

Article

An Update on the Top 100 Most-Cited Articles in Diabetes Research: A Bibliometric Analysis

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Abstract

Background: Diabetes mellitus remains one of the most extensively researched conditions in global health, with a rapidly growing body of literature addressing its prevention, management, and treatment. Characterising highly cited diabetes-related research helps identify research trends, shifts in scientific priorities, and factors associated with citation impact in diabetes research. **Objective:** This study aimed to perform a bibliometric analysis of the top 100 most-cited diabetes-related records published between 2011 and 2022, in order to describe major scientific contributions and citation patterns in this field. **Methods:** The search was conducted in April 2023 using the Web of Science Core Collection, Science Citation Index Expanded. Records containing the term “diabetes” were retrieved using the topic field and ranked according to total Web of Science citation count. The top 300 records were screened, and the 100 eligible diabetes-related records were selected for detailed analysis. Extracted data included title, citation count, citation density, PubMed Central (PMC) citations, patent citations, h-index, journal, year of publication, country of origin, study type, funding sources, and authorship patterns. Descriptive and correlational analyses were performed using IBM SPSS Statistics, version 27.0.1.0. **Results:** The 100 most-cited records accumulated 174,857 citations, with individual citation counts ranging from 832 to 5898. Most records were original research articles (68%), followed by reviews (27%). The most frequently represented journals were Diabetes Care ($n = 21$), New England Journal of Medicine ($n = 20$), and The Lancet ($n = 9$). The United States contributed 45% of the records. A strong positive correlation was observed between total Web of Science citations and PMC citations using both Pearson correlation ($r = 0.863$) and Spearman rank correlation ($\rho = 0.834$). The association between total citations and first-author h-index was weak and not statistically significant. Patent citation analysis showed that 41 records were cited in at least one patent. Most records acknowledged funding, with both public-sector and pharmaceutical funders represented among the most frequently reported sources. **Conclusions:** This study characterises highly cited diabetes-related research published from 2011 to 2022. The findings suggest that clinical trials, reviews, guidelines, collaborative research, patent citation activity, and publication in high-visibility journals were common features of highly cited diabetes-related records, although citation-based indicators should be interpreted with caution.



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Keywords: bibliometric analysis; diabetes mellitus; citation analysis; highly cited records; research impact; translational research

1. Introduction

Diabetes mellitus is a major global public health challenge, affecting hundreds of millions of people worldwide. According to the International Diabetes Federation (IDF), approximately 537 million adults aged 20 to 79 years were living with diabetes in 2021, and projections suggest that this number will rise to approximately 643 million by 2030 and 783 million by 2045 [1]. This chronic metabolic disease, which includes type 1 diabetes, type 2 diabetes, and gestational diabetes, can lead to serious health problems and mortality through macrovascular and microvascular complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy. The increasing global burden of diabetes has been accompanied by substantial growth in the scientific literature. For example, a previous bibliometric analysis of type 2 diabetes research identified 24,783 published items between 1951 and 2012 and reported that research output had increased in parallel with the rising global disease burden [2]. More recent diabetes-related bibliometric studies have also reported rapid growth in specialised areas such as machine learning, deep learning, remission research, and other emerging diabetes subfields [3,4]. This expansion of the literature supports the need for updated bibliometric analyses that identify highly influential articles and changing research priorities.

The rapid expansion of scientific literature has made bibliometric analysis an important tool for assessing scientific development. Quantitative bibliometric methods examine academic literature using citation patterns, authorship relationships, journal representation, and research trends. This approach provides insight into how research develops and generates impact within specific scientific fields. In diabetes research, bibliometric analysis allows systematic evaluation of influential articles and central themes while also identifying less-explored areas and patterns of knowledge dissemination [3,4].

Citation analysis constitutes a central component of bibliometric techniques that assess the impact of academic studies. Academic articles with a high citation count often present new ideas or techniques and create clinical guidelines that not only shape future academic research but also shape the overall scientific conversation. Thus, identifying highly cited diabetes research studies can be an important way to acknowledge principal contributions and indicate research priorities and changes in the field. Understanding citation patterns provides important information to funders, policymakers, and researchers about new trends to inform the allocation of resources and direction of research lines [5].

Prior bibliometric analyses of diabetes research have focused on narrow subfields (e.g., gestational diabetes, diabetic retinopathy, or gut microbiota) or have become outdated as the literature continues to grow. A comprehensive update covering the full spectrum of diabetes research over the most recent decade is therefore warranted. Rapid developments in precision medicine, artificial intelligence in healthcare, and novel pharmacological therapies further underscore the need for a current, broad-scope analysis to identify the most influential bodies of work [6].

