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Mapping Resveratrol Research Across Diabetic Microvascular Complications: A Bibliometric Analysis of Research Intensity and Themes

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Abstract

Resveratrol has been studied in diabetic retinopathy (DR), diabetic nephropathy (DN), and diabetic peripheral neuropathy (DPN), but raw publication counts ignore the size of each field. This bibliometric review compared resveratrol research across the three complications. We searched the Scopus database from 2016 to 2025 for related literature in the English language. Research intensity was the number of resveratrol records divided by the baseline, defined as all records on the same complication. The rate ratio (RR) divided the intensity of one complication by that of another. The primary definition, used for the main analysis, required an exact disease phrase (phrase-based). Two sensitivity definitions followed: proximity, which accepted a diabetes term within three words of the complication term, and extended-compound, which added related stilbenes to resveratrol. We audited topical precision, the share of records in which resveratrol was a main subject, and mapped author keywords with VOSviewer. The searches retrieved 369 records, of which 182 were unique. Under the primary definition, intensity was 0.52% for DN, 0.27% for DR, and 0.31% for DPN (DN versus DR RR 1.89, 95% CI 1.37-2.61). The ratio fell to 1.33 under the proximity definition and to 0.98 in a preclinical-only baseline, and it reached 1.88 for curcumin and 3.89 for quercetin. China contributed half of the records; DPN records appeared only from 2020, and seven records were clinical studies. The higher intensity in DN reflects how each literature is composed, not interest in resveratrol. Single-agent comparisons across diseases need a comparator compound and a restricted baseline.

Categories: Ophthalmology, Nephrology, Endocrinology/Diabetes/Metabolism
Keywords: bibliometrics, diabetic nephropathies, diabetic neuropathies, diabetic retinopathy, resveratrol

Introduction And Background

Diabetes affected an estimated 10.5% of adults aged 20-79 years in 2021 [1]. Diabetic retinopathy (DR) was estimated in 22.27% of people with diabetes [2]. Painful neuropathy was present in a pooled 46.7% of people with diabetic peripheral neuropathy (DPN) [3]. In plain terms, DR is damage to the retina at the back of the eye, diabetic nephropathy (DN) is damage to the filtering units of the kidney, and DPN is damage to the peripheral nerves. DR, DN, and DPN all follow chronic hyperglycemia, and they share oxidative stress and inflammation as mechanisms [4]. Evidence for a candidate agent is therefore easiest to judge when the three complications are viewed together.

Resveratrol is a polyphenol with antioxidant and anti-inflammatory activity. It has been reviewed as a candidate in diabetes and its complications [4]. Preclinical evidence has been synthesized in DR [5,6] and DN [7], and a randomized trial reported lower albuminuria [8]. In neuropathy models, an anti-inflammatory effect through Nrf2 has been described [9]. Clinical translation is limited by very low oral bioavailability [10,11], and resveratrol is also discussed among pan-assay interference compounds [12]. A publication count is therefore not a count of validated effects.

Bibliometric studies have mapped resveratrol as a whole [13] or ranked natural products in diabetes research [14]. Others described single complications without centering on resveratrol [15-17]. A bibliometric analysis studies a research field by counting and mapping its publications rather than by pooling their results. It describes how much work exists, where it comes from, and which topics recur. A raw publication count, however, confounds interest in an agent with the size of the field that hosts it: a complication with a large number of studies can accumulate more resveratrol papers simply because it accumulates more papers of every kind. Dividing the agent-specific count by the size of the same complication's literature removes that effect and puts the three complications on one scale. We call this quantity research intensity. This bibliometric review asks three questions. First (RQ1), how large is resveratrol research in DR, DN, and DPN relative to the size of each complication's literature? We measure this as research intensity, the number of resveratrol records divided by all records on the same complication. Second (RQ2), how did output develop from 2016 to 2025, and which countries and sources contributed? Third (RQ3), which themes does author-keyword co-occurrence show, and which themes are shared by the complications or specific to one? We also tested whether the answer to RQ1 depends on the search definition, on topical precision, and on the

composition of the baseline.

Review

Methods

Design and Data Source

This review applies bibliometric methods to the Scopus literature on resveratrol in DR, DN, and DPN. The unit of analysis was the bibliographic record. We did not register a protocol. No reporting guideline covers bibliometric studies. This was a bibliometric review and hence Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 was not directly applicable; however, we nevertheless followed its principle of transparent record accounting, reporting every step from retrieval through deduplication and exclusion to the analysis set, with the counts at each stage. We also report the database, dates, search strings, cleaning steps, and analysis settings in full.

We searched Scopus (Elsevier) in the Advanced search interface on October 3, 2026 to build the analysis set. We chose Scopus because it offers field codes, proximity operators, and export of author keywords [18]. On October 4, 2026, we separately searched PubMed, Scopus, Web of Science, and Google Scholar for earlier bibliometric or scientometric studies on resveratrol in DR, DN, and DPN, and found none (Appendix A); we did not merge these databases into the analysis set. Coverage differs between bibliographic databases such as Scopus, Web of Science, and Dimensions, and favors English-language and biomedical journals [18,19]. Research intensity requires a numerator and a baseline counted under one indexing policy and one set of field codes, and merging databases with different coverage, document typing, and keyword fields would make the denominator incoherent. The cost of this choice is that records indexed elsewhere but not in Scopus are missed, which we quantify and discuss in the Limitations.

Search Strategy and Eligibility

Each search combined a resveratrol block with a disease block. The resveratrol block was TITLE, ABS, or AUTHKEY containing resveratrol* or trihydroxystilbene*. We used three definitions of the disease block. The primary definition (Tier 1, phrase-based) required fixed phrases for each complication, such as "diabetic retinopathy", "diabetic nephropathy", "diabetic kidney disease" and "diabetic peripheral neuropathy", together with their variants. The proximity definition required diabet* within three words of retinopath*, nephropath*, neuropath*, or related stems. The extended-compound definition (Tier 2) kept the Tier 1 disease phrases and widened the resveratrol block with pterostilbene*, polydatin*, piceid*, and piceatannol*. Every search was limited to publication years 2016 to 2025, articles and reviews, and English language. We excluded 2026 because the year was incomplete.

