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Two Hundred Years of the Annals of the New York Academy of Sciences: A Bibliometric Overview

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ABSTRACT

Founded in 1824, the Annals of the New York Academy of Sciences (ANYAS) is a distinguished international journal that embraces various scientific disciplines. In 2024, the journal marks its 200th anniversary. To honor this remarkable milestone, this article provides a thorough bibliometric analysis of the journal's publications. The aim is to identify the main trends in the journal, particularly over the past few decades. Bibliographic data have been gathered from the Web of Science Core Collection and Scopus databases. The study also uses VOSviewer software to create and visualize bibliometric maps. This analysis reveals that researchers affiliated with American institutions are the most productive authors, surpassing their peers from other countries, with notable contributions also coming from France and Israel. The United States of America emerges as the leading nation in the total number of publications and citations, followed by the United Kingdom and Germany. Additionally, an in-depth examination of keywords and topics illustrates that ANYAS encompasses a diverse range of subjects, prominently featuring chemistry, hematology, and psychology research. This breadth of exploration underscores the journal's role as a significant platform for advancing scientific knowledge across multiple domains.

1 | Introduction

The *Annals of the New York Academy of Sciences* (ANYAS) is a prominent international multidisciplinary journal that publishes research in all areas of science. Established in 1824, originally named *Annals of the Lyceum of Natural History of New York*, the journal has consistently provided a platform for original research articles, commissioned reviews, commentaries, and perspectives. Its commitment to disseminating high-quality research and promoting interdisciplinary collaboration positions ANYAS as an essential resource for researchers, educators, and policymakers. ANYAS is published by Wiley, and it is available at https://nyaspubs.onlinelibrary.wiley.com/journal/17496632.

The inaugural volume, published in September 1824, included 33 research documents, whereas the subsequent issue, published in January 1825, included 16 articles alongside various supplementary materials. The journal adopted its current name in 1877, reflecting the Academy's updated identity. The New York Academy of Sciences distinguished itself in the 19th century through its democratic membership structure, embracing a broad spectrum of individuals, from passionate amateurs to esteemed scientists, clinicians, and engineers. This inclusivity fostered a rich diversity within its community, including notable members such as US Presidents Thomas Jefferson and James Monroe and luminaries like Alexander Graham Bell, Thomas Edison, Louis Pasteur, Charles Darwin, Nikola Tesla, and Margaret Mead. It

Summary

- A bibliometric overview of the Annals of the New York Academy of Sciences.
- Analysis of the leading trends and the most cited documents.
- Graphical mapping by using the VOSviewer software.

was not until 1877 that the Academy admitted its first female member, Erminnie Smith, marking a significant milestone in its history. Currently, the editor-in-chief of ANYAS is Douglas Braaten, who also serves as the Chief Scientific Officer of the New York Academy of Sciences. In 2023, the journal boasts an impact factor of 4.1, as reported in the Web of Science (WoS) Journal Citation Reports (JCR). It is ranked 24th out of 134 in the multidisciplinary sciences category of Journal Impact Factor and 29th out of 135 according to the Journal Citation Indicator, and it is in the first quartile (Q1) of its category. In the 2023 CiteScore ranking from Scopus, ANYAS scored 11.0, with 85% of its 721 documents published between 2020 and 2023 cited in 7902 research documents.

In honor of the 200th anniversary of the ANYAS, this research retrospectively evaluates the journal's publications using quantitative bibliometric metrics. To do so, all articles published until 2023 and indexed in the Scopus database and the WoS Core Collection are examined. Specifically, the analysis focuses on the publication and citation patterns, key publications, and the most prolific and impactful authors, institutions, and countries/regions over time. This study also conducts a comparative evaluation with other top journals. Furthermore, tools such as Visualization of Similarities (VOS) viewer [1] and bibliometric techniques, such as bibliographic coupling [2], co-citation [3], and co-occurrence patterns of keywords [4], were used.

It is typical for journals to commemorate historical milestones by organizing special activities [5]. Some journals opt to release a particular issue. For instance, the *American Economic Review* published one for its centennial [6], the *Journal of Political Economy* for its 125th year [7], and *Nature* for its 150th celebration [8]. Editorials and reviews also serve as a method to honor such momentous occasions, as seen with the *Lancet* [9], *the Review of Economic Studies* [10], *Journal of Product Innovation Management* [11], *Computers & Industrial Engineering* [12], *Technovation* [13], *Journal of Knowledge Management* [14], and *Omega—the International Journal of Management Science* [15]. Performing a bibliometric analysis is a widely accepted practice. For instance, Heck et al. reviewed the articles published in the *Journal of Finance* [16], and Kirchler and Hölzl investigated the *Journal of Economic Psychology* [17], inspired by its first 25 years. Kube et al. offered an overview of the *Journal of Environmental Economics and Management* [18], whereas Mulet-Forteza et al. examined the *Journal of Travel & Tourism Marketing* [19], and Merigó et al. assessed the 30 years of the *International Journal of Intelligent Systems* [20]. In celebration of its 50th anniversary, Merigó et al. realized a bibliometric overview of *Information Sciences* [21], Donthu et al. created a bibliometric review of the *Journal of Advertising* [22], and Singh et al. reviewed the *Journal of Ecotourism* [23]. Each of these endeavors underscores the journals' dedication to acknowledging their rich histories while engaging with their academic communities.

The remainder of this article is structured as follows. Section 2 outlines the methodology and the process for data collection. Section 3 discusses the findings derived from the bibliometric analysis. Specifically, it assesses the publication and citation patterns, highlights the most impactful articles, identifies the citing articles, and spotlights the primary contributors, including authors, institutions, and countries. Section 4 analyzes the networks of co-citation, bibliographic coupling, and co-occurrence. Finally, Section 5 provides concluding observations.

2 | Methods

The idea of "bibliometrics" was first put forward by Pritchard in 1969 [24]. This discipline employs mathematical and statistical methods to quantitatively evaluate academic publications, as emphasized by Broadus [25]. The growth of bibliometrics can be credited to key figures like Eugene Garfield, who made significant contributions since the 1950s [26], along with technological advancements as highlighted by Bar-Ilan [27], Bensman [28], and Mokhnacheva and Tsvetkova [29]. Bibliometrics is used to evaluate scientific research on a particular field or topic, as well as to examine journals, authors, institutions, regions, or various combinations of these elements, as indicated by Ding et al. [30] and Gaviria-Marin et al. [14]. In recent decades, scientific research publications have increased significantly across various disciplines. However, this growth lacks coherence, underscoring the need for better information integration [31]. Effective integration is vital for data analysis by researchers, educators, and policymakers. Thus, scientific mapping is essential for identifying the intellectual structure and research frontiers in various fields [32], with scholars agreeing that this methodology is particularly suitable for such research [33–35].

Bibliometric indicators serve to quantitatively evaluate the bibliographic data associated with a journal [36, 37]. This research examines various kinds of bibliometric indicators, which include the total count of publications, the overall number of citations, and the h-index [38]. The total count of publications helps assess the journal's productivity, whereas the total number of citations indicates the journal's impact. The h-index incorporates the quantity and quality of publications. It is defined as the number of publications h that have received at least h citations each. Numerous databases exist for bibliographic references and citations. The most widely used are WoS, Scopus, and Google Scholar, whereas specialized databases encompass PubMed, MathSciNet, and others [39, 40]. The bibliographic data utilized in this work have been sourced from Scopus and WoS Core Collection [41, 42]. Note that these databases index similar information, although the starting date of indexation of each journal may be different. Additionally, the classification system is not 100% equal. For example, Scopus distinguishes the articles and reviews published in special issues from the rest of articles and reviews. Moreover, WoS Core Collection is a sub-database in WoS that indexes the journals that have received the highest recognition. However, it is worth noting that WoS indexes many other sub-databases with a topical or regional focus.

The search was conducted in October 2024 and is split into two segments. First, the study uses Scopus and looks for "Annals of the New York Academy of Sciences" OR "Annals of The Lyceum of Natural History of New York" in the "Source Title" category. The search omits 2024 to encompass all the documents published in the journal from 1824 to 2023. This search yields 65,855 documents. An additional filter is utilized to specifically target research contributions by selecting only articles, reviews, and special issues (conference papers). This refines the results to 65,288 documents, which will be used to create the study's tables and figures. This article employs the scientific procedures and principles defined by the systematic literature reviews (SPAR-4-SLR) protocol [43–45]. Figure 1 illustrates the stages and characteristics of the bibliometric review.

Second, the method used to obtain bibliographic information from the WoS Core Collection is described as follows: Publication Titles—"Annals of the New York Academy of Sciences." The search excludes 2024 and shows the Final Pub Year. This search finds 65,202 documents. Another filter is employed, and it considers only articles and reviews. This search retrieved 54,947 documents. Finally, we exclude early access. This refines the results to 54,928 documents, which will be used to create figures and tables.

To enhance the comprehension of the intellectual and conceptual framework of the ANYAS, this research employs VOSviewer [1] to create and visualize bibliometric networks based on co-citation, bibliographic coupling, and co-occurrence relationships. Co-citation is when two documents are cited together by a third document [3], whereas bibliographic coupling occurs when two documents reference the same third document [2]. The co-occurrence of keywords examines how often two or more keywords appear together within the document [4].

3 | Results

This section outlines the bibliometric findings for the ANYAS. It starts with a summary of the journal's publication and citation framework and a comparison to other key economics journals. The next part focuses on the most impactful studies published in the ANYAS, whereas the following section analyzes the sources of citations received by the journal. The section concludes with in-depth information about the prominent authors, institutions, and countries involved.

3.1 | Publication and Citation Structure of ANYAS

Figure 2 illustrates the yearly count of articles released by the journal from 1946 to 2023. The peak year for publications was 1990, which saw 1952 articles. Over the past decade, the ANYAS has averaged 219 articles published each year. The trends in the annual publication numbers demonstrate the journal's dedication to maintaining high review standards.

Alongside analyzing the yearly volume of documents published in the journal, it is crucial to consider the citation count they have garnered. Table 1 displays an overview of the citation distribution. The findings indicate that most of the journal's published works (83.2%) have been cited at least once. Overall, 45.8% of these publications have received 10 or more citations, whereas 4.5% have surpassed 100 citations. Of the 1001 articles published in 2008, 13 have accrued over 500 citations, making 2008 the year with the highest citation count as of October 2024.

Figure 3 illustrates the citation distribution of all articles published in the ANYAS using a box–whisker plot [15, 46]. Each box–whisker plot examines the documents released in a specific year and presents the results based on the 25%, 50% (median), and 75% most cited documents. Furthermore, it showcases the average citations per article, the interquartile range (IQR), and the minimum, maximum, and any outliers [15]. It is important to note that the figure is capped at 1000 citations. Consequently, outliers with citation counts exceeding the 1000 thresholds are indicated in red, displaying the precise number of citations obtained according to WoS up to October 2024.

Overall, the boxes tend to be biased toward the upper end, a typical trend among academic journals. It is important to note that the individual points above the whiskers are considered outliers. The red points highlight documents that have garnered significant attention from the scientific community and are identified as the journal's most cited articles. As indicated in Table 1, 2008 holds the highest number of citations, mainly due to four red outliers, including this journal's third most cited study [47]. However, looking at the data broadly, 2010 and 2011 stand out as the years where the set of documents displays a more significant variability in citation numbers, with several exceeding 100 citations (refer to Table 1).

Articles published in the past 5 years require additional time to achieve a notable impact on the scientific community, based on the citation counts compared to earlier years. Publications from the seventies and eighties have received fewer citations than those from the nineties and the early 2000s. This is primarily because the volume of articles published during that time in WoS and the ease of access to literature information [48] were much smaller than in recent decades, thus reducing the potential for citations. This issue is more evident for old articles published before the 1950s, where most articles have received a very low number of citations. The only exceptions to this trend are pivotal and foundational articles that serve as the bedrock of a specific research field or topic. Furthermore, documents published in more recent years are often better aligned with the prevailing trends in the scientific community.

The JCR is a resource by WoS that facilitates the assessment of scientific journals based on citation data [49]. A prominent metric offered by the JCR is the impact factor. Irving H. Sher and Eugene Garfield initially created this measure during the early 1960s [50] and indicated the average number of citations published in a journal received over 2 years. Additional metrics available in the JCR include total cites, the 5-year impact factor, the immediacy index, citable items, article influence score, and the ranking, quartile, and percentile of a journal within its specific category. The findings are displayed in Table 2.

In 2023, the journal reached an impact factor of 4.1 and was positioned at 24 out of 134 journals in the WoS category of Multidisciplinary Sciences. Furthermore, it is essential to men-

TABLE 1 | Annual citation structure of Annals of the New York Academy of Sciences (ANYAS).

Year	TP	TC	≥500	≥200	≥100	≥50	≥20	≥10	≥5	≥1
Pre46	910	6470	2	2	8	27	67	117	204	485
1946	109	729	0	1	1	1	6	11	25	67
1947	59	376	0	0	1	2	3	6	15	37
1948	102	1808	1	3	3	4	10	21	32	71
1949	203	23,977	2	3	4	7	10	25	55	135
1950	182	912	0	0	0	4	11	17	41	118
1951	140	1883	1	1	3	4	20	34	54	97
1952	186	2631	1	1	4	4	19	35	57	125
1953	128	1322	0	1	2	6	13	26	43	97
1954	208	1504	0	0	0	7	19	43	73	149
1955	319	2986	1	2	5	9	28	58	105	212
1956	232	2613	0	2	4	10	33	62	86	181
1957	412	4248	0	3	9	19	43	91	140	268
1958	501	4873	0	1	7	20	59	121	203	359
1959	693	7549	1	2	7	25	76	159	265	470
1960	720	8827	0	2	8	42	126	219	366	570
1961	395	4195	0	0	6	13	62	104	178	289
1962	511	10,240	2	5	11	31	77	143	233	403
1963	872	15,086	2	4	17	58	180	316	461	684
1964	773	31,519	4	7	19	54	157	270	397	608
1965	975	15,168	1	7	21	61	199	333	485	750
1966	653	10,168	1	6	13	47	133	243	321	502
1967	599	8476	0	3	9	31	125	215	328	460
1968	743	11,304	0	3	12	52	170	279	414	597
1969	1131	19,109	1	7	32	86	256	414	577	892
1970	648	9715	0	3	13	39	147	239	338	475
1971	640	13,752	0	6	23	77	176	307	338	507
1972	542	7274	0	4	13	31	89	156	218	333
1973	858	12,038	0	3	15	62	174	299	417	619
1974	697	14,070	1	4	21	68	196	327	455	591
1975	1028	22,006	1	11	35	112	309	485	647	858
1976	780	16,948	2	11	27	67	213	349	465	630
1977	895	17,781	2	5	31	91	235	374	507	708
1978	539	9431	0	2	15	57	133	220	297	401
1979	691	10,507	1	5	16	54	146	223	303	477
1980	1032	17,253	0	8	29	76	227	389	555	820
1981	855	14,153	0	8	26	65	186	327	469	697
1982	1108	19,936	1	10	30	86	273	468	650	939
1983	966	11,232	0	2	10	38	168	316	498	779
1984	1053	12,643	1	2	13	38	156	286	437	761
1985	1000	18,700	0	8	24	101	276	420	583	853
1986	1563	20,547	0	6	29	94	280	470	715	1142
1987	1865	25,408	1	12	34	117	327	565	834	1395
1988	1947	27,569	0	7	40	123	389	687	975	1508
1989	1484	19,683	0	7	34	91	265	447	618	1031
1990	1952	32,125	1	14	54	162	430	715	1020	1582
1991	1669	24,956	2	4	24	112	379	670	946	1360