This study aims to provide an updated bibliometric evaluation of the 100 most-cited diabetes studies published between 2011 and 2022. We systematically reviewed key factors including citation count, citation density, year of publication, journal impact, study type, funding source, author location, PubMed Central citations, and patent citations. By identifying the most influential articles from this period, this study provides a comprehensive overview of the evolving diabetes-related research space and offers practical insights for researchers, stakeholders, and policymakers seeking to improve research practices and priorities.

2. Materials and Methods

This bibliometric study examined the 100 most-cited papers in diabetes research published between 2011 and 2022. Our approach comprised a pre-specified search protocol, defined eligibility criteria, structured extraction of bibliographic and citation characteristics, and descriptive and correlational statistical analysis, with the aim of providing a comprehensive overview of the most influential research in this field.

2.1. Data Source and Search Strategy

Data were extracted from the Science Citation Index Expanded (SCI-Expanded) database within the Web of Science Core Collection. Web of Science was selected because it provides standardised citation indexing and is widely used in bibliometric studies of highly cited articles. The search was conducted in April 2023 using the topic field search TS = “diabetes”, which retrieved records containing the term diabetes in the title, abstract, author keywords, or Keywords Plus. No additional document-type filter was applied at the search stage, as the aim was to identify the most-cited diabetes-related records before applying eligibility screening. Retrieved records were sorted in descending order by total Web of Science citation count. The top 300 records were screened by title and abstract, and records with unclear relevance were assessed further using the full text. Articles were retained if diabetes was a primary focus or if the article had direct relevance to diabetes diagnosis, pathophysiology, epidemiology, complications, treatment, management, or clinical guidance. Screening continued until 100 eligible records were identified. Records were excluded if diabetes was only mentioned incidentally or if the main focus was a broader cardiometabolic, obesity-related, or molecular mechanism topic without direct diabetes relevance.

2.2. Eligibility Criteria

We included records that had diabetes as a primary focus or had direct relevance to diabetes diagnosis, pathophysiology, epidemiology, complications, treatment, management, or clinical guidance. Eligible records included original research articles, randomised controlled trials (RCTs), observational studies, basic science studies, systematic or narrative reviews, major guidelines, consensus reports, and position statements. Records indexed under other Web of Science document types, including editorial material, letters, corrections, or book chapters, were not excluded solely on the basis of document type if they represented a highly cited diabetes-focused contribution or were directly linked to an eligible diabetes-related article.

Inclusion and exclusion criteria were applied to maintain topic specificity. Records focused mainly on blood glucose, blood pressure, obesity, adipose biology, cardiovascular disease, metabolic syndrome, or broader cardiometabolic health were excluded if diabetes was not a primary focus or if the diabetes relevance was only indirect. Studies on metabolic drugs, molecular pathways, or cardiometabolic risk markers were retained only when their findings were directly related to diabetes treatment, pathophysiology, complications, or clinical management. Records were excluded if diabetes was mentioned only incidentally, if the primary focus was outside diabetes, or if insufficient bibliographic information was available for extraction. The article selection process is summarised in Figure 1.

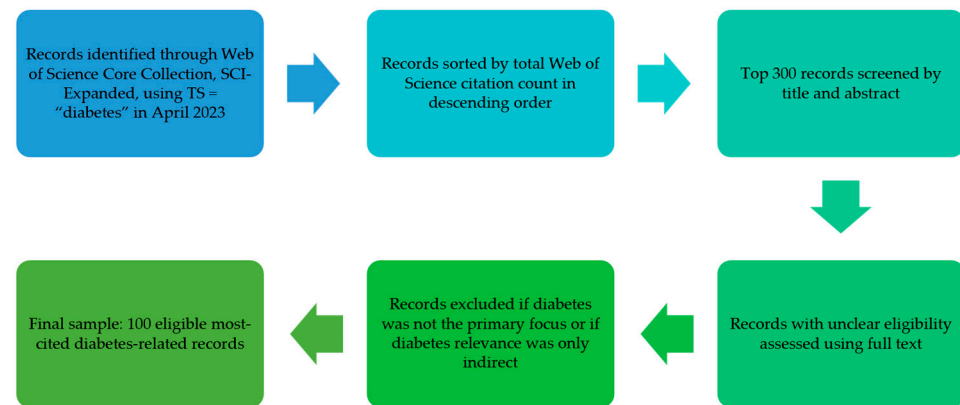


Figure 1. Article selection process.