The baseline for each complication was the number of Scopus records that matched the same disease block and limits without the resveratrol block. It is the denominator of research intensity. We read the baseline counts from the results page and did not export them, so the baseline also contains the records that mention resveratrol. We exported the records retrieved by the Tier 1 and proximity definitions, merged them, and removed duplicates by Scopus Electronic Identifier (EID). We excluded one erratum that Scopus coded as an article. This erratum appeared in the Tier 1, proximity, and Tier 2 searches for DN, and we removed it from every DN count reported in this article. The Tier 2 definition served only as a count-based sensitivity analysis, so we did not merge its records into the analysis set. Appendix B gives the strings.

Data Cleaning and Audit

We screened the records for retractions and errata. We searched the PubMed retraction and erratum publication types (129 of the 182 records had a PubMed Identifier (PMID)) and the Retraction Watch Database [20] (entries to September 22, 2026) by digital object identifier (DOI), PMID, and title. We then audited topical precision for every record from the title, abstract, and author keywords. A record was relevant when resveratrol was a main subject in DR, DN, or DPN. It was partly relevant when resveratrol was one of several agents, a comparator, a related compound, or a docking output. All other records were not relevant. One reviewer (CK) wrote the rubric and drafted the ratings with the help of Claude (Anthropic, PBC, San Francisco, California, United States), and two reviewers (RV and YSP) checked them. To test agreement, the latter two reviewers each re-rated the same random sample of 50 records without seeing the original ratings. We computed Cohen kappa between each rater and the original rating.

We also classified study design from the title, abstract, and Scopus document type. The classes were narrative review, systematic review or meta-analysis, in vitro only, animal only, in vitro and animal, computational or database analysis, clinical study (human participants), and other or mixed. The classes were drafted with the help of Claude (Anthropic, PBC, San Francisco, California, United States). We re-read the 26 ambiguous records against their abstracts, and six changed class. No second human rater verified the classes, and we did not test agreement, so the classes are treated as descriptive.

Statistical Analysis

Research intensity was the number of resveratrol records divided by the baseline for the same complication, expressed as a percentage. We compared two complications by their rate ratio (RR), which is the intensity in one complication divided by the intensity in the other. We computed the 95% confidence interval (CI) by the log method and tested the ratio with a two-sided z test; Appendix A gives the standard error formula. Two comparisons were primary, DN versus DR and DPN versus DR, and we adjusted their P values by the Holm method [21]. Every other comparison in this article is exploratory, is labeled as such, and is unadjusted; this includes DN versus DPN and all four robustness analyses described below. The standard error (SE) is approximate because the resveratrol records are a subset of the baseline and some records belong to more than one domain. As a post hoc check, we repeated each comparison with Fisher exact tests. We ran the calculations in Python version 3.11 (Python Software Foundation, Wilmington, Delaware, United States) with the SciPy 1.17 and pandas 3.0 libraries.

Four robustness analyses were done. All were exploratory, and none was prespecified. In the audit-reduced analysis, we removed records rated not relevant from the numerator, or kept only records rated relevant, and we left the baseline unchanged. In the preclinical analysis, run after the main results were known, we restricted both the numerator and the baseline to records with a preclinical term in the title, abstract, or keywords (mice, mouse, rat, rats, murine, rabbit*, zebrafish, in vitro, animal model*, cell line* or cultured cell*). This keyword proxy is not a design classification. In the comparator analysis, we repeated the Tier 1 comparison for curcumin and quercetin, which appear in the keyword map and are studied for similar antioxidant mechanisms. We replaced the resveratrol block with the comparator compound and divided by the full Tier 1 baseline, meaning the baseline without any restriction. In the multi-domain analysis, prompted by peer review, we removed every record retrieved for more than one complication and recomputed the ratios on the single-domain records alone. This tests whether the overlap between complications, which makes the variance estimator approximate, drives the result. We ran the preclinical and comparator searches on 5 October 2026. A control search for the Tier 1 DR numerator returned the same 63 records as before (Appendix A).

Keyword Co-occurrence Analysis

We mapped author keywords with VOSviewer version 1.6.21 (Centre for Science and Technology Studies, Leiden University, Leiden, the Netherlands) [22]. The settings were full counting, association-strength normalization, a resolution of 1.0, a minimum cluster size of three, and a minimum of three occurrences per keyword. A thesaurus of 79 rules merged synonyms and deleted generic terms; Appendix A summarizes the rule classes. Twelve records had no author keywords and were left out of this analysis. As a stability check, we mapped the 154 relevant and partly relevant records with an earlier and broader thesaurus (1,435 rules) and a minimum of five occurrences. We named the clusters descriptively after reading their members.

Ethics and Data Availability

The study used published bibliographic metadata only, so ethics approval and consent were not applicable. The Scopus export is subject to Elsevier license terms, so we do not share the exported fields. For audit and design tables for all records and data files, see Appendix C.

Results

Dataset, Audit, and Study Designs

Table *1* shows how the retrieved records were consolidated. The Tier 1 exports held 63 DR, 90 DN, and 22 DPN records, and the proximity exports held 66, 101, and 27 records, giving 369 retrieved records. Within each complication, 173 records were retrieved by both definitions and were counted once, which left 68 DR, 101 DN, and 27 DPN records. Nine records were retrieved for more than one complication (five for two complications and four for all three), so merging across complications removed 13 further duplicates and left 183 unique records. After we excluded the erratum, the analysis set held 182 unique records (119 articles and 63 reviews), flagged as 68 DR, 100 DN, and 27 DPN records. With the erratum removed, the DN counts were 89 for Tier 1 and 100 for proximity. The Tier 2 searches returned 67 DR, 101 DN, and 24 DPN records after the erratum was excluded; 17 of these records fell outside the analysis set and were used only for the Tier 2 counts. The median number of citations was 25 (interquartile range 12 to 58.5). No record matched a retraction or erratum entry.