(Continues)

TABLE 1 | (Continued)

Year	TP	TC	≥500	≥200	≥100	≥50	≥20	≥10	≥5	≥1
1992	1558	30,707	3	13	51	141	411	685	964	1329
1993	1740	34,723	3	18	54	170	438	696	974	1447
1994	1862	37,553	1	16	66	177	506	831	1113	1571
1995	1520	28,311	0	18	55	132	357	606	834	1253
1996	1500	24,855	0	3	35	107	381	657	933	1344
1997	1449	30,811	0	14	58	172	419	684	927	1302
1998	1775	49,217	3	29	102	239	594	880	1190	1607
1999	1516	59,391	9	43	133	309	642	891	1116	1368
2000	1365	56,364	7	34	110	287	654	896	1087	1292
2001	968	46,205	4	42	121	272	512	661	761	885
2002	1447	49,952	2	38	113	286	599	890	1080	1342
2003	1572	58,473	3	41	131	330	715	994	1195	1463
2004	1224	59,477	10	43	136	331	668	894	1048	1184
2005	1355	44,229	2	23	85	253	615	889	1070	1246
2006	1460	58,386	6	41	121	310	767	1067	1266	1402
2007	1074	46,705	1	28	103	279	622	841	952	1034
2008	1001	67,177	13	59	142	307	558	736	874	972
2009	1232	49,685	4	36	116	273	615	880	1049	1193
2010	720	49,496	8	48	124	254	482	618	665	707
2011	464	29,408	5	30	82	158	274	357	398	452
2012	445	25,098	4	16	55	133	297	377	419	438
2013	279	13,992	1	17	38	81	162	212	241	269
2014	258	17,120	4	15	36	88	171	217	236	252
2015	293	14,948	0	7	35	98	203	256	279	289
2016	260	10,996	0	8	27	58	148	207	235	252
2017	212	10,342	0	6	22	66	155	185	202	211
2018	276	10,275	1	8	19	58	150	215	250	269
2019	172	7487	0	5	17	40	92	137	159	171
2020	215	5905	1	4	8	26	74	141	183	212
2021	177	3651	0	1	5	12	50	100	139	174
2022	199	1793	0	0	1	3	14	56	129	193
2023	132	637	0	0	0	1	2	16	42	111
Pre54	2019	40,121	7	12	26	59	160	292	526	1233
54–63	4863	62,134	6	21	74	234	703	1316	2110	3585
64–73	7562	138,532	7	49	170	540	1646	2755	3833	5755
74–83	8591	153,317	8	66	240	714	2086	3478	4846	6900
84–93	15,831	247,061	11	91	357	1149	3351	5641	8066	12,408
94–03	14,974	441,132	29	278	924	2311	5379	7990	10,236	13,427
04–13	9254	443,653	54	341	1002	2379	5060	6871	7982	8897
14–23	2194	83,154	6	54	170	450	1059	1530	1854	2134
Total	65,288	1,609,069	128	912	2963	7863	19,423	29,873	39,453	54,326
%	100.0	—	0.2	1.4	4.5	12.0	29.8	45.8	60.4	83.2

Note: ≥500, ≥200, ≥100, ≥50, ≥20, ≥10, ≥5, ≥1 = number of studies with equal or more than 500, 200, 100, 50, 20, 10, 5, and 1 citations.
Abbreviations: TC, total citation; TP, total paper.

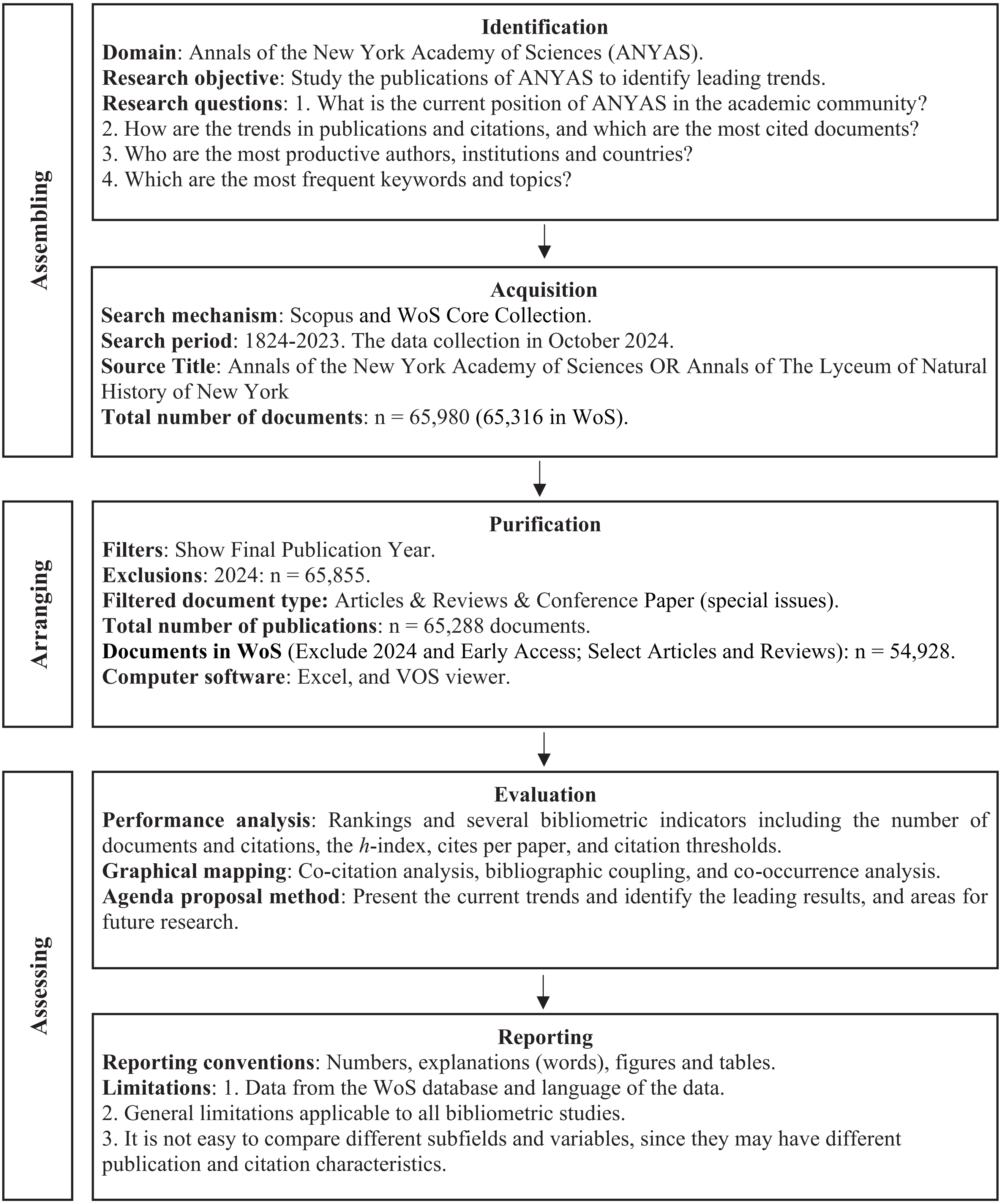

FIGURE 1 | The research process is based on the SPAR-4-SLR protocol. WoS, Web of Science.

tion that the article influence score has been consistently above one from 2011 to 2023. This suggests that the ANYAS generally maintains a higher-than-average influence, attracting citations from well-respected journals.

3.2 | Influential Studies in ANYAS

The ANYAS has released numerous significant articles in multidisciplinary sciences. Table 3 displays the 30 most impactful

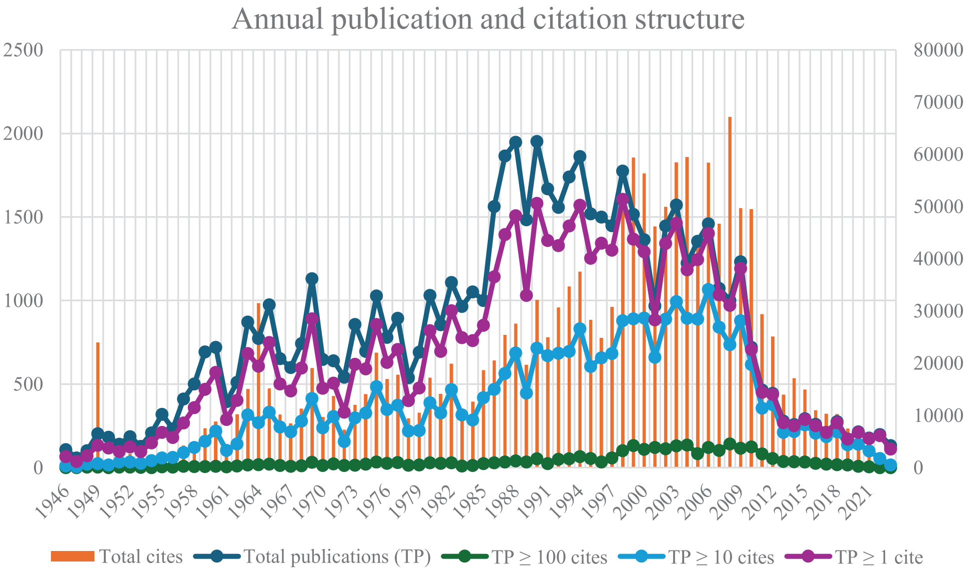

FIGURE 2 | Annual number of studies published in ANYAS.

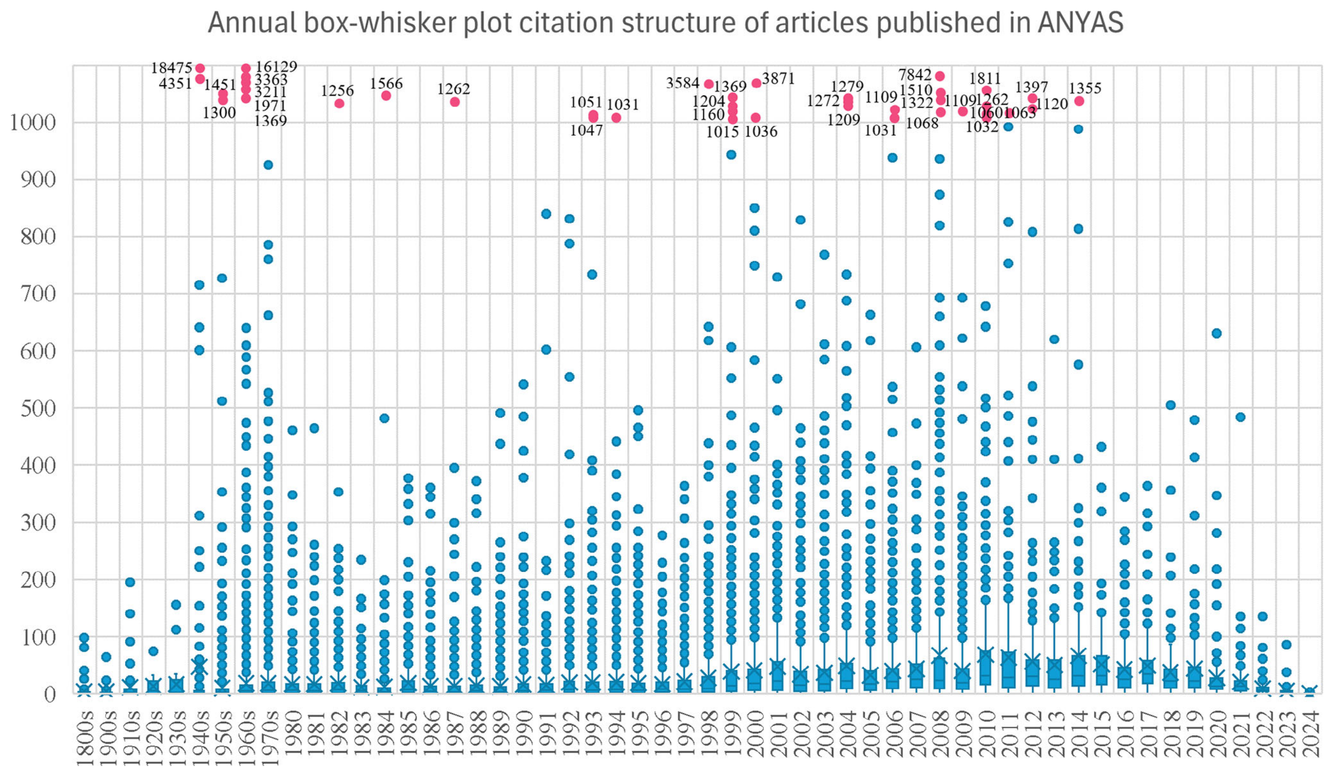

FIGURE 3 | Annual box-plot structure of the citations of all studies published in ANYAS. ANYAS, Annals of the New York Academy of Sciences.

documents of the ANYAS from 1949 to 2023. The article with the most citations was authored by chemist George Scatchard [51], which has 18,473 citations. Dr. Scatchard gained recognition for his research in the chemistry of solutions and contributed to the fractionation of plasma proteins during World War II. He also consulted on uranium isotope separation in the Manhattan Project, which was responsible for developing the atomic bomb. This was followed by Baruch J. Davis's 1964 study, which has 16,125 citations. His research introduced disk electrophoresis and highlighted the key technical factors that separate the standard components of human serum proteins [52]. Note that, according to Scopus, the work of Scatchard is the 312nd most cited document of all time indexed in Scopus, and the article of Davis is the 388th. Regarding citations per year, the study by Buckner et al. [47], all professors at the Department of Psychology, Harvard University, hold the top position with an average of 488.38 citations annually. Their research indicates that the default mode network is vital for future planning, social interactions, and moments of disconnection from the outside world and is relevant to mental disorders such as autism, schizophrenia, and Alzheimer's disease [47].

TABLE 2 | Analysis of Annals of the New York Academy of Sciences (ANYAS) in the Journal Citation Reports (JCR) of Web of Science (WoS).