2.3. Data Extraction

Through this screening, we identified and selected 100 of the most-cited articles meeting all inclusion criteria. We extracted the following data for each article: title and full citation (for each article), author(s) (and number of authors, total), year of publication, journal of publication and impact factor (IF 2023), total citation count, citation density (citations/year), PubMed Central (PMC) citations, patent citations (based on Scopus), h-index, article type (original article, review, editorial, letter, correction and book chapter), country of origin (based on first and corresponding authors' affiliations), funding source(s), and study design (basic science, RCT, observational, etc.). We also performed additional measures of authorship type, distinguishing between single- or multiple-author contributions and group (or consortium) authorship. Finally, we categorised the locations of funding sources as government or non-government organisations to investigate any associations between funding and the impact of research.

2.4. Statistical and Bibliometric Analysis

Descriptive statistics were used to examine publication patterns over time, journal representation, citation metrics, authorship patterns, country-level contributions, and funding sources. Journal names and article counts were summarised to describe journal representation among the top-cited records. Citation density was calculated as the total number of citations per article divided by the number of years since publication, to account partly for time-related citation bias. Article types were classified into six document types and analysed for their distribution among the most-cited articles. The relationship between total Web of Science citations and other measures of impact, including PubMed Central citations, first-author h-index, and patent citations, was examined using Pearson correlation coefficients. As citation data are commonly skewed, Spearman rank correlation coefficients were also calculated as a sensitivity analysis. Correlation analyses were performed using available data for each variable, with pairwise exclusion of missing values. Analyses were performed using IBM SPSS Statistics, version 27.0.1.0 (IBM Corp., Armonk, NY, USA).

2.5. Ethical Considerations

This study is a secondary analysis of publicly available data from citation databases, and contains no human subjects, animals, or otherwise identifiable private information. Hence, no ethical approval was required in this regard.

3. Results

3.1. Citation Review

The 100 most-cited diabetes-related records included in this analysis had a combined total of 174,857 Web of Science citations at the time of data extraction. Individual citation counts ranged from 832 to 5898. The highest-ranked record was the American Diabetes Association article “Diagnosis and Classification of Diabetes Mellitus”, published in *Diabetes Care* in 2013. A full list of the 100 records, including citation rank, total citation count, citation density, h-index, PubMed Central citations, patent citations, year of publication, journal, title, and authorship information, is provided in Supplementary Table S1.

3.2. Journals of Publication

Across the 100 most-cited records, 29 journals were represented. *Diabetes Care* contributed the largest number of records ($n = 21$), followed by the *New England Journal of Medicine* ($n = 20$) and *The Lancet* ($n = 9$). Together, these three journals accounted for 50% of the records analysed. Other journals represented included *JAMA*, *Cell*, *Nature*, *Nature Medicine*, and the *Journal of Clinical Investigation*, indicating that highly cited diabetes-related research was distributed across diabetes-specific journals, general medical journals, and basic science journals. The distribution of records by journal is reported in Table 1 and illustrated in Figure 2.

Table 1. Journals of publication of the top 100 most-cited records.

Journal	<i>n</i>
Diabetes Care	21
New England Journal of Medicine	20
Lancet	9
Diabetes Research and Clinical Practice	6
Journal of Clinical Investigation	5
Cell	4
Journal of the American Medical Association	4
Nature Reviews Endocrinology	3
Physiological Reviews	3
Cell Metabolism	2
Diabetologia	2
Nature	2
Nature Medicine	2
Obesity Reviews	2
Annual Review of Immunology	1
Circulation	1
Clinical Science	1
Current Hypertension Reports	1
Diabetes Technology & Therapeutics	1
European Heart Journal	1
International Journal of Molecular Sciences	1
Lancet Diabetes & Endocrinology	1
Molecular Cell	1
Nature Biotechnology	1
Nature Cell Biology	1
Nature Communications	1
Nature Reviews Immunology	1
Nature Reviews Molecular Cell Biology	1
Science	1