Step	DR	DN	DPN	Sum of complication counts	Unique records
1. Retrieved by the Tier 1 (primary) definition	63	90	22	175	171
2. Retrieved by the proximity definition	66	101	27	194	181
3. Steps 1 and 2 merged, duplicates removed	68	101	27	196	183
4. Erratum excluded	0	1	0	1	1
5. Analysis set	68	100	27	195	182
6. Retrieved by the Tier 2 definition, erratum excluded	67	101	24	192	187
7. Tier 2 records already in the analysis set	63	89	22	174	170
8. Tier 2 records outside the analysis set	4	12	2	18	17

TABLE 1: Flow of Scopus records from retrieval to the analysis set

Steps 1 to 5 build the analysis set. Step 1 and step 2 together held 369 records (175 plus 194). Within each complication, 173 records were retrieved by both definitions and were counted once in step 3. The sum of the complication counts exceeds the number of unique records because some records were retrieved for more than one complication (nine records in the analysis set: five for two complications and four for all three). One erratum, coded by Scopus as an article, appeared in the Tier 1, proximity, and Tier 2 searches for DN; it was removed from every count in the article. Steps 6 to 8 concern the Tier 2 (extended-compound) definition, which was a count-based sensitivity analysis: its 17 additional records were counted in Table 2 but not merged into the analysis set. Tier 1 requires an exact disease phrase; proximity accepts a diabetes term within three words of the complication term; Tier 2 keeps the Tier 1 disease phrases and adds pterostilbene, polydatin, piceid, and piceatannol to resveratrol.

DR, diabetic retinopathy; DN, diabetic nephropathy; DPN, diabetic peripheral neuropathy.

In the audit, 91 records (50.0%) were relevant, 63 (34.6%) were partly relevant, and 28 (15.4%) were not relevant. Cohen kappa against the original rating was 0.87 for RV and 0.90 for YSP. By design, 66 records (36.3%) were reviews (58 narrative and eight systematic). Another 88 (48.4%) were preclinical experimental studies (36 in vitro and animal, 34 animal only, and 18 in vitro only). The rest were 14 computational analyses, seven other or mixed designs, and seven (3.8%) clinical studies. Preclinical studies made up 27 of 68 DR records, 50 of 100 DN records, and 12 of 27 DPN records.

Research Intensity by Complication (RQ1)

Under the primary definition, research intensity was 0.27% for DR, 0.52% for DN, and 0.31% for DPN (Table *2*). The DN rate was 1.89 times the DR rate (95% CI 1.37 to 2.61; Holm-adjusted $P < 0.001$). The DPN rate did not differ from the DR rate (RR 1.14, 95% CI 0.70 to 1.85; adjusted $P = 0.593$). The exploratory DN to DPN ratio was 1.66 (95% CI 1.04 to 2.64; unadjusted $P = 0.033$). The DN to DR contrast depended on the definition. It was 1.33 (95% CI 0.97 to 1.81; adjusted $P = 0.145$) under the proximity definition and 2.02 (95% CI 1.48 to 2.75; adjusted $P < 0.001$) under the extended-compound definition (Tier 2).

Definition	Complication	Resveratrol records	Baseline records	Research intensity (%)	RR vs DR	95% CI	Holm-adjusted P
Tier 1 (primary)	DR	63	23,153	0.27	Reference	-	-
Tier 1 (primary)	DN	89	17,281	0.52	1.89	1.37-2.61	<0.001
Tier 1 (primary)	DPN	22	7,083	0.31	1.14	0.70-1.85	0.593
Proximity	DR	66	21,474	0.31	Reference	-	-
Proximity	DN	100	24,488	0.41	1.33	0.97-1.81	0.145
Proximity	DPN	27	9,038	0.30	0.97	0.62-1.52	0.901
Tier 2 (extended-compound)	DR	67	23,153	0.29	Reference	-	-
Tier 2 (extended-compound)	DN	101	17,281	0.58	2.02	1.48-2.75	<0.001
Tier 2 (extended-compound)	DPN	24	7,083	0.34	1.17	0.74-1.87	0.506

TABLE 2: Research intensity and rate ratios by search definition

Resveratrol records is the number of records that the definition retrieved for the complication. Baseline records is the number of all Scopus records on the same complication (English articles and reviews, 2016-2025) retrieved by the same disease terms without resveratrol terms. Research intensity is resveratrol records divided by baseline records, multiplied by 100. Tier 1, the primary definition, requires an exact disease phrase such as "diabetic retinopathy". Proximity, a sensitivity definition, accepts a diabetes term within three words of the complication term and therefore has its own, different baseline. Tier 2, a second sensitivity definition, keeps the Tier 1 disease phrases and baseline and adds pterostilbene, polydatin, piceid, and piceatannol to resveratrol. The three definitions overlap, so their counts do not add up to 182; Table 1 shows how the records were consolidated. All DN counts exclude one erratum that appeared in all three DN searches.

Holm-adjusted P, P value adjusted for the two comparisons against DR within each definition. The exploratory DN versus DPN comparison is reported in the text.

RR, rate ratio, the intensity in DN or DPN divided by the intensity in DR; CI, confidence interval by the log method; DR, diabetic retinopathy; DN, diabetic nephropathy; DPN, diabetic peripheral neuropathy.

Table *3* shows the robustness analyses. Removing records rated not relevant, or keeping relevant records only, left the Tier 1 DN to DR ratio at 2.00 and 2.14. The proximity ratio remained not significant (1.30 and 1.37). Fisher exact tests gave the same conclusions in all six scenarios.