Year	TC	IF	5YIF	ImIn	CI	AIS	R	Q	*P*
1997	22,151	0.90	—	0.10	879	—	17/56	Q2	70.54
1998	23,421	0.95	—	0.06	1466	—	13/62	Q1	79.84
1999	23,627	0.96	—	0.12	1034	—	12/52	Q1	77.88
2000	24,484	1.38	—	0.17	684	—	9/49	Q1	82.65
2001	25,593	1.59	—	0.07	627	—	7/45	Q1	85.56
2002	26,720	1.68	—	0.15	1149	—	7/48	Q1	86.46
2003	28,144	1.89	—	0.16	1019	—	6/46	Q1	88.04
2004	30,122	1.78	—	0.32	677	—	7/45	Q1	85.56
2005	31,034	1.97	—	0.23	811	—	5/48	Q1	90.63
2006	32,944	1.93	—	0.10	836	—	7/50	Q1	87
2007	34,259	1.73	2.07	0.24	1034	0.71	9/50	Q1	83
2008	37,539	2.30	2.37	0.19	975	0.79	8/42	Q1	82.14
2009	40,422	2.67	2.57	0.37	1101	0.86	5/50	Q1	91
2010	42,619	2.84	2.64	0.59	691	0.89	5/59	Q1	92.37
2011	43,725	3.15	2.99	0.81	447	1.04	6/56	Q1	90.18
2012	45,376	4.36	3.52	0.69	405	1.26	6/56	Q1	90.18
2013	46,347	4.03	3.85	1.08	275	1.33	6/55	Q1	90
2014	45,541	4.38	3.83	1.10	246	1.37	6/57	Q1	90.35
2015	44,076	4.51	4.41	0.86	295	1.62	8/63	Q1	88.1
2016	44,545	4.70	4.47	0.64	245	1.59	8/64	Q1	88.28
2017	46,160	4.27	4.60	1.07	209	1.59	10/64	Q1	85.16
2018	46,385	4.29	4.78	1.48	277	1.53	14/69	Q1	80.43
2019	45,596	4.72	5.16	1.90	180	1.63	13/71	Q1	82.39
2020	52,619	5.69	—	1.42	295	1.70	13/72	Q1	82.64
2021	53,645	6.49	6.57	0.73	149	1.70	14/74	Q1	81.76
2022	47,360	5.2	6.3	0.6	180	1.83	17/73	Q1	77.4
2023	44,441	4.1	6.3	1.0	117	1.91	24/134	Q1	82.5

Note: P means journal impact factor percentile in multidisciplinary sciences. "Q" means quartile in multidisciplinary sciences. "R" means ranking in the WoS category of multidisciplinary sciences.
Abbreviations: 5YIF, 5-year impact factor; AIS, article influence score; CI, citable items; IF, impact factor; ImIn, immediacy index; TC, total citations.

Another intriguing aspect is analyzing the documents most commonly referenced in the journal's articles. This information is displayed in Table 4. The table indicates that a document by Lowry (1951), titled "Protein measurement with the Folin phenol reagent," has been extensively cited in ANYAS publications. The text addresses the Folin phenol reagent for protein measurement, initially proposed by Wu in 1922. It investigates the reagent's limitations and factors such as pH, reaction time, and interfering substances. It outlines methods for measuring proteins in solution or after precipitation, with a detection limit of 0.2 μg [53]. The second most cited study was written by Laemmli [54] and appeared in *Nature*. In this work, Laemmli evaluated the stability of recombinant IL-2 in aqueous solutions with excipients suitable for cell therapy [54]. Note that the first three works in Table 4 are currently the three most cited studies of all time indexed in WoS and Scopus databases.

Notably, Science has seven articles in the Top 40, whereas the Journal of Biological Chemistry, Nature, Proceedings of the National Academy of Sciences, and the New England Journal of Medicine, each have three articles. The journals Analytical Biochemistry, Neurology, and Pharmacological Reviews contribute two articles each.

3.3 | Leading Authors, Institutions, and Countries

Table 5 highlights the 40 most productive authors in ANYAS. The ranking criteria are established on the basis of the total number of publications. When there is a tie, the ranking prioritizes the number of citations those publications receive. In the top position is Hubert Vaudry, who has contributed 75 publications to the journal, followed by Syed Ali, Yehuda Shoenfeld, and Didier

TABLE 3 | The 30 most cited documents of Annals of the New York Academy of Sciences (ANYAS).

R	TC	Title	Author/s	Year	*C/Y*
1	18,473	The attractions of proteins for small molecules and ions	Scatchard G.	1949	246.31
2	16,125	Disc electrophoresis—II method and application to human serum proteins	Davis B.J.	1964	268.75
3	7814	The brain's default network: Anatomy, function, and relevance to disease	Buckner R.L.; Andrews-Hanna J.R.; Schacter D.L.	2008	488.38
4	4342	The effects of shape on the interaction of colloidal particles	Onsager L.	1949	57.89
5	3854	Inflamm-aging. An evolutionary perspective on immunosenescence	Franceschi C.; Bonafè M.; Valensin S.; Olivieri F.; De Luca M.; Ottaviani E.; De Benedictis G.	2000	160.58
6	3557	Stress, adaptation, and disease allostasis and allostatic load	Wen B.M.	1998	136.81
7	3363	Disc electrophoresis—I background and theory	Ornstein L.	1964	56.05
8	3189	Electrode systems for continuous monitoring in cardiovascular surgery	Clark L.C., Jr.; Lyons C.	1962	51.44
9	1968	Densitometric analysis of body composition: revision of some quantitative assumptions	Brožek J.; Grande F.; Anderson J.T.; Keys A.	1963	32.26
10	1794	Neighborhoods and health	Diez Roux A.V.; Mair C.	2010	128.14
11	1560	Scalar Timing in Memory	Gibbon J.; Church R.M.; Meck W.H.	1984	39.00
12	1504	The adolescent brain	Casey B.J.; Jones R.M.; Hare T.A.	2008	94.00
13	1451	Influences of glucose loading and of injected insulin on hepatic glucose output	Steele R.	1959	22.32
14	1391	Functional imaging studies of emotion regulation: a synthetic review and evolving model of the cognitive control of emotion	Ochsner K.N.; Silvers J.A.; Buhle J.T.	2012	115.92
15	1369	Problems of experimental trials of therapy in multiple sclerosis: report by the panel on the evaluation of experimental trials of therapy in multiple sclerosis	Schumacher G.A.; Beebe G.; Kibler R.F.; Kurland L.T.; Kurtzke J.F.; McDowell F.; Nagler B.; Sibley W.A.; Tourtellotte W.W.; Willmon T.L.	1965	23.20
16	1365	Protective and damaging effects of mediators of stress. Elaborating and testing the concepts of allostasis and allostatic load	McEwen B.S.; Seeman T.	1999	54.60
17	1344	The default network and self-generated thought: Component processes, dynamic control, and clinical relevance	Andrews-Hanna J.R.; Smallwood J.; Spreng R.N.	2014	134.40
18	1315	Chronic stress, drug use, and vulnerability to addiction	Sinha R.	2008	82.19
19	1298	Definition of the stages of the cycle of the seminiferous epithelium in the rat	Leblond C.P.; Clermont Y.	1952	18.03
20	1271	Adolescent brain development: A period of vulnerabilities and opportunities—Keynote Address	Dahl R.E.	2004	63.55
21	1268	Structural magnetic resonance imaging of the adolescent brain	Giedd J.N.	2004	63.40
22	1260	Spatial Localization in NMR Spectroscopy In Vivo	Bottomley P.A.	1987	34.05

(Continues)

TABLE 3 | (Continued)

R	TC	Title	Author/s	Year	C/Y
23	1255	Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease	McEwen B.S.; Gianaros P.J.	2010	89.64
24	1255	The phenomenon of the acute phase response	Kushner I.	1982	29.88
25	1205	Protection and damage from acute and chronic stress: Allostasis and allostatic overload and relevance to the pathophysiology of psychiatric disorders	McEwen B.S.	2004	60.25
26	1198	Race, socioeconomic status, and health the added effects of racism and discrimination	Williams D.R.	1999	47.92
27	1157	Socioeconomic status and health: What we know and what we don't	Adler N.E.; Ostrove J.M.	1999	46.28
28	1111	Socioeconomic status and smoking: A review	Hiscock R.; Bauld L.; Amos A.; Fidler J.A.; Munafò M.	2012	92.58
29	1103	Bone remodeling	Hadjidakis D.J.; Androulakis I.I.	2006	61.28
30	1103	The social neuroscience of empathy	Singer T.; Lamm C.	2009	73.53

Abbreviations: *C*/Y, cites per year; R, rank; TC, total citations.

Raoult, each with over 50 publications. Regarding citations, George P. Chrousos leads with 3760 citations, closely followed by Yehuda Shoenfeld, who has 2574 citations. Furthermore, Yehuda Shoenfeld holds the highest *h*-index of 32, and Rachel Yehuda holds the best citation-to-publication ratio (*C*/*P*) of 78.1. Lastly, regarding country representation, the United States of America (USA), Germany, and Italy rank at the top with 11, 7, and 6 authors, respectively.

Table 6 presents the 40 most productive and influential universities in ANYAS. Harvard University leads the list with 1592 publications, 62,280 citations, and an impressive 39.1 citations per publication (*C*/*P*) ratio. Significant contributors include the National Institutes of Health (NIH) and Columbia University, each boasting over 1000 publications and exceeding 30,000 citations. Furthermore, the VA Medical Center, University of Pennsylvania, and Icahn School of Medicine at Mount Sinai have published more than 600 studies, amassing nearly 20,000 citations, which results in a high *C*/*P* ratio of over 28 citations per published study in ANYAS. Notably, the USA hosts 85% of the most influential institutions that contribute to publishing in ANYAS.

Table 7 presents the 40 most productive and influential countries in ANYAS. As mentioned, the USA stands out as the leading nation on this list, boasting an impressive 39,486 publications, over 1 million citations, and a notable *h*-index of 306. The United Kingdom (UK) follows in second place with nearly 4000 publications and 120,940 citations, demonstrating a commendable *C*/*P* ratio of 30.4, even though it lags significantly behind the USA. Germany ranks third with more than 3000 publications and 92,340 citations, exhibiting a *C*/*P* ratio of 30.2. Notably, Switzerland has achieved high numbers of publications and citations about its population, distinguishing itself by having the highest number of citations per capita (*C*/Po) on the list.

Table 8 presents a count of publications in ANYAS categorized by period for the 30 leading countries. The USA ranks first, boasting 39,486 publications and consistently leading in publication numbers across all periods. However, similar to other nations, there has been a noticeable downward trend in recent years. Following the USA, the UK and Germany demonstrate a comparable pattern, with their influence remaining similar since the 1990s. Furthermore, the subsequent countries on the list follow this trend, most having experienced a peak in publications from 1984 to 1993 before undergoing a gradual decline, as shown on the right side of the table.

4 | Mapping ANYAS With VOSviewer Software

This section presents a graphical representation of bibliographic information. It explores different types of bibliometric networks, enhancing our understanding of the structure and dynamics of the ANYAS literature. The first portion focuses on co-citation [3] and bibliographic coupling networks [2], whereas the second section analyzes keyword co-occurrence networks [4] and the most prevalent topics. The figures are produced using VOSviewer software [1]. It is essential to highlight that all figures derived from WoS data are accessible from 1945 to 2023. Data presented before 1945 present numerous inconsistencies. Therefore, this study focuses exclusively on this specified period.

4.1 | Co-Citation Analysis of ANYAS

As previously stated, *co-citation* is when a third document cites two other documents simultaneously [3] published in the ANYAS. The software VOSviewer [1] offers a graphical representation of bibliographic maps based on co-citation [55]. Figure 4 illustrates the co-citation network of journals referenced in the ANYAS. This visualization is created by applying a minimum

TABLE 4 | Top 40 most cited documents in Annals of the New York Academy of Sciences (ANYAS) publications.

Rank	Year	First author	Reference	Vol	Page	Type	TC
1	1951	Lowry OH	J Biol Chem	v193	p265	A	378
2	1970	Laemmli UK	Nature	v227	p680	A	229
3	1976	Bradford MM	Anal Biochem	v72	p248	A	128
4	1987	Chomczynski P	Anal Biochem	v162	p156	A	94
5	2011	Mittal VA	Psychiat Res	v189	p158	A	85
6	1984	Mckhann G	Neurology	v34	p939	A	82
7	1979	Towbin H	P Natl Acad Sci USA	v76	p4350	A	78
8	1981	Hamill OP	Pflug Arch Eur J Phy	v391	p85	A	74
9	1993	Spengler D	Nature	v365	p170	A	73
10	1981	Vale W	Science	v213	p1394	A	72
11	1985	Grynkiewicz G	J Biol Chem	v260	p3440	A	71
12	1956	Harman D	J Gerontol	v11	p298	A	70
13	1995	Chrousos GP	New Engl J Med	v332	p1351	A	68
14	1952	Hodgkin AL	J Physiol-London	v117	p500	A	64
15	1989	Miyata A	Biochem Bioph Res Co	v164	p567	A	63
16	1982	Sambrook J	Mol Cloning Lab Manu	v2nd		B	63
17	1975	Folstein MF	J Psychiat Res	v12	p189	A	60
18	2002	Hsu SY	Science	v295	p671	A	60
19	1992	Chrousos GP	JAMA-J Am Med Assoc	v267	p1244	A	59
20	1984	Munck A	Endocr Rev	v5	p25	A	59
21	1987	Sapolsky R	Science	v238	p522	A	59
22	1949	Scatchard G	Ann NY Acad Sci	v51	p660	A	59
23	1990	Nicoll DA	Science	v250	p562	A	57
24	1988	Reaven GM	Diabetes	v37	p1595	A	55
25	1973	Patrick J	Science	v180	p871	A	54
26	1977	Sanger F	P Natl Acad Sci USA	v74	p5463	A	54
27	1979	Chirgwin JM	Biochemistry-US	v18	p5294	A	52
28	1974	Jerne NK	Ann Inst Pasteur Imm	vc125	p373	A	52
29	1989	Steinberg D	New Engl J Med	v320	p915	A	52
30	1988	Evans RM	Science	v240	p889	A	50
31	1972	Kerr JFR	Brit J Cancer	v26	p239	A	50
32	1976	Lindstrom JM	Neurology	v26	p1054	A	50
33	1975	Southern EM	J Mol Biol	v98	p503	A	50
34	1993	Ross R	Nature	v362	p801	A	49
35	1999	Ross R	New Engl J Med	v340	p115	A	49
36	2000	Vaudry D	Pharmacol Rev	v52	p269	A	49
37	1991	Moncada S	Pharmacol Rev	v43	p109	A	48
38	1990	Beckman JS	P Natl Acad Sci USA	v87	p1620	A	47
39	1993	Corder EH	Science	v261	p921	A	47
40	1969	Weber K	J Biol Chem	v244	p4406	A	47

Abbreviations: A, article; B, book; TC, total citation.

TABLE 5 | Top 40 most productive authors in Annals of the New York Academy of Sciences (ANYAS).