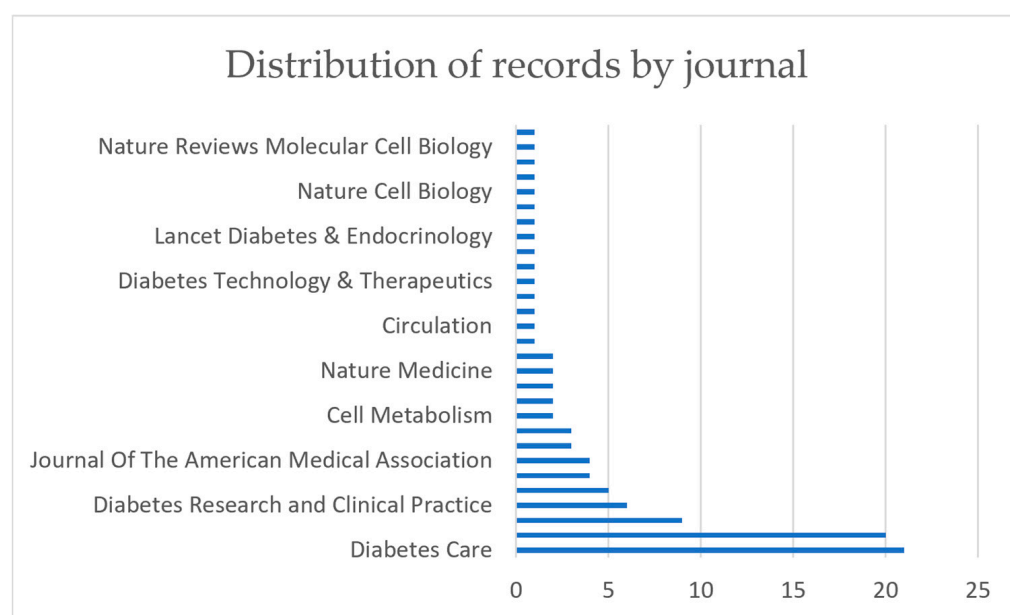


Figure 2. Distribution of the top 100 most-cited records by journal of publication. Bar length indicates the number of records published in each journal.

3.3. Geographical Distribution

The geographic distribution of corresponding authors showed representation from 15 countries, indicating a broad international contribution to the top 100 articles. The United States contributed the largest number of articles ($n = 45$), followed by the United Kingdom ($n = 20$) and Canada ($n = 8$). Other countries with multiple contributions included Belgium ($n = 5$), Australia, China, and Germany (each $n = 3$), as well as France, Greece, the Netherlands, Sweden, and Switzerland (each $n = 2$). Austria, Slovenia, and South Korea each contributed one article. A full breakdown by country is presented in Table 2, and the geographic distribution is illustrated in Figure 3.

Table 2. Countries of origin of corresponding authors for the top 100 most-cited records.

Country	No. of Articles
USA	45
UK	20
Canada	8
Belgium	5
Australia	3
China	3
Germany	3
France	2
Greece	2
Netherlands	2
Sweden	2
Switzerland	2
Austria	1
Slovenia	1
South Korea	1

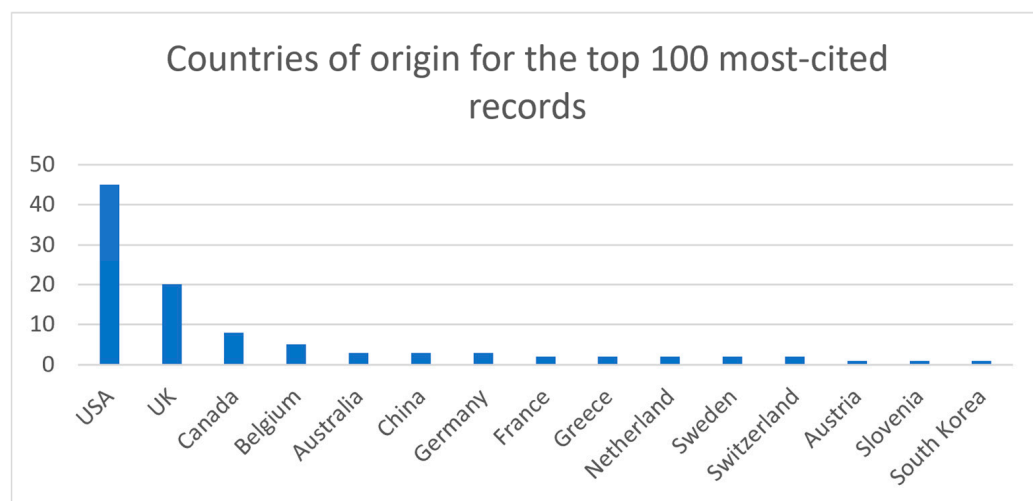


Figure 3. Geographical distribution of the top 100 most-cited records according to corresponding-author affiliation.