Analysis	DR	DN	DPN	DN/DR RR	Lower CI	Upper CI	Holm P	DPN/DR RR	Lower CI	Upper CI	Holm P
Primary: Tier 1, all records	63	89	22	1.89	1.37	2.61	<0.001	1.14	0.70	1.85	0.593
Audit-reduced: Tier 1, not relevant excluded	53	79	21	2.00	1.41	2.83	<0.001	1.30	0.78	2.15	0.315
Audit-reduced: Tier 1, relevant only	30	48	10	2.14	1.36	3.38	0.002	1.09	0.53	2.23	0.814
Proximity: all records	66	100	27	1.33	0.97	1.81	0.145	0.97	0.62	1.52	0.901
Audit-reduced: proximity, not relevant excluded	56	83	25	1.30	0.93	1.82	0.258	1.06	0.66	1.70	0.806
Audit-reduced: proximity, relevant only	32	50	13	1.37	0.88	2.13	0.328	0.97	0.51	1.84	0.914
Preclinical: resveratrol, restricted baseline	36	64	12	0.98	0.65	1.46	0.904	0.70	0.36	1.33	0.548
Comparator: curcumin, full baseline	59	83	25	1.88	1.35	2.63	<0.001	1.39	0.87	2.21	0.172
Comparator: quercetin, full baseline	40	116	32	3.89	2.71	5.56	<0.001	2.62	1.64	4.16	<0.001
Multi-domain removed: Tier 1	61	87	18	1.91	1.38	2.65	<0.001	0.96	0.57	1.63	0.893
Multi-domain removed: proximity	60	93	18	1.36	0.98	1.88	0.127	0.71	0.42	1.21	0.207

TABLE 3: Robustness of the rate ratios to topical precision, baseline composition and compound

Each row repeats the rate ratio comparison after one change to the primary analysis, and the label before the colon names the type of check. DR, DN, and DPN give the numerator (resveratrol record) counts for each complication. The first group of four columns (RR through P) shows the DN versus DR comparison; the second group shows the DPN versus DR comparison. Primary and proximity rows use all retrieved records, as in Table 2. Audit-reduced rows test topical precision: not relevant excluded removes the records that the audit rated not relevant; relevant only keeps the records rated relevant; the baseline does not change. The preclinical row tests baseline composition: both the numerator and the baseline are limited to records with an animal or cell-study keyword such as mice, rats, or in vitro (full list in Appendix A), giving baselines of 3,774 (DR), 6,879 (DN) and 1,809 (DPN). The comparator rows test whether the pattern is specific to resveratrol: they run the same Tier 1 search with curcumin or quercetin in place of resveratrol and divide by the full Tier 1 baseline; their records are not part of the 182. The multi-domain rows, added at peer review, drop every record retrieved for more than one complication and recompute the ratios on single-domain records alone, which tests the overlap that makes the variance estimator approximate. All of these checks are exploratory, and none was prespecified. RR, rate ratio (intensity in DN or DPN divided by intensity in DR); Lower and Upper, 95% confidence interval limits by the log method; P, Holm-adjusted P value for the two comparisons against DR.

DR, diabetic retinopathy; DN, diabetic nephropathy; DPN, diabetic peripheral neuropathy.

Removing the records that were retrieved for more than one complication left 61 DR, 87 DN and 18 DPN Tier 1 records. The DN to DR ratio was 1.91 (95% CI 1.38 to 2.65), and the DPN to DR ratio was 0.96 (95% CI 0.57 to 1.63). Under the proximity definition, the corresponding ratios were 1.36 (95% CI 0.98 to 1.88) and 0.71 (95% CI 0.42 to 1.21). The main contrast therefore does not depend on the overlapping records. Preclinical records made up 16.3% of the DR baseline (3,774 of 23,153), 39.8% of the DN baseline (6,879 of 17,281) and 25.5% of the DPN baseline (1,809 of 7,083). They made up 57.1%, 71.9%, and 54.5% of the Tier 1 resveratrol records. Within the preclinical subset, intensity was 0.95% for DR, 0.93% for DN, and 0.66% for DPN. The DN to DR ratio was 0.98 (95% CI 0.65 to 1.46; adjusted P = 0.904).

Against the full baseline, curcumin gave a DN to DR ratio of 1.88 (95% CI 1.35 to 2.63) and quercetin gave 3.89 (95% CI 2.71 to 5.56). The DPN to DR ratio was significant for quercetin (2.62, 95% CI 1.64 to 4.16) but not for curcumin (1.39, 95% CI 0.87 to 2.21) or resveratrol. At most 12 curcumin records and eight quercetin records per complication were also resveratrol Tier 1 records.

Trends, Countries, and Sources (RQ2)

Raw annual output rose from 11 unique records in 2016 to 27 in 2025, with a peak of 28 in 2024. DN records appeared in every year (three to 15 per year), and DR records ranged from three to 13 per year. DPN records appeared only from 2020 (one to eight per year). No DPN record before 2020 was retrieved under any definition. A 2019 article on resveratrol and diabetic neuropathy, found by a web search, matches the phrase definition but is not indexed in Scopus [23].

Authors from 43 countries contributed. China appeared in 92 of 182 records (50.5%), followed by India (n=15), the United States (n=13), Iran (n=11), Italy (n=8), and Poland (n=8). China appeared in 25 of 68 DR records, 63 of 100 DN records, and eight of 27 DPN records. The records appeared in 123 sources, most often

Nutrients (n=7), *International Journal of Molecular Sciences* (n=6), *European Journal of Pharmacology* (n=5), and *Frontiers in Pharmacology* (n=5).

Thematic Clusters (RQ3)

The keyword analysis used the 170 records that had author keywords. Of 537 distinct keyword strings, 34 keywords reached three occurrences after cleaning. The network showed six clusters (Figure *1*). The largest nodes were DN (65 occurrences), DR (36 occurrences), and oxidative stress (35 occurrences).

