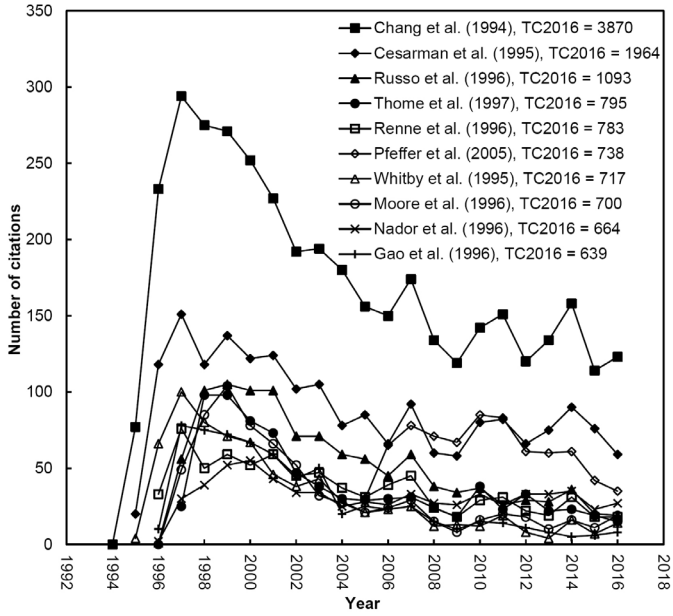

Figure 3

The lives of the top ten most frequently cited articles.

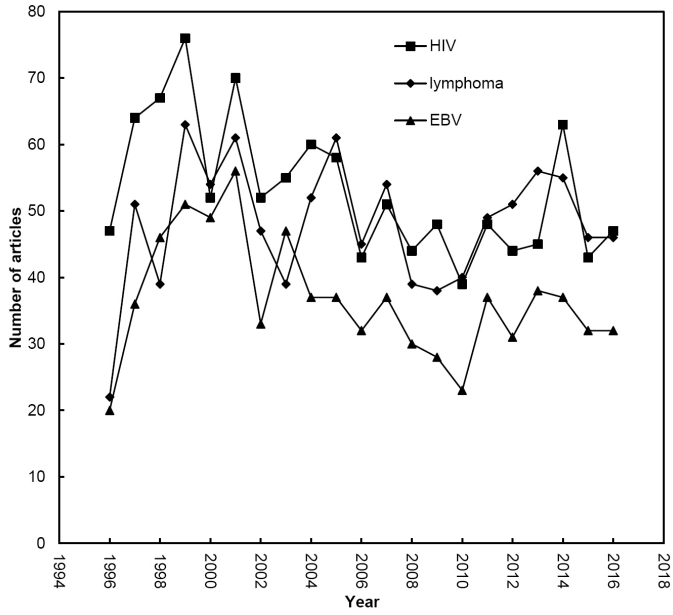

Figure 4

Growth trends of main focis during 1994-2016

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