3.4. Types of Articles and Study Design

Among the 100 most-cited records, 68 were indexed as articles and 27 were indexed as reviews. The remaining records were indexed as editorial material ($n = 2$), correction ($n = 1$), letter ($n = 1$), and review/book chapter ($n = 1$). These records were retained because they were highly cited and directly related to diabetes diagnosis, classification, clinical guidance, or diabetes-related scientific mechanisms. Original research records included basic science studies, randomised controlled trials, and observational or epidemiological studies. A breakdown of document types is included in Table 3.

Table 3. Types of documents among the top 100 most-cited articles.

Type of Document	<i>n</i>
Article	68
Correction	1
Editorial Material	2
Letter	1
Review	27
Review/Book Chapter	1

3.5. PMC Citations

The total PMC citations for the top 100 articles ranged from 46 to 4118, with a mean of 1058 and a median of 847. The article with the highest number of PMC citations was Zinman et al. [7], followed by the 2013 American Diabetes Association position statement [8], Neal et al. [9], Marso et al. [10], and Saeedi et al. [11]. A strong positive association was observed between total Web of Science citations and PMC citations using both Pearson correlation ($r = 0.863$) and Spearman rank correlation ($\rho = 0.834$, $p < 0.001$; $n = 99$). These findings indicate broad consistency between the two citation sources in capturing article-level scientific impact. Detailed article-level citation, PMC citation, and h-index data are provided in Supplementary Table S2. The relationship between total Web of Science citations and PMC citations is illustrated in Figure 4.

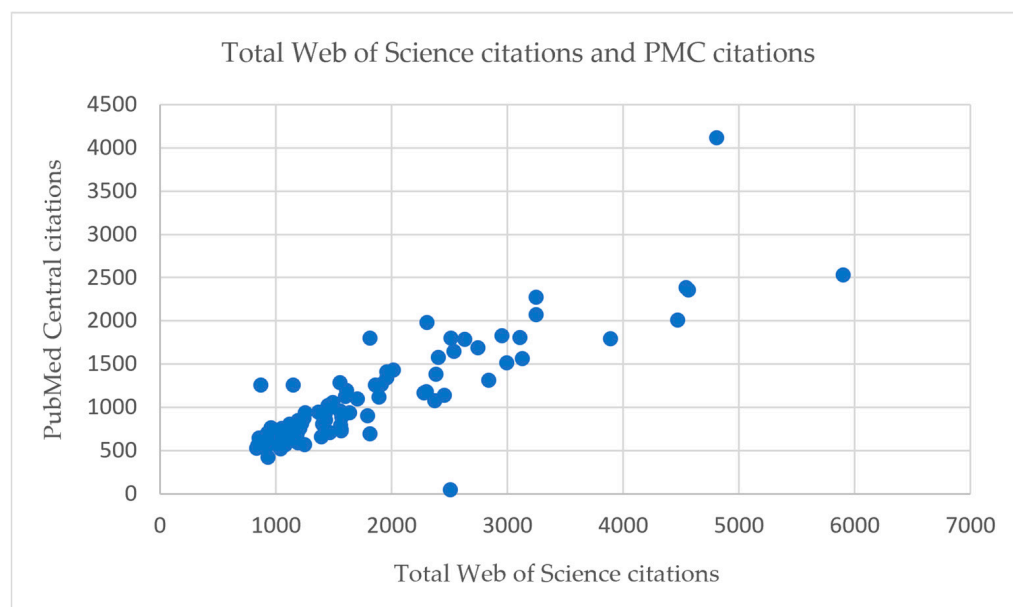


Figure 4. Scatter plot showing the association between total Web of Science citations and PubMed Central citations.

3.6. Correlation with H-Index

The h-index values of the first authors ranged from 1 to 152, with a mean of 49.5 and a median of 41. The association between total Web of Science citations and first-author h-index was weak and not statistically significant using both Pearson correlation ($r = 0.074$) and Spearman rank correlation ($\rho = 0.100$, $p = 0.332$; $n = 97$). This finding suggests that highly cited diabetes articles were not limited to authors with higher overall publication-level citation profiles. The relationship between total Web of Science citations and first-author h-index is illustrated in Figure 5.