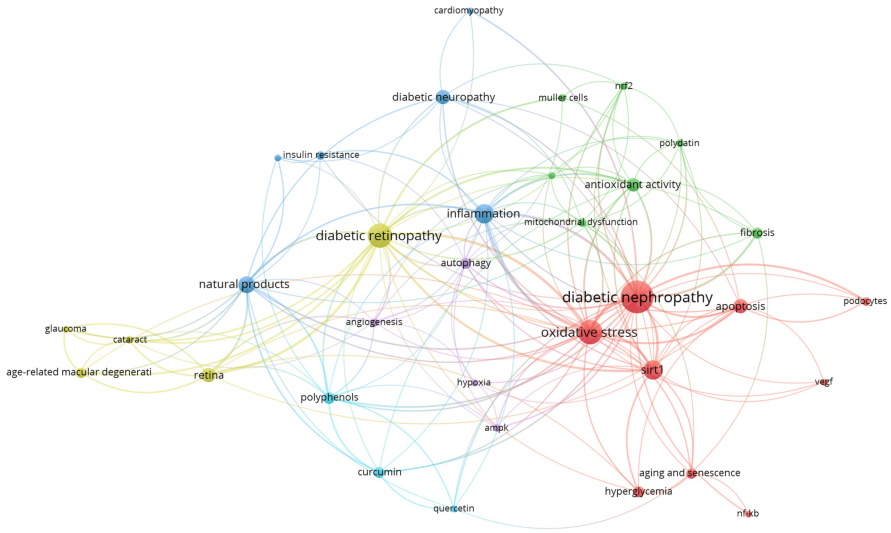


FIGURE 1: Author keyword co-occurrence network

Each circle is one author keyword, and a larger circle means the keyword occurs in more records. A line joins two keywords that appear together in the same records, and a thicker line means they appear together more often. Keywords that often appear together sit closer to each other. Color marks the cluster, a group of keywords that appear together more often with one another than with the rest of the network. The six clusters are red (diabetic nephropathy, oxidative stress, SIRT1, apoptosis, podocytes), yellow (diabetic retinopathy and ocular terms), blue (natural products, inflammation, diabetic neuropathy), green (antioxidant activity, mitochondrial dysfunction, fibrosis), purple (autophagy, AMPK, angiogenesis), and cyan (polyphenols, curcumin, quercetin). Only keywords with at least three occurrences are shown (34 of 537 distinct keyword strings). A thesaurus of 79 rules merged synonyms and removed generic terms such as resveratrol.

Map made with VOSviewer (Scopus records 2016-2025; full counting, association-strength normalization, resolution 1.0, minimum cluster size three).

Table *4* lists the 10 most frequent keywords by complication. Some keywords were shared, and others were specific to one complication. SIRT1 appeared in 10 DR and 10 DN records, and oxidative stress in 13 DR, 19 DN, and three DPN records. Podocytes and NF-kB occurred only in DN records. Retina, cataract, glaucoma, and age-related macular degeneration occurred only in DR records, and diabetic neuropathy occurred only in DPN-flagged records. Mitochondrial dysfunction (mean year 2023.6), fibrosis (2023.2), and flavonoids (2023.0) were the newest keywords, and hypoxia (2016.7) and AMPK (2018.8) were the oldest.

Keyword	Occurrences	DR	DN	DPN	Mean year
Diabetic Nephropathy	65	1	65	2	2021.1
Diabetic Retinopathy	36	36	1	2	2022.2
Oxidative Stress	35	13	19	3	2021.8
Inflammation	22	5	17	3	2022.5
SIRT1	22	10	10	2	2020.3
Natural Products	17	8	9	4	2021.9
Diabetic Neuropathy	13	2	2	13	2022.8
Apoptosis	12	4	7	1	2020.7
Retina	12	12	0	0	2020.4
Antioxidant Activity	11	5	6	2	2021.6

TABLE 4: Leading author keywords by domain and mean publication year

Occurrences is the number of records that carry the keyword after thesaurus cleaning. The DR, DN, and DPN columns show how many of those records were flagged in that domain (68 DR, 100 DN, and 27 DPN records among the 182). Nine records were flagged in more than one domain, so a record can be counted in more than one column, and the three columns can add up to more than the total number of records. Mean year is the mean publication year of the records that carry the keyword. The table lists the 10 most frequent of 34 keywords with at least three occurrences.

DR, diabetic retinopathy; DN, diabetic nephropathy; DPN, diabetic peripheral neuropathy.

Separate maps for DR (17 keywords, four clusters), DN (18 keywords, five groups), and the exploratory DPN set (15 keywords, four groups) showed the same split and are not shown. In the sensitivity map of 154 records (22 keywords, four clusters), the ocular terms stayed together. DN stayed with podocyte injury, apoptosis, inflammation, and oxidative stress, and SIRT1 moved to a separate cluster with autophagy and retinal cells.

Discussion

Main Findings and Interpretation

This review asked three questions about resveratrol research in diabetic microvascular complications. For RQ1, resveratrol research was more intense in DN than in DR under the primary definition (0.52% versus 0.27%; RR 1.89), whereas DPN did not differ from DR. This contrast is not a property of resveratrol. It weakened under the proximity definition (RR 1.33) and disappeared when the numerator and the baseline were both restricted to preclinical records (RR 0.98). It was as large or larger for curcumin (RR 1.88) and quercetin (RR 3.89). For RQ2, annual output more than doubled over the decade, China contributed half of the records, and DPN records appeared in Scopus only from 2020. For RQ3, the three literatures shared an oxidative stress and SIRT1 core. Podocytes and NF-kB occurred only in DN records, and retinal and ocular terms only in DR records. In all three complications, the evidence base was preclinical, with seven clinical studies among 182 records.

The composition of the baseline best explains the behavior of the DN-to-DR ratio. Research intensity divides an agent-specific numerator by a disease-wide baseline, so it depends on how much of each baseline an experimental compound could plausibly enter. Preclinical records formed 39.8% of the DN baseline but only 16.3% of the DR baseline. The DR literature carries a large clinical, imaging, and screening component. It includes deep learning systems for fundus photograph grading [24,25] and population screening programs [26], which a nutraceutical study is unlikely to join. Once the baseline was limited to preclinical work, resveratrol occupied about 0.9% of both fields.

Three polyphenols with different pharmacology produced the same DN-dominant pattern. This points to a property of the renal literature and not of resveratrol, although the comparator and preclinical analyses were post hoc. The definition dependence points the same way. Proximity matching added 42% to the DN baseline but only 12% to the DN resveratrol count, so the ratio moved with the denominator and not with resveratrol output. The thematic map is consistent with biology. A shared redox and SIRT1 vocabulary reflects the common hyperglycemic injury pathway [4], and organ-specific terms follow the cell types that each model studies, such as podocytes in the kidney and Müller cells in the retina.

Comparison With Previous Studies

Our findings agree with earlier work in some respects and differ in others. Wei et al. mapped resveratrol research as a whole [13], and Yeung et al. ranked natural products in diabetes research [14]. Neither scaled output to the size of a disease literature. Single-complication analyses of DR and of traditional Chinese medicine in DN described each field as a whole [15-17]. They could not show whether one agent is over- or under-represented. The same descriptive design prevails in recent bibliometric work on other metabolic conditions, which maps countries, prolific authors, and keyword hotspots but reports raw counts only [27]. Our contribution is not a new mapping technique but the denominator that these designs omit. The redox and SIRT1 core agrees with systematic reviews of preclinical DR [5,6] and DN [7]. It also agrees with mechanistic studies in retina and nerve [9,28].