R	Author name	University	Country	TP	TC	*H*	*C/P*	≥100	≥10
1	Vaudry, H.	U Rouen	FRA	75	798	16	10.6	1	26
2	Ali, S.F.	Natl Center Toxicological Res	USA	65	1881	25	28.9	3	48
3	Shoenfeld, Y.	Reichman U	ISR	57	2574	32	45.2	5	49
4	Raoult, D.	Aix Marseille U	FRA	55	2045	27	37.2	4	43
5	Cutolo, M.	U Genova	ITA	49	2051	26	41.9	4	45
6	Sanjeevi, C.B.	Karolinska Inst	SWE	49	508	13	10.4	0	21
7	Brandt, T.	Klinikum U München	GER	43	1525	19	35.5	3	26
8	Chrousos, G.P.	Natl Kapodistrian U Athens	GRE	40	3760	24	94	11	26
9	Lawrence, G.N.	—	—	39	79	5	2.0	0	0
10	Selikoff, I.J.	The City U New York	USA	37	2460	23	66.5	6	28
11	Arimura, A.	Tulane U Sch Medicine	USA	37	632	13	17.1	1	19
12	Leigh, R.J.	Case Western Res U Sch Medicine	USA	36	721	14	20.0	1	20
13	Bland, T.	—	—	35	22	2	0.6	0	0
14	Fromm, M.	Charité–U Med Berlin	GER	33	1325	19	37.9	2	24
15	Glasauer, S.	Brandenburgische Tech U Cottbus	GER	33	621	15	18.1	0	18
16	Slikker, W.	Natl Center Toxicological Res	USA	32	444	9	13.9	1	9
17	Bathgate, R.A.D.	U Melbourne	AUS	31	580	16	18.7	0	18
18	Mastorakos, G.	Aretaio Hospital	GRE	30	1525	17	50.8	5	20
19	Schulzke, J.D.	St. Josef-Hospital Kath Klinik Bochum	GER	30	1525	17	50.8	3	22
20	Lahiri, D.K.	Indiana U Sch Medicine	USA	30	859	18	28.6	0	27
21	Yehuda, R.	Icahn School of Medicine at Mount Sinai	USA	29	2264	18	78.1	8	25
22	Sulli, A.	U Genova	ITA	29	1538	19	53.0	4	26
23	Newsom-Davis, J.	U Oxford Medical Sciences Division	UK	28	387	9	13.8	0	9
24	Bertoni-Freddari, C.	Istituto Nazionale Riposo e Cura Anziani	ITA	28	347	11	12.4	0	16
25	Vincent, A.	U Oxford Medical Sciences Division	UK	27	885	16	32.8	2	17
26	Shioda, S.	Shonan U Medical Sciences	JAP	27	699	13	25.9	2	16
27	Strupp, M.	Klinikum U München	GER	27	656	14	24.3	0	17
28	Carruba, G.	Division Research Internationalization	ITA	27	571	15	21.2	0	20
29	Kvetňanský, R.	Inst Exper Endocr Slovak Acad Sci	SLK	27	467	11	17.3	1	16
30	Fattoretti, P.	Istituto Nazionale Riposo e Cura Anziani	ITA	27	317	11	11.7	0	15
31	Creatsas, G.	School of Medicine	GRE	26	671	15	25.8	0	18
32	Zaidi, M.	Icahn Sch Med at Mount Sinai	USA	26	576	12	22.2	1	16
33	Peretz, I.	U Montreal	CAN	25	1717	18	68.7	3	20
34	Caruso, C.	U Palermo	ITA	25	1058	17	42.3	3	23
35	Kim, H.	Yonsei U	SK	25	486	15	19.4	0	20
36	Kanz, L.	Eberhard Karls U Tübingen	GER	24	1202	15	50.1	2	18
37	Straub, R.H.	Klinikum U Regensburg	GER	24	963	15	40.1	1	18
38	Gershwin, M.E.	UC Davis School of Medicine	USA	24	686	13	28.6	2	13
39	Zee, D.S.	Johns Hopkins U Sch Medicine	USA	24	570	14	23.8	1	15
40	Gordon, A.S.	New York U	USA	24	199	7	8.3	0	6

Note: ≥100 and ≥10 = number of studies with equal or more than 100 and 10 citations.
Abbreviations: *C/P*, cites per paper; *H*, *h*-index; TC, total citation; TP, total paper.

TABLE 6 | The most productive and influential institutions in Annals of the New York Academy of Sciences (ANYAS).

R	Institution	Country	TP	TC	*H*	*C/P*	≥100	≥10	QS	ARWU
1	Harvard U	USA	1592	62,280	111	39.1	129	853	11	14
2	Natl Inst Health (NIH)	USA	1428	52,610	110	36.8	121	847	—	—
3	Columbia U	USA	1173	30,041	76	25.6	51	509	34	8
4	New York U	USA	775	16,873	59	21.8	35	300	43	28
5	Yale U	USA	745	28,629	78	38.4	51	392	23	11
6	VA Medical Center	USA	695	19,866	70	28.6	46	371	—	—
7	U Pennsylvania	USA	672	19,704	78	29.3	45	322	11	14
8	Johns Hopkins U	USA	636	19,589	73	30.8	51	357	32	16
9	Icahn Sch Med Mount Sinai	USA	631	19,991	70	31.7	46	339	—	—
10	INSERM	FRA	611	16,039	59	26.3	34	338	—	—
11	The City U New York	USA	535	8906	47	16.7	16	172	671	—
12	U California, San Francisco	USA	513	21,137	74	41.2	53	312	—	21
13	U California, Los Angeles	USA	504	17,160	67	34.1	42	278	42	13
14	Natl Cancer Institute (NCI)	USA	498	12,173	58	24.4	21	266	—	—
15	Rockefeller U	USA	491	20,750	58	42.3	32	236	—	39
16	Stanford U	USA	479	15,659	62	32.7	32	252	6	2
17	U Michigan	USA	477	18,129	65	38.0	40	254	44	26
18	CNRS	FRA	472	11,288	56	23.9	19	249	—	—
19	Massachusetts General Hospital	USA	466	29,485	74	63.3	55	287	—	—
20	Weill Cornell Medicine	USA	458	15,935	62	34.8	29	252	—	—
21	U Washington	USA	446	12,435	57	27.9	26	269	76	18
22	Yeshiva U	USA	414	8565	47	20.7	13	186	413	901–1000
23	The U Chicago	USA	413	9995	50	24.2	19	190	21	10
24	Albert Einstein Coll Med	USA	412	9081	47	22.0	14	195	—	—
25	U California, San Diego	USA	395	12,925	59	32.7	32	242	72	19
26	U Toronto	CAN	391	12,185	58	31.2	29	214	25	24
27	Cornell U	USA	387	16,354	61	42.3	30	210	16	12
28	Massachusetts Inst Tech	USA	386	27,480	49	71.2	21	163	1	3
29	Karolinska Inst	SWE	371	9548	51	25.7	16	206	—	37
30	U California, Berkeley	USA	352	11,123	55	31.6	28	161	12	5
31	U McGill	CAN	350	12,836	63	36.7	41	217	29	70
32	Washington U St. Louis	USA	349	10,975	53	31.5	27	191	176	25
33	U Wisconsin-Madison	USA	346	12,834	61	37.1	33	187	116	35
34	U Minnesota Twin Cities	USA	343	11,862	48	34.6	20	168	203	44
35	U California, Davis	USA	332	10,155	56	30.6	24	188	130	101–150
36	Pfizer Inc.	USA	312	5446	38	17.5	11	113	—	—
37	Case Western Reserve U	USA	311	7713	42	24.8	12	146	259	151–200
38	U Pittsburgh	USA	289	11,532	56	39.9	25	177	275	83
39	Natl Inst Mental Health	USA	288	13,996	62	48.6	34	203	—	—
40	Baylor Coll Med	USA	281	7925	49	28.2	15	153	—	151–200

Note: Abbreviations available in Table 5 except: ARWU = Academic Ranking of World Universities; QS = Quacquarelli & Symonds University Ranking.

TABLE 7 | The most productive and influential countries in Annals of the New York Academy of Sciences (ANYAS).

R	Country	TP	TC	*H*	*C/P*	≥100	≥10	Population	*P*/Po	*C*/Po
1	USA	39,486	1,061,586	306	26.9	2073	18,215	334,915	117.90	3169.72
2	UK	3966	120,490	135	30.4	226	2096	68,350	58.02	1762.84
3	Germany	3063	92,340	124	30.2	191	1806	84,482	36.26	1093.01
4	Italy	2595	66,881	101	25.8	103	1407	58,761	44.16	1138.19
5	Canada	2482	71,572	114	28.8	148	1374	40,097	61.90	1784.97
6	Japan	2452	51,753	89	21.1	76	1190	124,517	19.69	415.63
7	France	2366	53,235	96	22.5	90	1231	68,170	34.71	780.92
8	Sweden	1151	29,730	82	25.8	53	613	10,537	109.23	2821.49
9	Netherlands	1123	30,587	79	27.2	60	636	17,880	62.81	1710.68
10	Switzerland	1066	34,858	87	32.7	70	626	9850	108.22	3538.88
11	Australia	883	28,577	82	32.4	65	515	26,639	33.15	1072.75
12	Israel	851	22,112	73	26.0	41	460	9757	87.22	2266.27
13	Spain	602	16,648	61	27.7	29	365	48,373	12.44	344.16
14	Belgium	568	13,829	54	24.4	21	284	11,822	48.05	1169.77
15	China	530	10,517	53	19.8	17	226	1,410,710	0.38	7.46
16	Denmark	486	11,859	58	24.4	20	269	5947	81.72	1994.11
17	Austria	379	11,775	55	31.1	24	192	9134	41.49	1289.14
18	South Korea	335	10,141	53	30.3	21	232	51,713	6.48	196.10
19	Finland	327	9649	52	29.5	17	189	5584	58.56	1727.97
20	Greece	326	11,474	53	35.2	22	216	10,361	31.46	1107.42
21	Russia	303	6436	40	21.2	11	145	143,823	2.11	44.75
22	Brazil	297	7173	41	24.2	15	163	216,422	1.37	33.14
23	Hungary	268	6505	43	24.3	10	157	9590	27.95	678.31
24	India	247	6500	44	26.3	11	122	1,428,628	0.17	4.55
25	Mexico	241	4132	34	17.2	4	114	128,456	1.88	32.17
26	Poland	231	5293	38	22.9	9	106	36,686	6.30	144.28
27	Argentina	220	5444	34	24.8	12	104	46,656	4.72	116.68
28	Norway	215	6835	44	31.8	15	125	5520	38.95	1238.22
29	South Africa	205	5320	42	30.0	8	124	60,415	3.39	88.06
30	Portugal	178	4109	34	23.1	8	97	10,525	16.91	390.40
31	Taiwan	169	6273	44	37.1	10	114	23,265	7.26	269.63
32	Slovakia	159	3578	33	22.5	6	88	5427	29.30	659.30
33	New Zealand	117	3428	31	29.3	8	66	5223	22.40	656.33
34	Czech Republic	116	2971	27	25.6	4	68	10,874	10.67	273.22
35	Ireland	98	3709	29	37.9	9	58	5262	18.62	704.87
36	Turkey	95	2472	29	26.0	3	61	85,326	1.11	28.97
37	Thailand	68	2076	26	30.5	4	45	71,801	0.95	28.91
38	U Arab Emirates	67	1571	20	23.5	2	40	9517	7.04	165.07
39	Singapore	65	2877	24	44.3	5	42	5918	10.98	486.14
40	Chile	62	996	14	16.1	2	19	19,630	3.16	50.74

Note: Population source: World Bank (in thousands). Abbreviations are available in Table 5 except: *P*/Po and *C*/Po = papers and cites per million inhabitants.

TABLE 8 | Annual number of studies classified by countries.

R	Country	Total	DL	D1	D2	D3	D4	D5	D6	D7	D8	D9	23	22	21	20	19	18	17	16	15	14
1	USA	39,486	37	110	730	3880	5608	6093	9743	7804	4259	1270	72	87	93	129	94	156	116	185	168	170
2	UK	3966	1	0	19	210	433	440	999	954	650	260	20	41	16	22	15	47	14	23	28	39
3	Germany	3063	0	0	1	53	125	221	633	1053	769	208	18	30	14	14	17	22	25	14	34	20
4	Italy	2595	0	0	2	19	53	69	691	860	783	118	6	14	5	5	4	20	11	17	18	18
5	Canada	2482	1	2	15	98	183	300	673	654	343	213	21	25	19	19	13	33	17	16	24	26
6	Japan	2452	37	0	0	27	68	197	657	891	538	72	5	4	6	12	5	8	9	6	7	10
7	France	2366	0	0	5	46	110	217	603	840	441	104	10	9	14	8	6	19	4	7	13	14
8	Sweden	1151	1	0	1	36	107	134	320	332	187	33	5	3	4	0	0	7	2	3	5	4
9	Netherlands	1123	0	0	4	15	67	124	287	317	218	91	9	8	6	4	7	16	7	8	7	19
10	Switzerland	1066	1	0	1	28	57	119	287	257	186	137	10	12	14	9	19	28	8	13	7	17
11	Australia	883	0	0	1	24	44	52	177	242	244	99	9	5	10	16	10	10	13	2	10	14
12	Israel	851	0	1	1	6	51	104	206	220	225	37	5	3	5	2	1	3	3	5	5	5
13	Spain	602	0	0	0	2	1	3	77	221	221	77	6	11	9	8	10	10	7	5	10	1
14	Belgium	568	1	0	1	7	21	62	124	206	101	42	2	7	4	4	3	8	4	0	5	5
15	China	530	0	0	1	0	0	2	91	125	120	191	12	41	32	29	11	13	23	18	4	8
16	Denmark	486	0	0	2	16	42	49	81	156	94	46	5	6	2	5	2	3	3	7	4	9
17	Austria	379	0	0	0	2	15	22	106	94	94	46	3	13	7	4	3	4	2	5	2	3
18	South Korea	335	0	0	0	0	0	1	12	111	187	24	3	1	2	2	1	5	2	5	3	0
19	Finland	327	0	0	1	2	17	30	97	92	61	27	2	8	3	1	0	6	2	0	3	2
20	Greece	326	0	0	0	0	2	18	43	110	144	9	0	1	2	2	2	1	0	0	0	1
21	Russia	303	0	0	0	0	0	4	27	151	110	15	1	2	1	1	0	3	1	2	0	4
22	Brazil	297	0	0	5	7	10	9	20	91	109	46	4	10	6	4	3	6	0	3	5	5
23	Hungary	268	0	0	0	4	8	14	49	100	88	5	0	0	1	0	0	0	2	0	2	0
24	India	247	0	0	0	5	13	8	42	77	46	56	3	6	8	7	7	10	2	3	0	10
25	Mexico	241	0	0	0	13	8	17	37	62	86	18	0	2	4	0	5	2	2	0	1	0
26	Poland	231	0	0	0	1	15	23	18	97	52	13	0	4	1	0	2	2	3	0	3	0
27	Argentina	220	0	0	5	7	6	7	18	93	64	20	4	4	5	0	2	1	1	0	2	0
28	Norway	215	0	0	1	5	18	24	41	85	23	18	1	5	2	0	1	2	2	2	1	4
29	South Africa	205	0	0	0	11	14	6	26	57	55	36	2	6	4	3	5	5	2	2	0	7
30	Portugal	178	0	0	0	3	5	7	18	50	75	20	3	7	2	0	2	0	2	2	0	2

Note: D1 = TP 1934–1943; D2 = TP 1944–1953; D3 = TP 1954–1963; D4 = TP 1964–1973; D5 = TP 1974–1983; D6 = TP 1984–1993; D7 = TP 1994–2003; D8 = TP 2004–2013; D9 = TP 2014–2023. "DL" is the number of papers (TP) between 1824 and 1933 (with known affiliation).

citation threshold of 1000 and 200 links. Each node represents a journal, with its size relative to the number of citations it receives. The connections between journals are represented by lines, where a thicker line indicates a higher frequency of joint citations. Moreover, the proximity of the two nodes signifies a stronger connection between the journals. Each color denotes a different cluster.