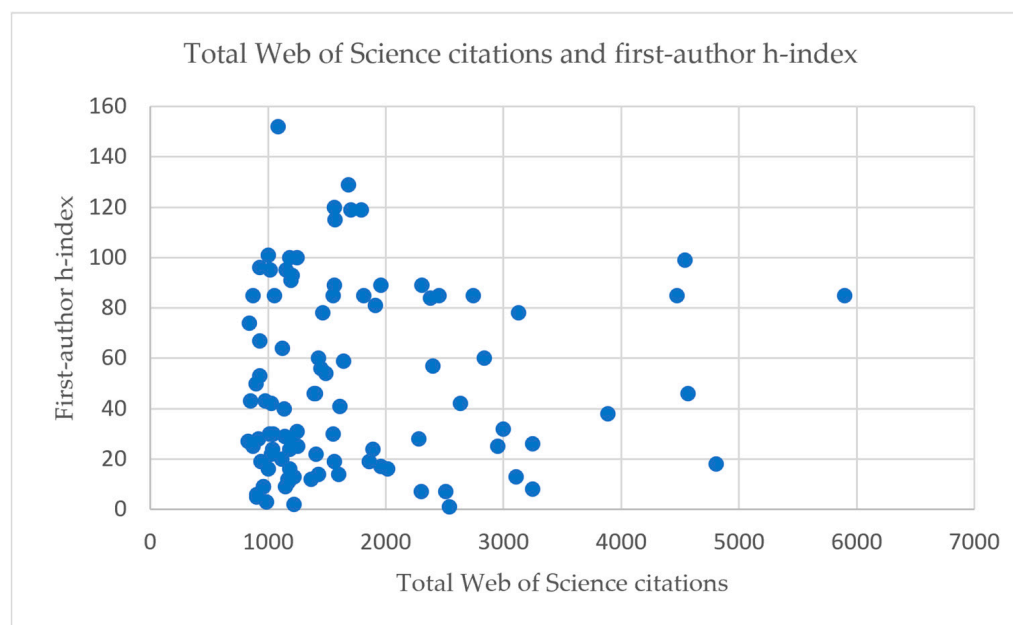


Figure 5. Scatter plot showing the association between total Web of Science citations and first-author h-index.

3.7. Patent Citations

Patent citation analysis indicated that 41 of the top 100 articles were cited in at least one patent, based on available patent citation data. Among these patent-cited records, the article by Zinman et al. [7] had the greatest number of patent citations, followed by Marso et al. [10], Saeedi et al. [11], Cho et al. [12], and the 2013 American Diabetes Association position statement [8]. A strong positive association was observed between total Web of Science citations and patent citations among articles with available patent citation data, using both Pearson correlation ($r = 0.853$) and Spearman rank correlation ($\rho = 0.859$, $p < 0.001$; $n = 41$). These findings suggest that a subset of highly cited diabetes articles also had measurable translational relevance through citation in patents. The relationship between total Web of Science citations and patent citations is illustrated in Figure 6.

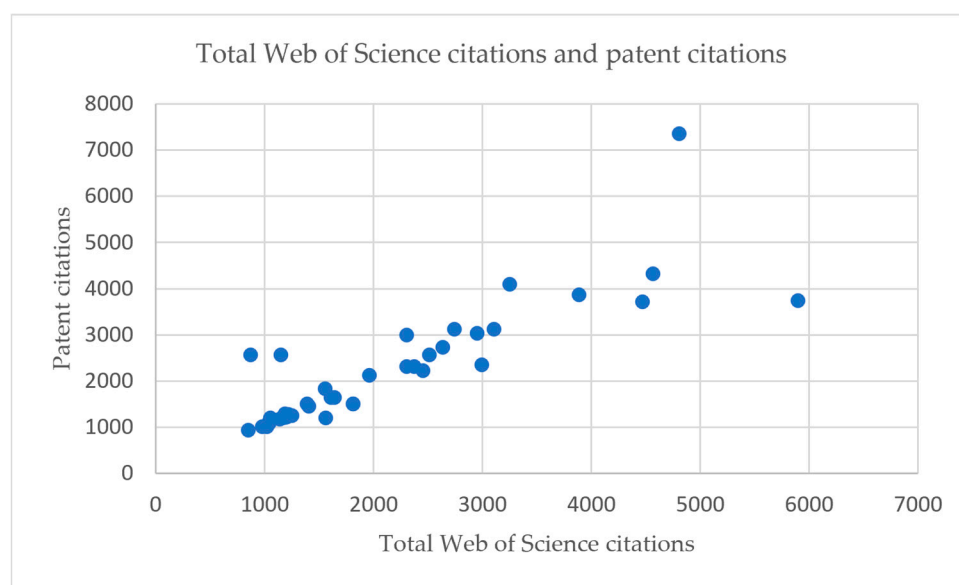


Figure 6. Scatter plot showing the association between total Web of Science citations and patent citations among records with available patent citation data.