One difference concerns emphasis. Harley et al., in their systematic review, found anti-inflammatory effects most prominent in preclinical DR [6]. In our DR records, oxidative stress outnumbered inflammation as an author keyword (13 versus five). This is reasonable because keywords record how authors frame a study, whereas reviews weigh the outcomes they extract. Kitada et al. also reported renoprotection independent of SIRT1 [29], so the prominence of SIRT1 as a keyword should not be read as mechanistic dominance.

Contribution and Novelty

The main contribution of this review is a denominator-aware framework for comparing one agent across diseases. It expresses output as research intensity, so the three complications are compared on a common scale and not by raw counts. It then tests that indicator against the search definition, topical precision, baseline composition, and the choice of compound. We found none of these steps in the earlier bibliometric studies we identified (Appendix A). The framework also exposed a pitfall that applies beyond resveratrol. An apparently agent-specific signal can arise entirely from differences between disease literatures. To our knowledge, this is the first bibliometric comparison of resveratrol across DR, DN and DPN, and the first to use comparator compounds to test whether such a result is specific to the agent.

Implications

For bibliometric practice, normalized publication counts should not be read as a measure of interest in an agent unless a comparator and a restricted baseline are reported. A ratio that falls to unity in a preclinical baseline and recurs across compounds describes the field and not the agent. We recommend that comparisons of a single agent across diseases report a comparator compound and a restricted or design-matched baseline alongside raw intensity.

For researchers, the scarcity of clinical studies and the late, sparse DPN output identify concrete gaps. DPN carries a high burden of painful neuropathy [3] yet has the fewest resveratrol records. For vitreoretinal research, resveratrol work in DR remains preclinical. Its translation depends on ocular pharmacokinetics and on formulations that overcome very low oral bioavailability [10,11,30]. Animal findings often fail to translate to humans [31], and clinical evidence for resveratrol is still insufficient for recommendations [32]. Clinicians should therefore not take publication volume as evidence of efficacy.

Limitations and Future Work

Several limitations qualify these conclusions. We used Scopus alone and English-language records, and database coverage is incomplete [18,19]. One 2019 DPN article that matched our phrase definition was not indexed [22], so the late appearance of DPN may partly reflect coverage. The exact-phrase definition missed neuropathy studies that report hyperalgesia or nerve function without the disease term, which biases the DPN counts downward. The audit rated 15.4% of records as not relevant, and the baseline was not audited. The DN to DR ratio persisted with both audit-reduced numerators, so off-target records do not explain it.

Ratings were drafted with a generative AI assistant and checked by co-authors. Agreement was high (kappa 0.87 and 0.90), but the raters knew the study aims, and no second human rater verified the design classes. The preclinical baseline relied on a keyword proxy with wide intervals. Like the comparator analysis, it was run post hoc, so a modest resveratrol-specific difference cannot be excluded. Future work should repeat the analysis in Web of Science and PubMed, classify designs with two independent raters, use a design-based baseline, and add comparators such as other stilbenes and non-polyphenol agents. Pairing VOSviewer with CiteSpace (https://citespace.podia.com/) would add burst detection and co-citation structure that a single mapping tool does not provide [27].

Conclusions

Under the primary search definition, resveratrol research looked more concentrated in DN than in DR. The contrast shrank under a broader definition, disappeared when the baseline was restricted to preclinical records, and appeared just as strongly for curcumin and quercetin. It most likely reflects how the literature on each complication is composed and not interest in resveratrol itself. DPN remained sparsely studied in

Scopus.

Publication volume describes research activity, not efficacy or clinical readiness, and clinical studies were rare in all three complications. Future comparisons of one agent across diseases should include a comparator compound and a restricted baseline, verify design classification with independent raters, and repeat the analysis in other databases.

Appendices

Appendix A. Search for earlier bibliometric studies (October 4, 2026)

We looked for any bibliometric or scientometric study of resveratrol in diabetic retinopathy, nephropathy or neuropathy. We screened titles and, where needed, abstracts of the results from PubMed (n=4), Scopus (n=13), Web of Science (n=17) and Google Scholar (n=594, of which we screened the first 100). We found no study with that scope. The closest records were bibliometric work on resveratrol as a whole [13], a quantitative analysis of natural products in diabetes research [14], and bibliometric studies of single complications that did not center on resveratrol. The PubMed string was: (resveratrol OR trihydroxystilbene) AND (bibliometric OR bibliometrics OR scientometric OR scientometrics OR "science mapping" OR "knowledge map" OR "research trends" OR "research landscape" OR "citation analysis" OR VOSviewer OR CiteSpace OR bibliometrix) AND diabet*, with each term searched in the Title/Abstract field. The other strings are available from the corresponding author.

Statistical Detail

The rate ratio compares the research intensity of two complications. For complications 1 and 2, with resveratrol counts a and b and baselines A and B, $RR = \frac{b/B}{a/A}$. The standard error of ln(RR) is $\sqrt{\frac{1}{a} + \frac{1}{b} - \frac{1}{A} - \frac{1}{B}}$. The 95% confidence interval is $\exp\left(\ln(RR) \pm 1.96 \times SE\right)$, and the two-sided z test uses z = ln(RR)/SE. The estimator is approximate for two reasons: the resveratrol records are a subset of the baseline rather than an independent sample, and a small number of records are retrieved for more than one complication. The multi-domain robustness analysis reported in the Results addresses the second of these directly.