The *Journal of Biological Chemistry* is the most cited, followed by *Nature*, *the Proceedings of the National Academy of Sciences*, and *Science*. Four main clusters are visible in Figure 4: blue, red, green, and yellow. The blue cluster contains some of the most highly cited journals, including the *Journal of Biological Chemistry*, the *Proceedings of the National Academy of Sciences*, *Science*, and the ANYAS. This cluster includes multidisciplinary journals and topics connected to biology and chemistry. The red cluster focuses on neurosciences and includes journals such as *Brain Research* and the *Journal of Neuroscience*. The *Journal of Clinical Investigation*, the *New England Journal of Medicine*, and *The Lancet* primarily influence the green cluster that considers journals mostly in medicine. Finally, the yellow cluster also highlights journals in medicine but more oriented to immunology like the *Journal of Immunology* and *Journal of Experimental Medicine*.

To obtain a more detailed perspective on the citations and their progression over time, Table 9 showcases the 30 most referenced journals in the ANYAS from 1945 to 2023 and for the intervals 2014–2023, 2004–2013, 1994–2003, and 1974–1993. The *Journal of Biological Chemistry* is significantly the most referenced, followed

TABLE 9 | Most cited journals in Annals of the New York Academy of Sciences (ANYAS): global and temporal analysis.

	Global (1945–2023)		2014–2023		2004–2013		1994–2003		1974–1993	
R	**Journal**	**Cit**	**Journal**	**Cit**	**Journal**	**Cit**	**Journal**	**Cit**	**Journal**	**Cit**
1	J Biol Chem	40,372	P Natl Acad Sci USA	3895	P Natl Acad Sci USA	9525	J Biol Chem	11,301	J Biol Chem	12,895
2	Nature	37,940	Nature	3203	Nature	7826	P Natl Acad Sci USA	11,094	Nature	12,272
3	P Natl Acad Sci USA	36,896	PLOS One	2732	Science	7662	Nature	8881	Science	10,402
4	Science	34,584	Science	2722	J Biol Chem	7335	Science	8796	P Natl Acad Sci USA	9939
5	Ann NY Acad Sci	21,483	Ann NY Acad Sci	1919	J Neurosci	5178	Brain Res	5130	Brain Res	6595
6	J Immunol	17,576	J Neurosci	1827	Ann NY Acad Sci	4590	J Immunol	4490	Ann NY Acad Sci	5756
7	Brain Res	14,439	J Biol Chem	1499	J Immunol	4507	Cell	4451	J Immunol	5519
8	J Exp Med	14,376	Cell	1292	New Engl J Med	3438	J Neurosci	4096	Biochim Biophys Acta	4452
9	J Clin Invest	13,846	Lancet	1286	Cell	3259	Ann NY Acad Sci	4059	J Cell Biol	4392
10	New Engl J Med	13,434	New Engl J Med	1256	Blood	3258	J Clin Invest	3410	Astrophys J	4348
11	J Neurosci	12,917	Blood	1153	J Clin Invest	2958	New Engl J Med	3202	J Exp Med	4246
12	Lancet	12,671	Neuroimage	1090	J Clin Endocr Metab	2624	J Exp Med	3140	P Natl Acad Sci-Biol	4145
13	Cell	12,543	Neuron	953	J Exp Med	2566	Cancer Res	2999	New Engl J Med	4096
14	Endocrinology	10,747	Sci Rep-UK	869	Lancet	2324	Endocrinology	2965	J Clin Invest	3960
15	Blood	10,684	Am J Clin Nutr	867	Endocrinology	2297	Lancet	2875	Lancet	3815
16	Cancer Res	10,580	J Clin Invest	836	Brain Res	2178	Blood	2739	Endocrinology	3606
17	Am J Physiol	9435	Antimicrob Agents Ch	831	Cancer Res	2134	Am J Physiol	2721	Biochemistry-US	3582

(Continues)

TABLE 9 | (Continued)

R	Global (1945–2023)		2014–2023		2004–2013		1994–2003		1974–1993	
	Journal	**Cit**	**Journal**	**Cit**	**Journal**	**Cit**	**Journal**	**Cit**	**Journal**	**Cit**
18	Biochem Bioph Res Co	8772	Nat Neurosci	809	Circulation	2000	J Neurochem	2503	Cell	3515
19	Biochim Biophys Acta	8592	Gastroenterology	807	Neuron	1981	Bioch Bioph Res Co	2494	Bioch Bioph Res Co	3417
20	J Physiol-London	8538	J Immunol	801	Neurology	1951	J Clin Endocr Metab	2375	J Physiol-London	3417
21	J Cell Biol	8411	J Nutr	788	J Neurophysiol	1793	J Neurophysiol	2187	Am J Physiol	3035
22	Biochem J	7803	Nat Commun	720	J Comp Neurol	1700	J Comp Neurol	1957	Cancer Res	2866
23	J Clin Endocr Metab	7518	Front Psychol	639	Nat Genet	1681	Neuron	1915	Biochem J	2810
24	P Soc Exp Biol Med	7463	Diabetes	620	Bioch Bioph Res Co	1619	Febs Lett	1901	Blood	2381
25	Biochemistry-US	7280	Trends Cogn Sci	616	Diabetes	1600	J Cell Biol	1897	J Neurochem	2329
26	J Pharmacol Exp Ther	6844	Neurology	609	Nat Med	1532	Neurology	1842	Life Sci	2238
27	J Neurochem	6712	J Exp Med	600	J Neurochem	1460	Neuroscience	1827	J Pharmacol Exp Ther	2228
28	Circulation	6421	Cereb Cortex	590	Nat Neurosci	1376	Biochemistry-US	1779	Eur J Pharmacol	2186
29	J Am Chem Soc	6302	Nat Med	565	Biol Psychiat	1367	Neurosci Lett	1760	Febs Lett	2122
30	Astrophys J	6286	J Clin Endocr Metab	560	Neuroimage	1347	Circulation	1731	Phys Lett B	1852

Abbreviations: Cit, citations; R, rank.

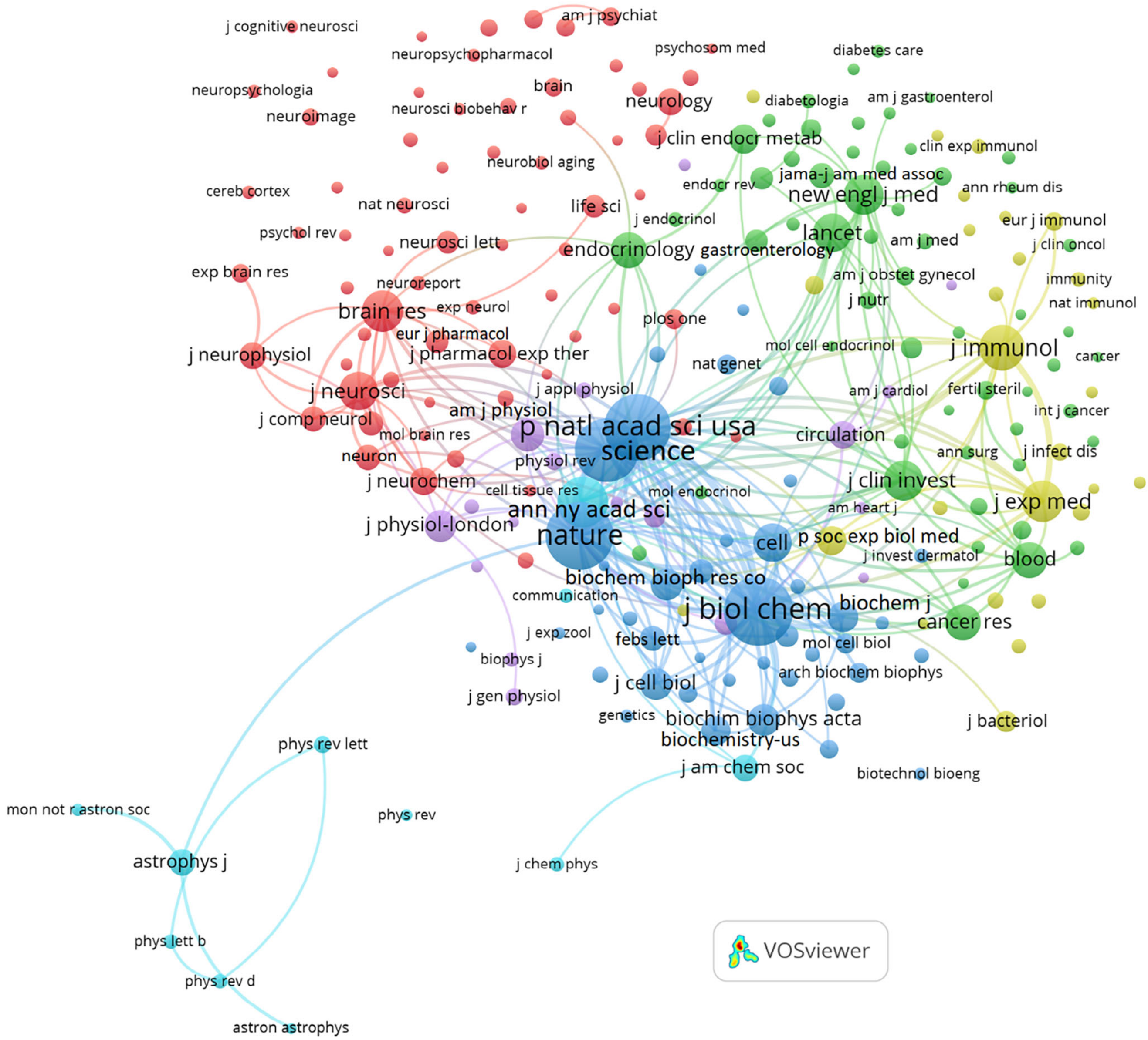

FIGURE 4 | Co-citation of journals: minimum citation threshold of 1000 and 200 links.

by *Nature*, the *Proceedings of the National Academy of Sciences*, and *Science*, which rank in the second, third, and fourth spots, respectively. The ANYAS ranks fifth. Most of these journals are in the multidisciplinary sciences category, and several are linked to significant sub-areas such as biochemistry, molecular biology, chemistry, and biomedicine. The results also reveal that the *Journal of Biological Chemistry* led this ranking in two periods (1994–2023 and 1974–1993), whereas the *Proceedings of the National Academy of Sciences of the USA* led this ranking in the most recent periods (2004–2013 and 2014–2023).

An intriguing aspect is the co-citation network of documents referenced in the ANYAS, represented in Figure 5 (refer to Table 4). This visualization is created by applying a minimum citation threshold of 30 and 200 links. The references illustrated on the map are categorized into 13 groups. For instance, documents in the brown group concentrate on biochemistry, whereas documents in the purple group pertain to biochemistry and molecular biology. It is important to note that many of these references are foundational articles.

Figure 6 illustrates the co-citation network of authors cited in the ANYAS. The findings are derived from a minimum citation threshold of 100 and 200 links. In descending order, the journal's three authors with the highest citation counts are Oliver Howe Lowry, Ulrich K. Laemmli, and Marion Mckinley Bradford. Lowry, an influential American biochemist, is best known for developing the Lowry protein assay, which appears as the most cited scientific work ever published, according to the WoS and Scopus databases.

Laemmli is a professor in the biochemistry and molecular biology departments at the University of Geneva and is recognized for advancing SDS–PAGE, a widely used technique for separating proteins based on their electrophoretic mobility. Bradford, also an American scientist, invented and patented the

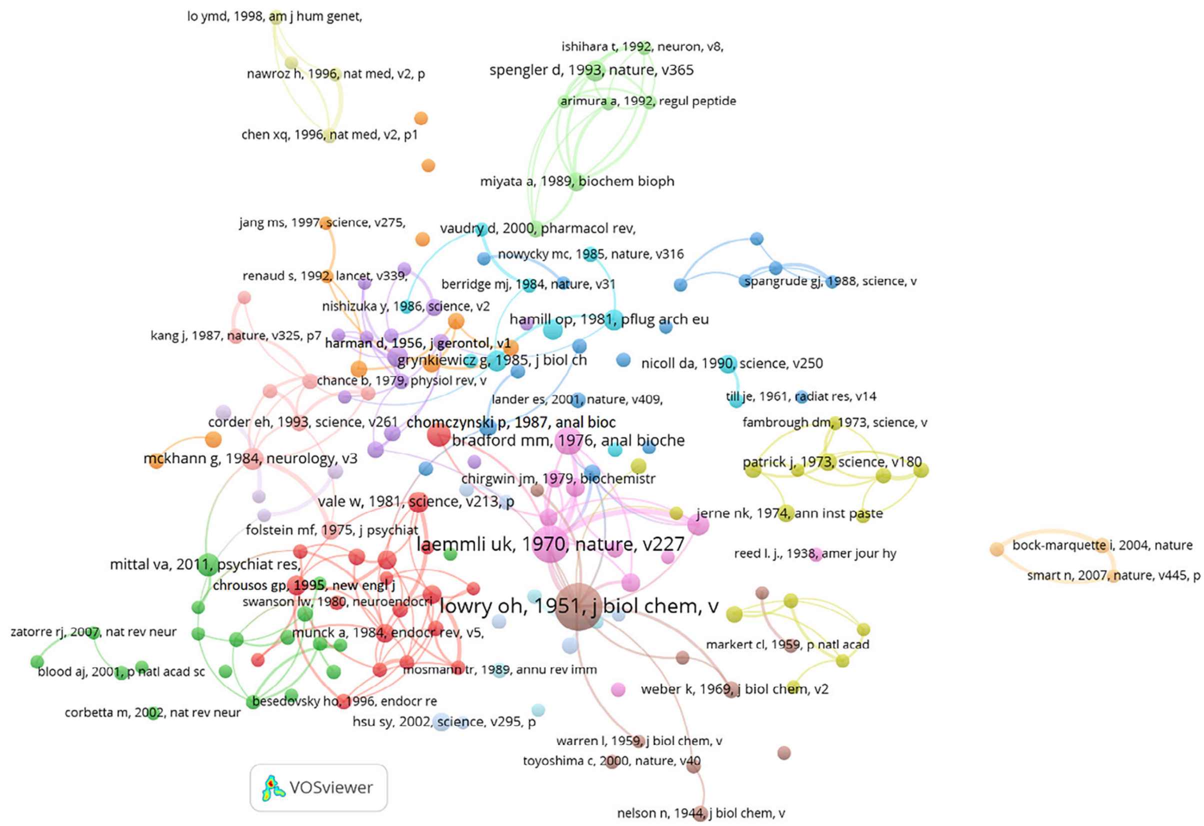

FIGURE 5 | Co-citation of documents in ANYAS: minimum citation threshold of 30 and 200 links.