3.8. Citation Density and Trends over Time

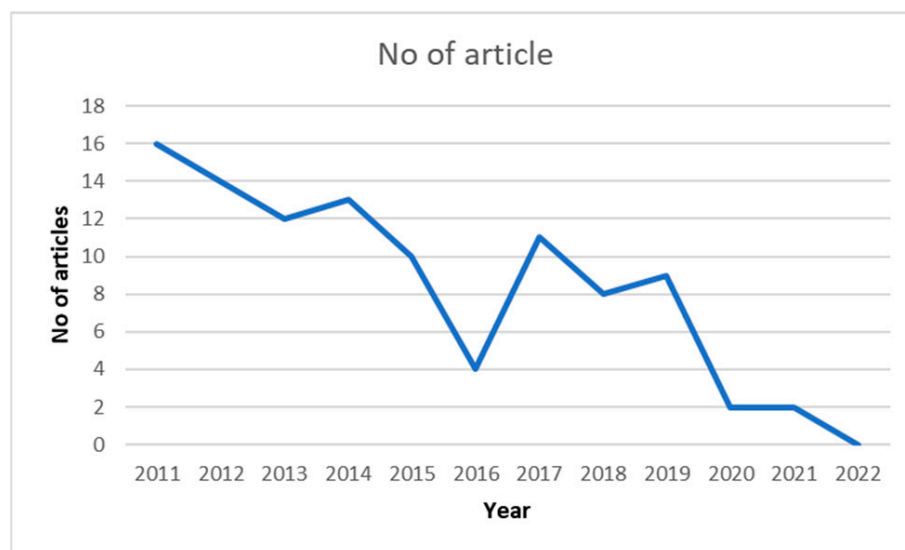
Citation density was calculated for each article as the average number of citations per year from the date of publication. This was meant to normalise for the time factor. The articles by Saeedi et al. [11], Wiviott et al. [13], and Cho et al. [12] had the greatest rates of citation density, indicating rapid citation accumulation shortly after an article was published. The distribution of citation frequency of the top-cited articles by the year the article was published indicated that 65% of the articles were published between 2011 and 2015, with 2011 having the most articles ($n = 16$), followed by 2012 ($n = 14$), 2014 ($n = 13$), and 2013 ($n = 12$). Of note, only four articles since 2020 have made the top 100, which could support a citation lag. Yearly trends are summarised in Table 4 and illustrated in Figure 7.

Table 4. Number of records by year of publication.

Year	No. of Records
2011	16
2012	14
2013	12
2014	13
2015	10
2016	4
2017	11

Table 4. *Cont.*

Year	No. of Records
2018	8
2019	8
2020	2
2021	2
2022	0

**Figure 7.** Temporal distribution of the top 100 most-cited records by publication year.

3.9. Funding Sources

Out of the 100 articles, 77 reported at least one funding source, while 23 did not report funding. The National Institute for Health Research (NIHR) was the most frequently reported funder ($n = 17$). Other notable funders included AstraZeneca ($n = 6$), Boehringer Ingelheim ($n = 4$), Janssen Research and Development ($n = 3$), and Lilly Diabetes ($n = 3$). Other funding sources appeared in one or two articles and included public agencies, charitable foundations, academic institutions, and industry sponsors. The funding breakdown is presented in Table 5.

Table 5. Funding organisations reported in the top 100 most-cited articles.