Keyword Thesaurus

The primary thesaurus contains 79 label-to-replacement pairs generated from 39 regular-expression rules. The rules fall into seven classes. First, deletion of the search term itself, covering resveratrol and its spelling and formulation variants. Second, deletion of generic diabetes terms and of indexing artefacts such as document types (review, meta-analysis, bibliometric analysis) and organism or study-setting descriptors (humans, animals, rats, mice, in vitro, in vivo). Third, consolidation of disease-name variants into canonical complication labels (Diabetic Retinopathy, Diabetic Nephropathy, Diabetic Neuropathy, Diabetic Macular Edema). Fourth, consolidation of molecular-target synonyms and abbreviations (SIRT1, AMPK, Nrf2, VEGF, NF-kB). Fifth, consolidation of process terms (Oxidative Stress, Inflammation, Apoptosis, Autophagy, Angiogenesis, Fibrosis, Hyperglycemia, Insulin Resistance). Sixth, consolidation of compound classes and named comparators (Polyphenols, Natural Products, Flavonoids, Stilbenes, Curcumin, Quercetin, Pterostilbene, Polydatin). Seventh, consolidation of cell and tissue terms (Muller Cells, Podocytes, Mesangial Cells, Retina, Blood-Retinal Barrier). The broader 1,435-rule thesaurus used for the stability check applies the same classes with finer granularity. Both files are in the data deposit.

Appendix B. Scopus search strings (accessed October 3, 2026)

The strings are written for the Scopus Advanced search box. The extended-compound definition (Tier 2) uses the Tier 1 disease block below with a wider resveratrol block: TITLE(resveratrol* OR trihydroxystilbene* OR pterostilbene* OR polydatin* OR piceid* OR piceatannol*) OR ABS(same terms) OR AUTHKEY(same terms). Each baseline string is the matching numerator without the resveratrol block.

Diabetic Retinopathy

Tier 1 numerator (phrase): (TITLE(resveratrol* OR trihydroxystilbene*) OR ABS(resveratrol* OR trihydroxystilbene*) OR AUTHKEY(resveratrol* OR trihydroxystilbene*)) AND (TITLE("diabetic retinopathy" OR "diabetic retinopathies" OR "diabetic macular edema" OR "diabetic macular oedema" OR "diabetic retinal neurodegeneration" OR "diabetic eye disease" OR "diabetic eye diseases") OR ABS("diabetic retinopathy" OR "diabetic retinopathies" OR "diabetic macular edema" OR "diabetic macular oedema" OR "diabetic retinal neurodegeneration" OR "diabetic eye disease" OR "diabetic eye diseases") OR AUTHKEY("diabetic retinopathy" OR "diabetic retinopathies" OR "diabetic macular edema" OR "diabetic macular oedema" OR "diabetic retinal neurodegeneration" OR "diabetic eye disease" OR "diabetic eye diseases")) AND PUBYEAR >

2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Baseline (denominator, phrase): (TITLE("diabetic retinopathy" OR "diabetic retinopathies" OR "diabetic macular edema" OR "diabetic macular oedema" OR "diabetic retinal neurodegeneration" OR "diabetic eye disease" OR "diabetic eye diseases") OR ABS("diabetic retinopathy" OR "diabetic retinopathies" OR "diabetic macular edema" OR "diabetic macular oedema" OR "diabetic retinal neurodegeneration" OR "diabetic eye disease" OR "diabetic eye diseases") OR AUTHKEY("diabetic retinopathy" OR "diabetic retinopathies" OR "diabetic macular edema" OR "diabetic macular oedema" OR "diabetic retinal neurodegeneration" OR "diabetic eye disease" OR "diabetic eye diseases")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Diabetic Nephropathy

Tier 1 numerator (phrase): (TITLE(resveratrol* OR trihydroxystilbene*) OR ABS(resveratrol* OR trihydroxystilbene*) OR AUTHKEY(resveratrol* OR trihydroxystilbene*)) AND (TITLE("diabetic nephropathy" OR "diabetic nephropathies" OR "diabetic kidney disease" OR "diabetic kidney diseases" OR "diabetic renal disease" OR "diabetic renal diseases" OR "diabetic glomerulosclerosis" OR "diabetic kidney injury" OR "diabetic renal injury") OR ABS("diabetic nephropathy" OR "diabetic nephropathies" OR "diabetic kidney disease" OR "diabetic kidney diseases" OR "diabetic renal disease" OR "diabetic renal diseases" OR "diabetic glomerulosclerosis" OR "diabetic kidney injury" OR "diabetic renal injury") OR AUTHKEY("diabetic nephropathy" OR "diabetic nephropathies" OR "diabetic kidney disease" OR "diabetic kidney diseases" OR "diabetic renal disease" OR "diabetic renal diseases" OR "diabetic glomerulosclerosis" OR "diabetic kidney injury" OR "diabetic renal injury")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Baseline (denominator, phrase): (TITLE("diabetic nephropathy" OR "diabetic nephropathies" OR "diabetic kidney disease" OR "diabetic kidney diseases" OR "diabetic renal disease" OR "diabetic renal diseases" OR "diabetic glomerulosclerosis" OR "diabetic kidney injury" OR "diabetic renal injury") OR ABS("diabetic nephropathy" OR "diabetic nephropathies" OR "diabetic kidney disease" OR "diabetic kidney diseases" OR "diabetic renal disease" OR "diabetic renal diseases" OR "diabetic glomerulosclerosis" OR "diabetic kidney injury" OR "diabetic renal injury") OR AUTHKEY("diabetic nephropathy" OR "diabetic nephropathies" OR "diabetic kidney disease" OR "diabetic kidney diseases" OR "diabetic renal disease" OR "diabetic renal diseases" OR "diabetic glomerulosclerosis" OR "diabetic kidney injury" OR "diabetic renal injury")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Diabetic Peripheral Neuropathy