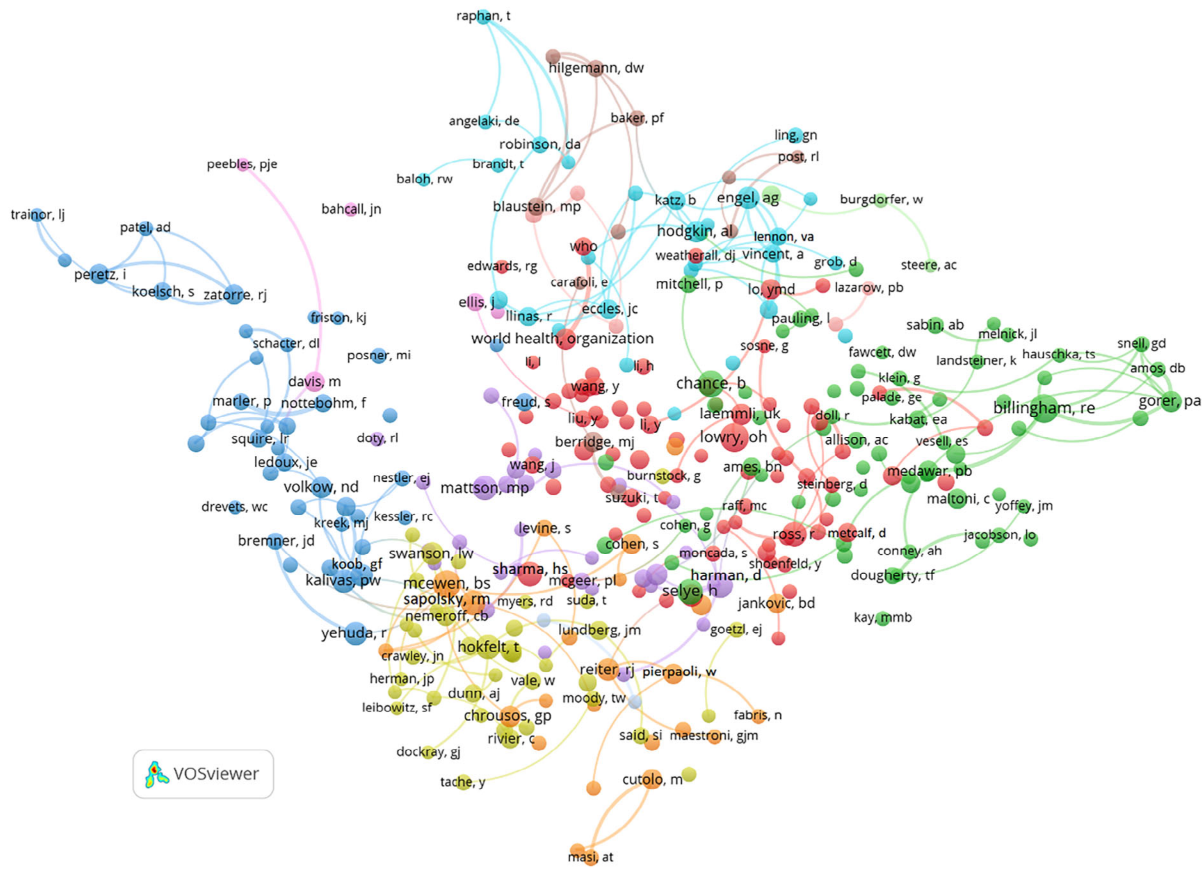

FIGURE 6 | Co-citation of authors in ANYAS: minimum citation threshold of 100 and 200 links.

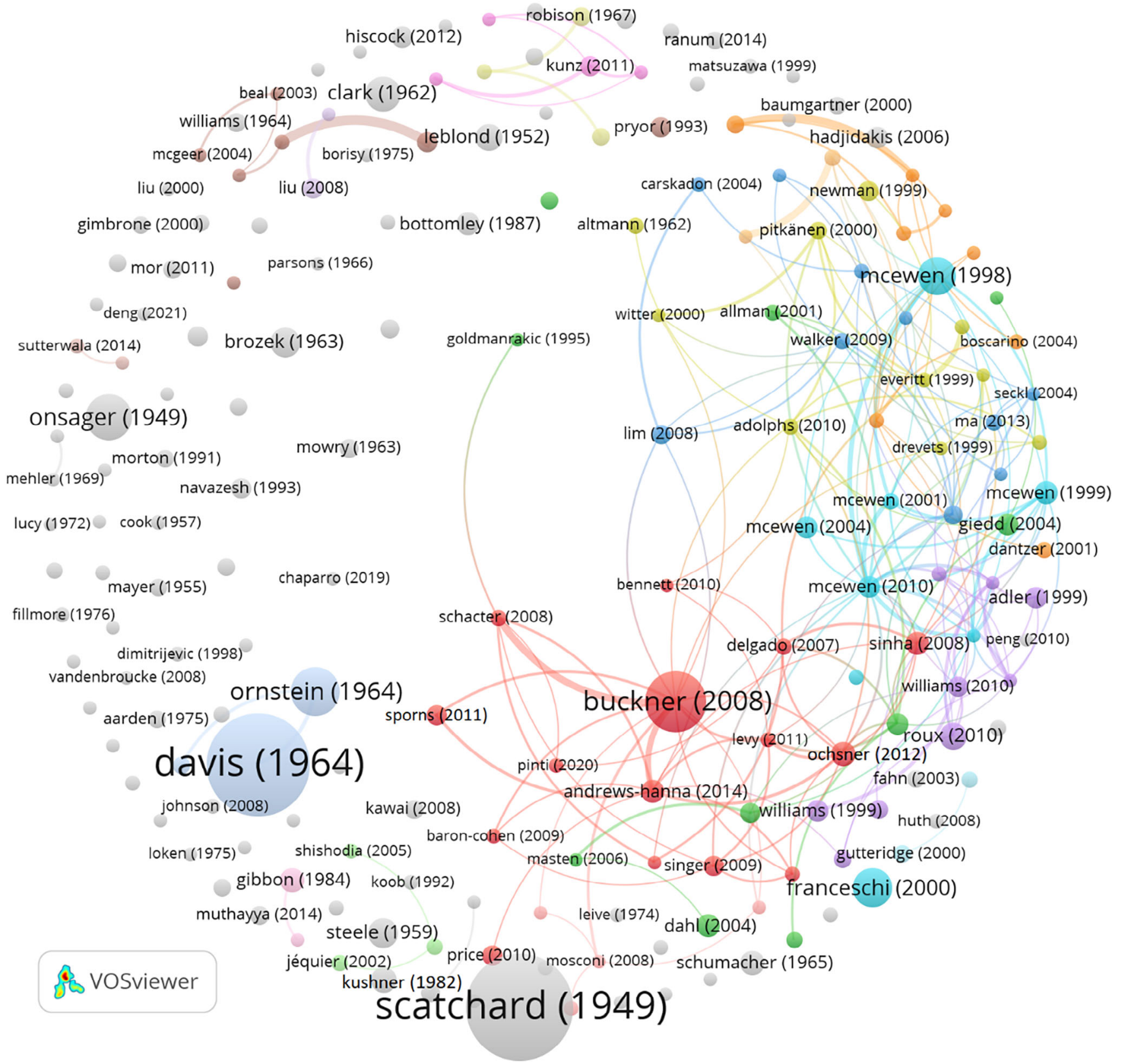

FIGURE 7 | Bibliographic coupling of documents published in ANYAS: minimum threshold of 400 citations and 200 links.

Bradford protein assay, a method employed for quickly determining the protein content in a sample. His publication detailing this technique ranks among history's most cited scholarly articles.

4.2 | Bibliographic Coupling of ANYAS

Let us now explore the bibliographic coupling of documents [2]. Unlike co-citation, bibliographic coupling occurs when two documents published in the ANYAS cite a shared third document.

Figure 7 displays the visualization of the bibliographic coupling among documents published in the ANYAS. The findings are derived from a minimum threshold of 400 citations and 200 links. Note that in this instance, the colors represent the publication year, whereas the size of the circles indicates the total number of citations each document has received. Please be aware that this illustration visually represents the information in Table 3. Consequently, the documents that are most frequently cited in Table 3 are also depicted here as the most cited works, such as Scatchard [51], Davis [52], and Buckner et al. [47].

Figure 8 presents the author's bibliographic coupling. It is essential to observe that in the overlay visualizations depicted in Figures 8–10, the dimensions of a node indicate the number of published documents instead of the number of citations.

Figure 8 illustrates the findings from Table 5, categorizing each author based on their bibliographic coupling profile. The colors of the clusters represent the average publication year in the ANYAS. Authors marked in dark and light blue generally published in the

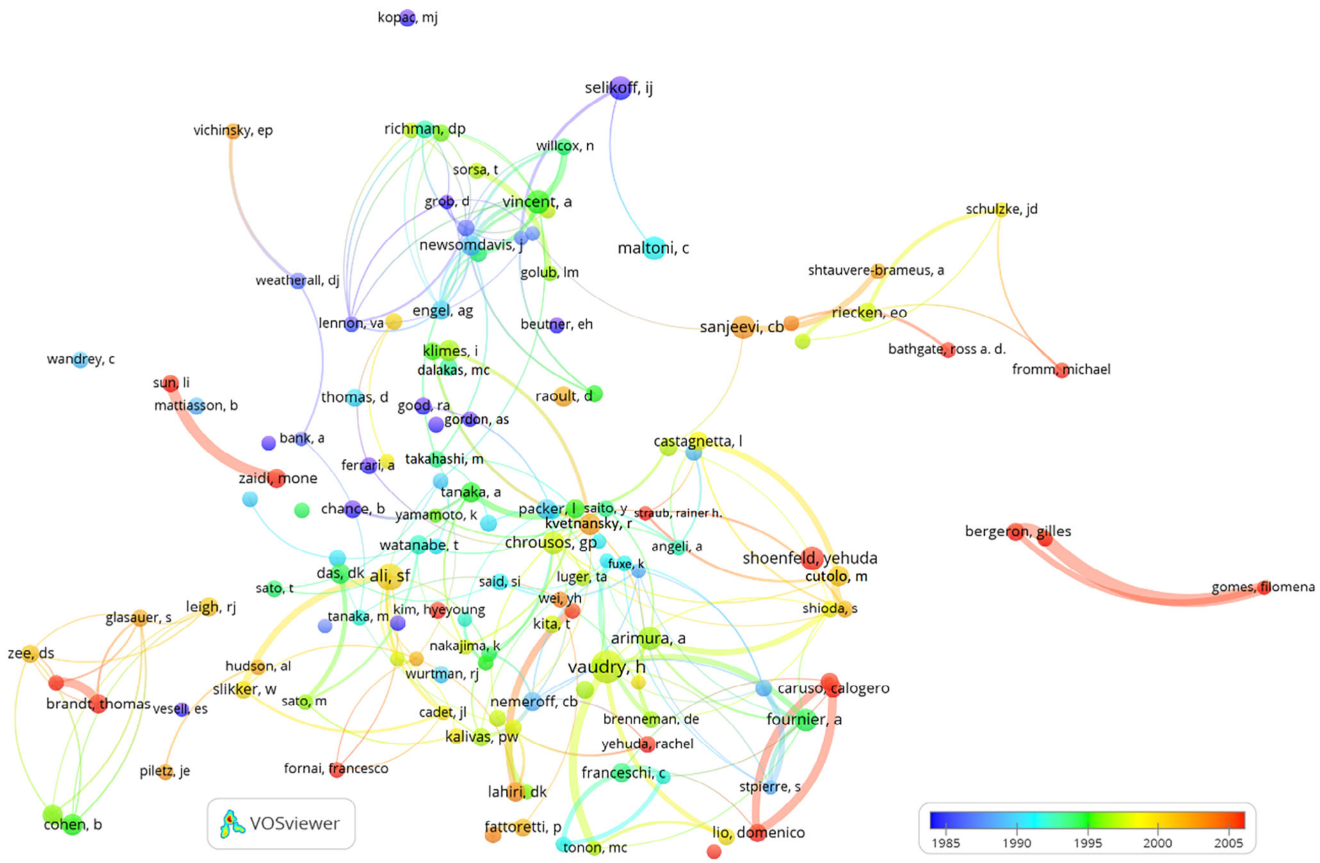

FIGURE 8 | Bibliographic coupling of authors publishing in ANYAS: minimum threshold of 15 documents and 200 links.

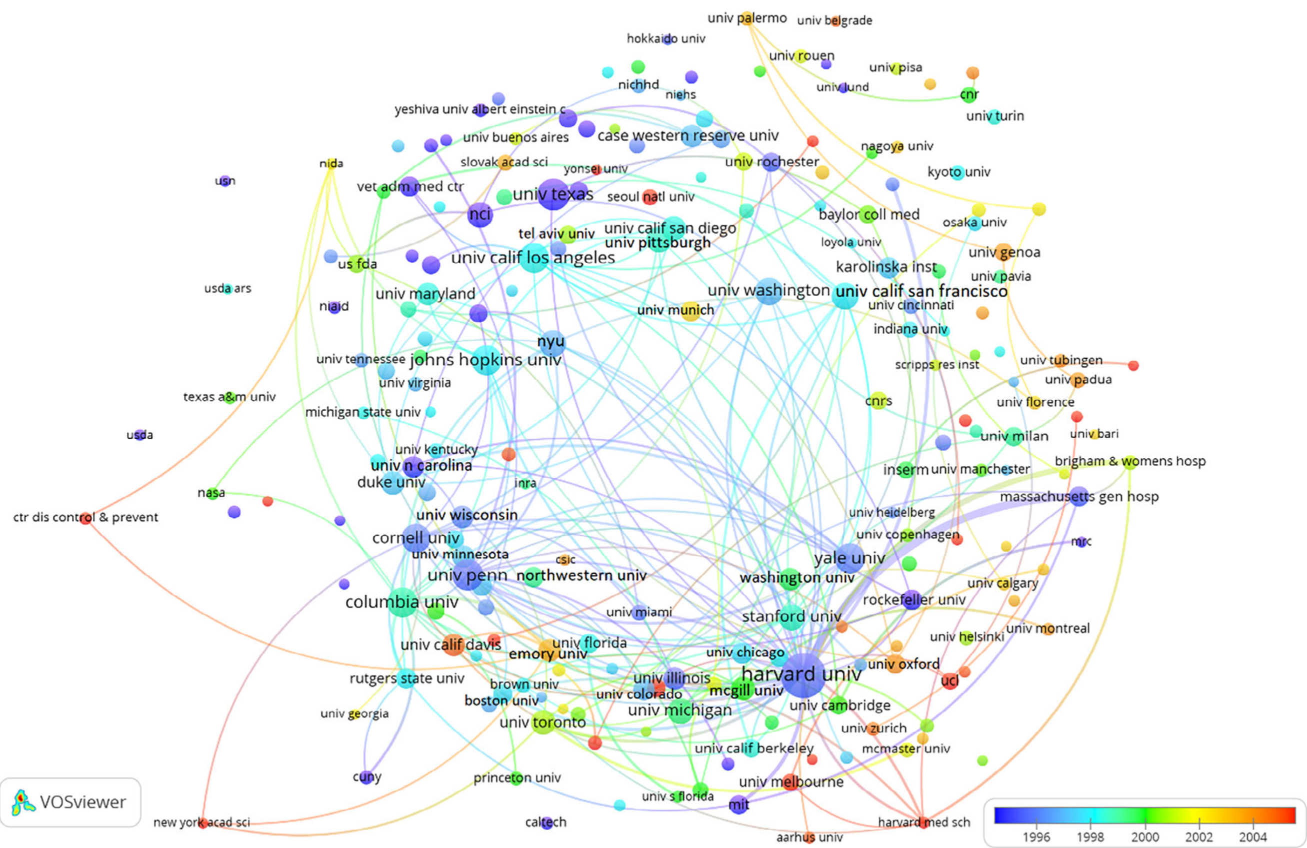

FIGURE 9 | Bibliographic coupling of institutions publishing in ANYAS: minimum publication threshold of 50 documents and 200 links.

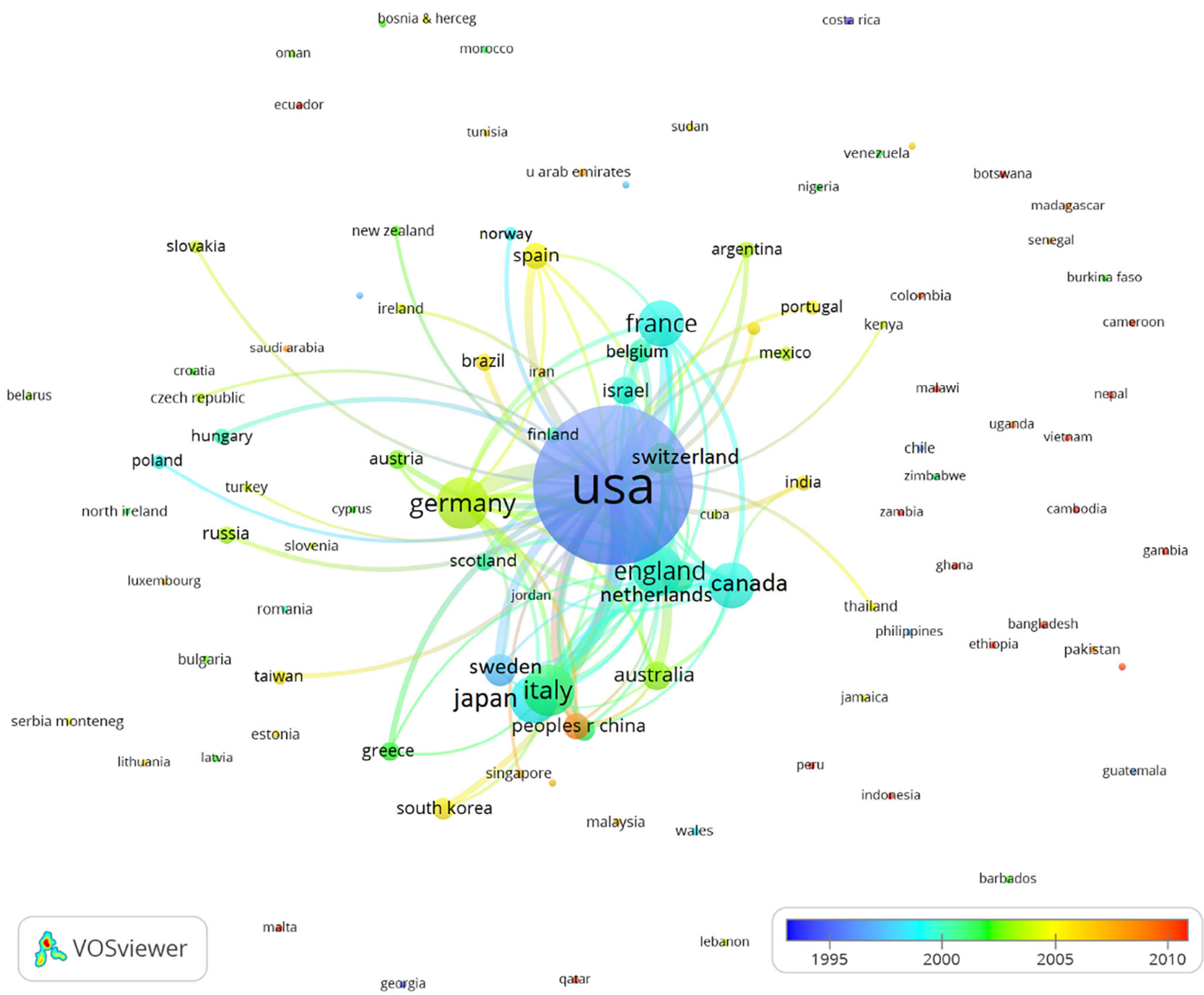

FIGURE 10 | Bibliographic coupling of countries publishing in ANYAS: minimum publication threshold of 5 documents and 100 links.

journal primarily during the eighties and nineties. Conversely, the authors identified in orange and red are typically younger contributors who have primarily published in the last two decades.

Figure 9 illustrates the bibliographic coupling of the leading institutions in the ANYAS. Only those institutions with fifty or more publications are included in this analysis. It is important to note that this figure corresponds with the findings of Table 6. Typically, the most robust connections are seen among institutions within the same nation. For instance, a thick line links Harvard University and Massachusetts General Hospital, indicating a close partnership. It is important to note that this map is heavily influenced by co-authorship, as studies with multiple authors demonstrate that the bibliographic coupling of those authors is identical for those specific documents.

Figure 10 illustrates the bibliographic coupling relationships among countries. In this instance, the figure implements a minimum requirement of five documents for inclusion in the map. The visualization shows that the USA and England have the most significant nodes, highlighting them as the most productive countries, mainly between 1984 and 1993. In addition, Germany is increasing its productivity in the journal, mainly due to the substantial growth observed between 1994 and 2003. It is worth noting that these findings align with the data presented in Tables 7 and 8.

4.3 | Keyword and Topical Analysis

Co-occurrence is when two or more keywords are found within the document. The co-occurrence of keywords is an important method that helps understand a journal's conceptual framework and trends [4, 55].

The co-occurrence network of author keywords presented in Figure 11 illustrates the interconnections among various terms used in the journal, utilizing a minimum occurrence threshold of 30 and 100 links. Within this network, each keyword is represented by a node, with the node's size indicating the frequency of that keyword's appearance—the larger the node, the more frequently the keyword is cited. The primary relationships

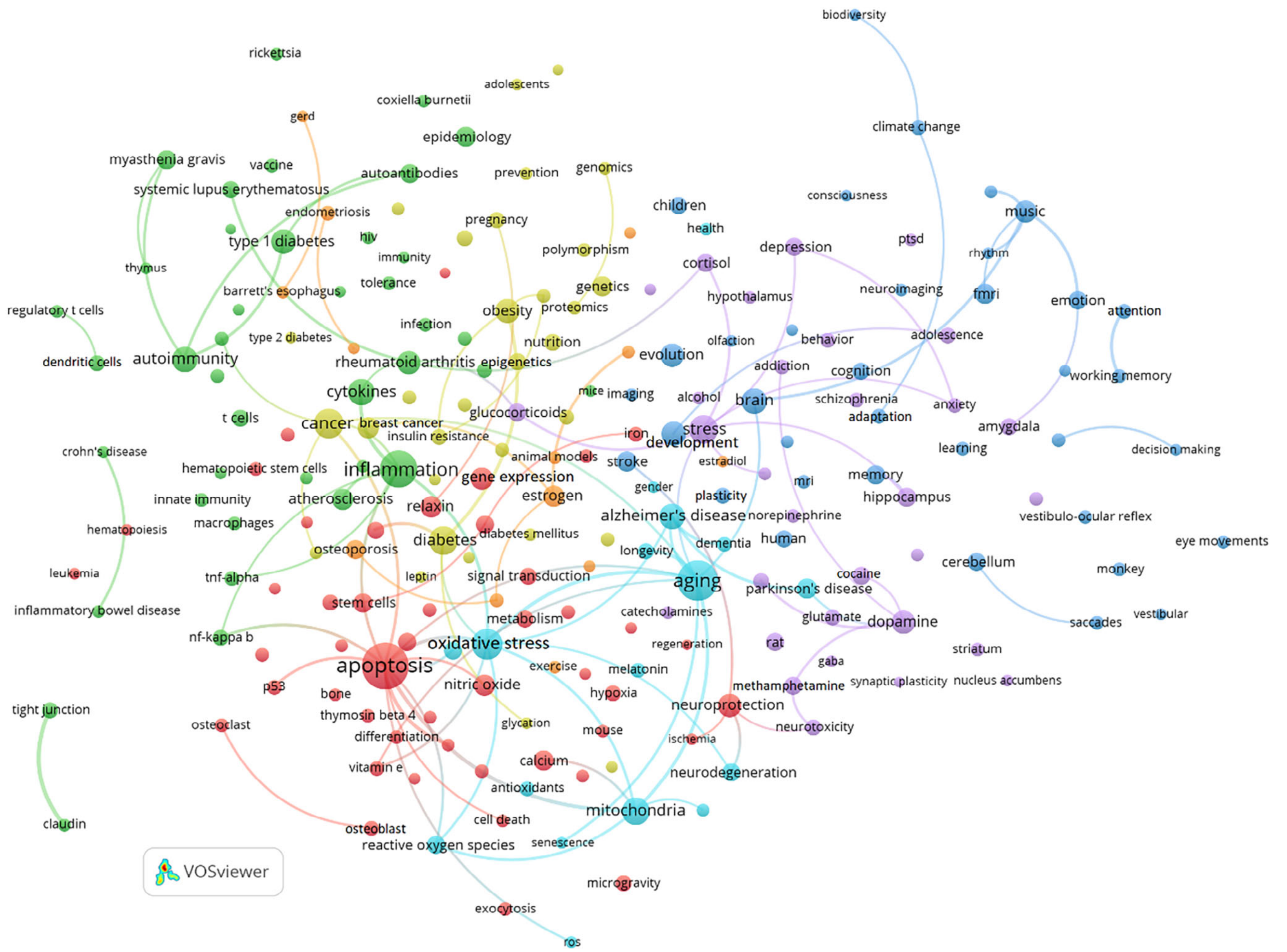

FIGURE 11 | Co-occurrence of author keywords in ANYAS: minimum occurrence threshold of 30 and 100 links.

among the keywords are represented by connecting lines, visually indicating which terms frequently appear together in the literature. Notably, the keyword "apoptosis" stands out as the most frequently occurring term in the network, with "inflammation" and "aging" closely trailing behind. This visualization effectively underscores the prevalent themes within the research, revealing critical areas of focus and interrelated concepts in the field.

Figure 12 provides a detailed visual representation of the co-occurrence of author keywords in the journal ANYAS between 2004 and 2013. This analysis employs a minimum occurrence threshold of 5 and 200 links. In this diagram, each node corresponds to a specific keyword, with the node's size reflecting its frequency of occurrence—larger nodes indicate a higher number of mentions. The connections between the nodes represent the co-occurrence relationships among the keywords. Notably, the keyword "inflammation" emerges as the most frequently occurring term, followed closely by "nutrition" and "obesity," emphasizing the critical topics of investigation during this timeframe.

Figure 13 provides a detailed visualization of the co-occurrence of author keywords within the ANYAS journal from 2014 to 2023. This analysis is based on a minimum occurrence threshold of 20 and 200 links. In this diagram, each node symbolizes a specific keyword, with the node's size reflecting its frequency of occurrence—larger nodes represent keywords that appear more frequently in the literature. The connections between these nodes are illustrated by lines, highlighting the central relationships among the keywords. Notably, the keyword "aging" stands out with the highest frequency of occurrences, followed closely by "apoptosis" and "inflammation," indicating their prominence in the research conducted during this period.

To conclude the keyword analysis, we will provide a comprehensive table displaying the 30 most frequently used Keywords Plus (of WoS) in ANYAS from 1994 to 2023 while also considering their progression over the past three decades: 1994–2003, 2004–2013, and 2014–2023. The results can be found in Table 10. Among the most frequently occurring keywords, "Expression" stands out as the top-ranked term, closely followed by "cells," "activation," and "brain." Additionally, the table reveals a significant presence of keywords associated with "mice" and "genes," underscoring their relevance in the research published throughout these years.