Tier 1 numerator (phrase): (TITLE(resveratrol* OR trihydroxystilbene*) OR ABS(resveratrol* OR trihydroxystilbene*) OR AUTHKEY(resveratrol* OR trihydroxystilbene*)) AND (TITLE("diabetic neuropathy" OR "diabetic neuropathies" OR "diabetic peripheral neuropathy" OR "diabetic peripheral neuropathies" OR "diabetic polyneuropathy" OR "diabetic polyneuropathies" OR "diabetic neuropathic pain" OR "painful diabetic neuropathy" OR "painful diabetic neuropathies" OR "diabetic autonomic neuropathy") OR ABS("diabetic neuropathy" OR "diabetic neuropathies" OR "diabetic peripheral neuropathy" OR "diabetic peripheral neuropathies" OR "diabetic polyneuropathy" OR "diabetic polyneuropathies" OR "diabetic neuropathic pain" OR "painful diabetic neuropathy" OR "painful diabetic neuropathies" OR "diabetic autonomic neuropathy") OR AUTHKEY("diabetic neuropathy" OR "diabetic neuropathies" OR "diabetic peripheral neuropathy" OR "diabetic peripheral neuropathies" OR "diabetic polyneuropathy" OR "diabetic polyneuropathies" OR "diabetic neuropathic pain" OR "painful diabetic neuropathy" OR "painful diabetic neuropathies" OR "diabetic autonomic neuropathy")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Baseline (denominator, phrase): (TITLE("diabetic neuropathy" OR "diabetic neuropathies" OR "diabetic peripheral neuropathy" OR "diabetic peripheral neuropathies" OR "diabetic polyneuropathy" OR "diabetic polyneuropathies" OR "diabetic neuropathic pain" OR "painful diabetic neuropathy" OR "painful diabetic neuropathies" OR "diabetic autonomic neuropathy") OR ABS("diabetic neuropathy" OR "diabetic neuropathies" OR "diabetic peripheral neuropathy" OR "diabetic peripheral neuropathies" OR "diabetic polyneuropathy" OR "diabetic polyneuropathies" OR "diabetic neuropathic pain" OR "painful diabetic neuropathy" OR "painful diabetic neuropathies" OR "diabetic autonomic neuropathy") OR AUTHKEY("diabetic neuropathy" OR "diabetic neuropathies" OR "diabetic peripheral neuropathy" OR "diabetic peripheral neuropathies" OR "diabetic polyneuropathy" OR "diabetic polyneuropathies" OR "diabetic neuropathic pain" OR "painful diabetic neuropathy" OR "painful diabetic neuropathies" OR "diabetic autonomic neuropathy")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Proximity Definition (Sensitivity)

DR, proximity numerator: (TITLE(resveratrol* OR trihydroxystilbene*) OR ABS(resveratrol* OR trihydroxystilbene*) OR AUTHKEY(resveratrol* OR trihydroxystilbene*)) AND (TITLE(diabet* W/3

retinopath*) OR ABS(diabet* W/3 retinopath*) OR AUTHKEY(diabet* W/3 retinopath*)) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

DR, proximity baseline: (TITLE(diabet* W/3 retinopath*) OR ABS(diabet* W/3 retinopath*) OR AUTHKEY(diabet* W/3 retinopath*)) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

DN, proximity numerator: (TITLE(resveratrol* OR trihydroxystilbene*) OR ABS(resveratrol* OR trihydroxystilbene*) OR AUTHKEY(resveratrol* OR trihydroxystilbene*)) AND (TITLE(diabet* W/3 nephropath*) OR TITLE(diabet* W/3 "kidney disease") OR TITLE(diabet* W/3 "renal disease") OR ABS(diabet* W/3 nephropath*) OR ABS(diabet* W/3 "kidney disease") OR ABS(diabet* W/3 "renal disease") OR AUTHKEY(diabet* W/3 nephropath*) OR AUTHKEY(diabet* W/3 "kidney disease") OR AUTHKEY(diabet* W/3 "renal disease")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

DN, proximity baseline: (TITLE(diabet* W/3 nephropath*) OR TITLE(diabet* W/3 "kidney disease") OR TITLE(diabet* W/3 "renal disease") OR ABS(diabet* W/3 nephropath*) OR ABS(diabet* W/3 "kidney disease") OR ABS(diabet* W/3 "renal disease") OR AUTHKEY(diabet* W/3 nephropath*) OR AUTHKEY(diabet* W/3 "kidney disease") OR AUTHKEY(diabet* W/3 "renal disease")) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

DPN, proximity numerator: (TITLE(resveratrol* OR trihydroxystilbene*) OR ABS(resveratrol* OR trihydroxystilbene*) OR AUTHKEY(resveratrol* OR trihydroxystilbene*)) AND (TITLE(diabet* W/3 neuropath*) OR TITLE(diabet* W/3 polyneuropath*) OR ABS(diabet* W/3 neuropath*) OR ABS(diabet* W/3 polyneuropath*) OR AUTHKEY(diabet* W/3 neuropath*) OR AUTHKEY(diabet* W/3 polyneuropath*)) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

DPN, proximity baseline: (TITLE(diabet* W/3 neuropath*) OR TITLE(diabet* W/3 polyneuropath*) OR ABS(diabet* W/3 neuropath*) OR ABS(diabet* W/3 polyneuropath*) OR AUTHKEY(diabet* W/3 neuropath*) OR AUTHKEY(diabet* W/3 polyneuropath*)) AND PUBYEAR > 2015 AND PUBYEAR < 2026 AND (DOCTYPE(ar) OR DOCTYPE(re)) AND LANGUAGE(english)

Post Hoc Analyses (Accessed October 5, 2026)

We built each string from the Tier 1 strings above. For the preclinical analysis, we appended AND TITLE-ABS-KEY(mice OR mouse OR rat OR rats OR murine OR rabbit* OR zebrafish OR "in vitro" OR "animal model*" OR "cell line*" OR "cultured cell*") to both the Tier 1 numerator and the Tier 1 baseline of each complication. The restricted baselines returned 3,774 (DR), 6,879 (DN) and 1,809 (DPN) records. The restricted numerators returned 36, 64 and 12 records. For the comparator analysis, we replaced the resveratrol block of each Tier 1 numerator with (TITLE(curcumin*) OR ABS(curcumin*) OR AUTHKEY(curcumin*)) or with (TITLE(quercetin*) OR ABS(quercetin*) OR AUTHKEY(quercetin*)), and we kept the disease block and the limits. The curcumin numerators returned 59, 83 and 25 records for DR, DN and DPN. The quercetin numerators returned 40, 116 and 32 records. The unrestricted Tier 1 baselines served as the denominator. The Tier 1 DR control string returned 63 records.

Appendix C

The topical-precision audit and design classification of all 182 records, the keyword table, both thesaurus files, and the analysis scripts are deposited in a public repository: https://doi.org/10.5281/zenodo.23585905.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Chalid Kurniawan, Yuni S. Pratiwi, Arief Kartasasmita

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