5 | Conclusions and Discussions

This section summarizes the main results and findings of the article. First, it focuses on a general discussion of the main conclusions. Second, it briefly provides some practical impli-

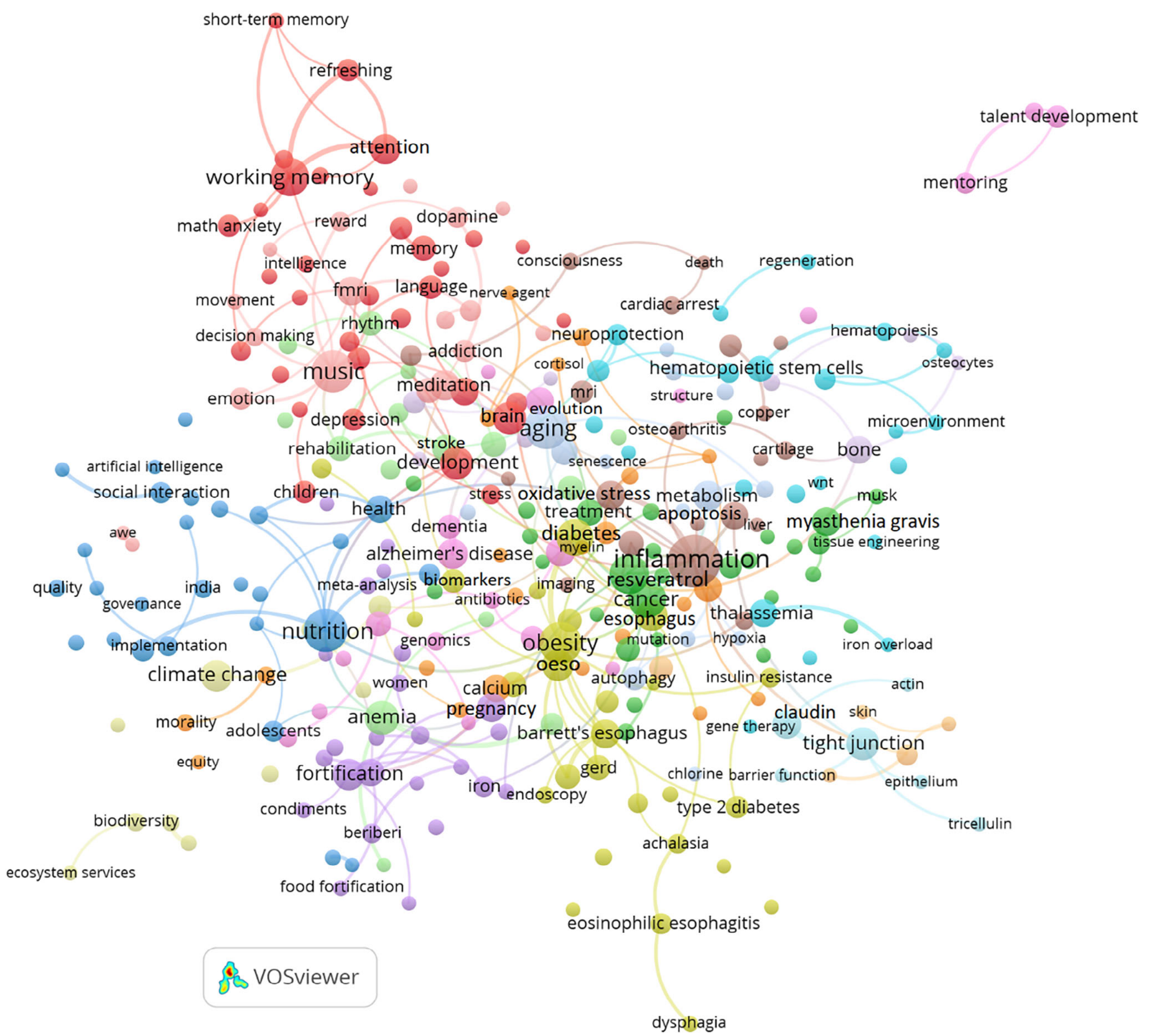

FIGURE 12 | Co-occurrence of author keywords in ANYAS (2004–2013): minimum occurrence threshold of 5 and 200 links.

cations. Third, the section concludes by summarizing some key limitations and providing some open questions for future research.

5.1 | General Discussion

In 2024, the ANYAS marks the significant milestone of its 200th anniversary. A bibliometric analysis of ANYAS from 1824 to 2023 was conducted to commemorate this achievement. This study thoroughly examines ANYAS publications, revealing key trends and offering readers a contemporary overview of its publication and citation patterns. It highlights the most prolific authors, institutions, and countries, as well as frequently used keywords and reference articles associated with the journal. Additionally, the analysis incorporates various research metrics from Scopus, SciVal, and WoS to deliver a more comprehensive evaluation of the journal.

The results indicate that ANYAS has demonstrated considerable progress over time. In 2023, the journal achieved a total of 65,288 articles, accumulating 1,609,069 citations. The findings indicated that the most cited articles are mainly focused on chemistry, hematology, and psychology, with notable works by George Scatchard [51] with 18,473 citations, followed by the article by Baruch J. Davis [52] with 16,125 citations and by Buckner et al. [47] with 7814 citations. Lowry's work [53] holds the record for most citations in ANYAS, with 378 citations, followed by Laemmli [54] with 229 citations. Hubert Vaudry is the most productive author in ANYAS, followed by Syed Ali, Yehuda Shoenfeld, and Didier Raoult.

ANYAS is a distinguished multidisciplinary journal that publishes research in all areas of science. Numerous researchers from different nations aim to publish their work on it, particularly those from France, the USA, and Israel. Other findings indicate that the USA is the top country regarding overall publications and

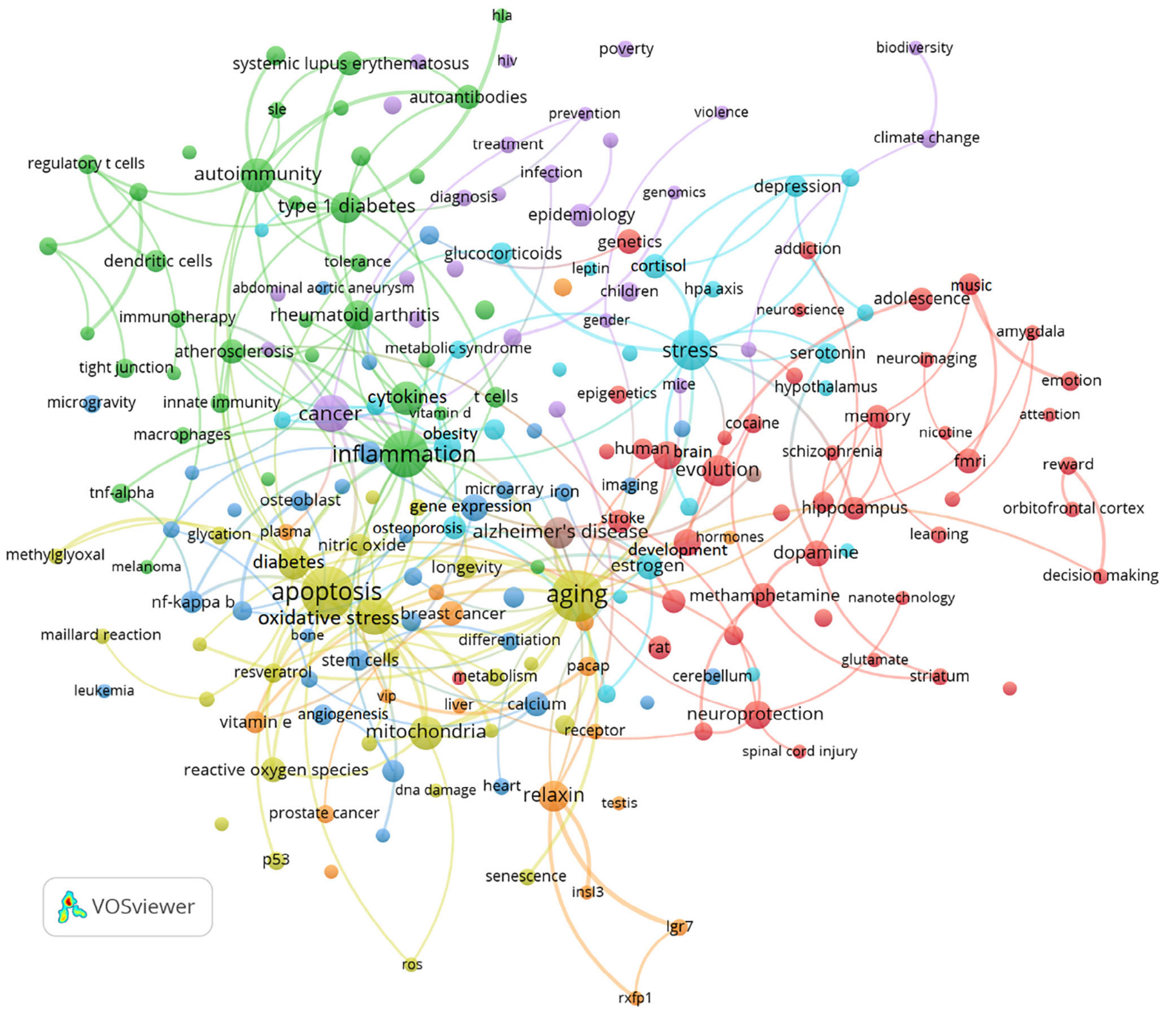

FIGURE 13 | Co-occurrence of author keywords in ANYAS (2014–2023): minimum occurrence threshold of 20 and 200 links.

total citations, with the UK and Germany following. However, when considering the population size of each country, Switzerland emerges as having the highest number of citations per capita.

Acknowledging that the USA houses approximately 85% of the most influential institutions that significantly contribute to ANYAS publications is essential. This statistic underscores these institutions' central role in shaping academic discourse and advancing research across various fields in the USA. Harvard University is the leading institution in the journal, followed by the NIH and Columbia University.

The study employs VOSviewer to create bibliometric maps focused on co-citation, bibliometric coupling, and keyword co-occurrence to analyze the bibliometric findings thoroughly. The primary benefit of this methodology is that it allows for identifying connections among various journal variables. The author's keyword co-occurrence method is utilized to gain insights into the thematic structure and trends within the journal. The analysis of keywords indicates that researchers contributing to the ANYAS often focus on topics concerning apoptosis. Moreover, this keyword exhibits a significant co-occurrence connection with inflammation and aging, suggesting that these topics are frequently examined together.

In recent decades, the landscape of academic research has witnessed a remarkable surge in the publication of studies spanning a wide array of disciplines. Although impressive, this burgeoning output often needs more coherence and organization, underscoring the pressing need for improved information integration across various fields. Such effective integration is crucial, as it provides researchers, educators, and policymakers with the tools they need to conduct thorough and insightful data analyses. A bibliometric overview becomes indispensable to navigate and comprehend the complex intellectual structure and evolving frontiers of these diverse research domains. Many scholars concur that this method is particularly well suited for analyzing the vast body of literature, as it facilitates a deeper understanding of academic trends and connections.

TABLE 10 | Frequency of Keywords Plus (Web of Science [WoS]) in Annals of the New York Academy of Sciences (ANYAS): global and temporal analysis.

	Global		2014–2023		2004–2013		1994–2003	
R	Keyword	TP	Keyword	TP	Keyword	TP	Keyword	TP
1	Expression	1951	Expression	118	Expression	749	Expression	879
2	Cells	1155	Children	67	Cells	382	Cells	533
3	Rat	948	Gene-Expression	65	Activation	342	Rat	493
4	Activation	770	Activation	63	Mice	267	Brain	323
5	Brain	765	Brain	59	Gene-Expression	239	Activation	311
6	Mice	650	Mechanisms	57	Disease	238	Mice	287
7	Gene	589	Oxidative Stress	56	In-Vitro	237	Gene	286
8	Identification	572	In Vitro	54	Brain	230	Protein	283
9	Protein	566	Perception	54	Identification	228	Messenger-RNA	258
10	Disease	554	Model	53	Rat	218	Rat-Brain	233
11	Gene-Expression	554	Disease	51	In Vivo	212	Identification	220
12	Inhibition	484	Risk	50	Oxidative Stress	185	Gene-Expression	217
13	Messenger-RNA	475	Health	49	Gene	184	Neurons	206
14	In-Vitro	462	Inhibition	42	Apoptosis	183	Receptor	206
15	Receptor	450	Cells	41	Protein	181	Disease	205
16	Neurons	432	Individual-Differences	41	Inhibition	170	Inhibition	201
17	In Vivo	423	Responses	41	Receptor	159	Binding	198
18	Rat-Brain	420	Double-Blind	40	Mechanisms	149	Alzheimers-Disease	181
19	Growth	400	Growth	40	Responses	148	In Vivo	173
20	Binding	398	Attention	39	Differentiation	147	In-Vitro	171
21	Responses	375	Risk-Factors	39	Risk	144	Growth	170
22	Alzheimers-Disease	356	Evolution	38	Growth	133	Tumor-Necrosis-Factor	156
23	Differentiation	345	Quality-of-Life	38	Induction	129	Release	155
24	Oxidative Stress	337	Therapy	38	Model	128	Responses	155
25	Mechanisms	330	In Vivo	37	Neurons	126	Cloning	154
26	Model	327	Women	37	Cancer	124	Receptors	153
27	Apoptosis	326	Identification	36	Children	121	Secretion	145
28	Induction	325	Information	36	Proteins	120	Induction	142
29	Risk	321	Speech	36	T-Cells	114	Molecular-Cloning	139
30	Children	316	Prevalence	35	Association	113	Central-Nervous-System	128

Note: Keyword Plus is used in ANYAS (not all studies) since 1989.
Abbreviations: R, rank; TP, total papers.

5.2 | Practical Implications

This research significantly broadened the existing knowledge base by synthesizing two centuries of scholarly contributions in ANYAS. This article enabled the identification of a comprehensive intellectual framework and offered valuable insights into the contemporary research landscape of this journal. Additionally, the investigation highlighted the most interconnected terms within the field, which can serve as a valuable resource for researchers, educators, and policymakers as they navigate their decision-making processes and management strategies.

Finally, this article presented a bibliometric review methodology accessible to other researchers, providing them with a structured approach to conducting similar analyses in the future. Note that this approach is very useful to any reader that wants to get a quick overview of the leading trends of the journal, but it is also very useful for PhD students and newcomers in the field as a starting point to identify the general publication and citation characteristics of ANYAS without the need to develop deep bibliographic searchers.

5.3 | Limitations and Future Research

This study presents an overview of the current state of research in the ANYAS up to 2023. Nevertheless, it is essential to highlight certain limitations. First, future results may vary on the basis of the journal's ongoing progress, which could encompass new emerging trends and other unforeseen events. For instance, the evident growth of developing countries raises an intriguing question about the extent of their impact on the ANYAS.

Second, this analysis relies on the Scopus and WoS databases, meaning that any limitations of these databases are also relevant to this work. A notable example is that WoS employs full counting instead of fractional counting. Although this method encourages collaboration among researchers, as each co-author earns full credit for each published document, it also has the drawback of placing greater emphasis on documents with multiple co-authors over those authored by a single researcher. To partly address this limitation, this study incorporates fractional counting in the graphical analysis using VOSviewer. However, note that fractional counting also has limitations because usually the contribution of each co-author is not equal. Another limitation from these databases, and very common for old information, is that in some articles the author affiliation address and country information are missing, and even the author's name in some cases [56–58]. Therefore, when this limitation appears, it is difficult to provide accurate results of the information.

Lastly, another constraint is that each research field or subfield possesses unique publication and citation characteristics. Thus, comparing publications from various subfields and periods [59] can be challenging, as certain areas may receive more citations due to specific factors that can misrepresent the findings in a bibliometric analysis. Regardless, conducting a comprehensive bibliometric overview enables the identification of predominant trends within the journal. However, it is crucial to conclude the article by noting that this method reveals some leading and popular trends, yet numerous outstanding cases demand a more in-depth examination for accurate evaluation, and often, the necessary tools must be at hand.

Author Contributions

Luciano Barcellos-Paula: data curation (equal), formal analysis (equal), investigation (equal), methodology (equal), software (equal), validation (equal), visualization (equal), writing – original draft (lead). **José M. Merigó**: conceptualization (lead), data curation (equal), formal analysis (equal), investigation (equal), methodology (equal), project administration (equal), software (equal), supervision (equal), validation (equal), visualization (equal), writing – original draft (supporting), writing – review and editing (equal). **Anna M. Gil-Lafuente**: project administration (equal), supervision (equal), validation (supporting), writing – review and editing (equal).

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Ethical Statement

The authors declare that the article follows the ethical responsibilities of the journal. The article does not include any research involving human participants and/or animals.

Conflicts of Interest

The authors declare no conflicts of interest.

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Data are available upon request.

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