Name of Funding Organisation	No. of Records
NA	23
National Institute for Health Research	17
AstraZeneca	6
Boehringer Ingelheim	4
Janssen Research and Development	3
Lilly Diabetes	3
ATTD Congress	2
Canadian Institutes of Health Research	2
Chinese central government	2
EASD; ADA; National Institute for Health Research	2
Howard Hughes Medical Institute	2
Merck Co.	2
National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)	2

Table 5. *Cont.*

Name of Funding Organisation	No. of Records
Novo Nordisk	2
Sanofi	2
American Diabetes Association	1
Bill and Melinda Gates Foundation	1
British Heart Foundation	1
CDC	1
Cunningham Trust	1
Danish National Research Foundation	1
Danish Strategic Research Council	1
Deutsche Forschungsgemeinschaft	1
Directorate for Biological Sciences	1
Druckenmiller Fellowship of the New York Stem Cell Foundation	1
Eli Lilly	1
European Commission	1
GlaxoSmithKline	1
Harvard Stem Cell Institute	1
JDRF	1
Leona M. and Harry B. Helmsley Charitable Trust	1
National Institute of General Medical Sciences	1
Pfizer–MSD Alliance	1
SRC Programme	1
Swedish Research Council	1
Takeda Development Center Americas	1
UCSD/UCLA NIDDK Diabetes Research Center	1
UK Medical Research Council	1
US National Institutes of Health	1
US Department of Veterans Affairs	1
Wellcome Trust; British Heart Foundation	1

3.10. Authorship Patterns

Authorship pattern analysis indicated that 80% of the records had three or more authors, with only three records having a single author (Saklayen, Hu, and Hotamisligil). Seventeen records had two authors. One record had 21 to 25 authors, and 17 records had more than 25 authors, reflecting the contribution of large multicentre trials and collaborative networks. Eight records were recorded as group-authored records, and three were recorded as anonymous-authored records. Authorship information is summarised in Table 6.

Table 6. Authorship pattern among the top 100 most-cited records.

Authorship Category	No. of Records
Single author	3
Two authors	17
Three to ten authors	32
Eleven to twenty authors	19
Twenty-one to twenty-five authors	1
More than twenty-five authors	17
Group-authored records	8
Anonymous-authored records	3

Correlation analyses for PubMed Central citations, first-author h-index, and patent citations are summarised in Table 7.

Table 7. Correlation analyses between total Web of Science citations and additional impact metrics.

Variable	<i>n</i>	Pearson <i>r</i>	Spearman ρ	<i>p</i> -Value
PubMed Central citations	99	0.863	0.834	<0.001
First-author h-index	97	0.074	0.100	0.332
Patent citations	41	0.853	0.859	<0.001

Note: Correlation analyses were performed using available data for each variable. Missing values were excluded pairwise. The *p*-value shown refers to the Spearman correlation, except where both Pearson and Spearman correlations were significant at $p < 0.001$.

3.11. Top Articles and Their Impact

Several of the most-cited articles were impactful clinical trials or guidelines that have influenced diabetes management globally, for example, the EMPA-REG OUTCOME, LEADER, and CANVAS trials and the ADA 2013 position statement. High-impact articles in basic science that focused on inflammation, insulin resistance, and more molecular mechanisms of diabetes were also prominent. Overall, the message is that both clinical and basic science research contribute significantly to the scientific knowledge and practical management of diabetes.

4. Discussion

4.1. Main Findings

This bibliometric analysis aimed to identify and describe the 100 most-cited articles in diabetes research published between 2011 and 2022. The findings characterise the nature, impact, and trajectory of diabetes-related literature over the past decade, describing citation metrics alongside publication source, geographic origin, study design, funding, authorship patterns, and translational reach as evidenced by patent citations.

The majority of the 100 most-cited articles were original research (68%), with review articles comprising a further 27% and editorials, letters, and book chapters making up the remaining 5%. The most-cited individual article was the American Diabetes Association 2013 position statement on the diagnosis and classification of diabetes mellitus, published in *Diabetes Care*, which received 5898 citations and serves as a foundational reference for defining diabetes types and their aetiological basis [8]. Other highly cited articles included those by Cho et al. [12], Saeedi et al. [11], and Wiviott et al. [13]. These articles reflect major areas of influence in the field, including global diabetes prevalence estimation, cardiovascular outcomes research, and evaluation of newer glucose-lowering therapies.

The 100 most-cited articles scored a range of 832 to 5898 degrees of citation impact, a mean of 1748.6, and a median of 1416.5, suggesting a high top-level impact overall. Although the citation counts consider the importance of time in the accrual of citations, it is reasonable to argue that the newness of many recent publications has generated incredible momentum in the face of shrinking timelines. The momentum is also clear in the density of citations, given the high citation counts of recent reflections within just a few annual cycles, suggesting an uptake rate that results in growing rapidly and spreading evenly [14]. The newness is, in fact, a hallmark of a significant number of the most-cited papers in this review, and this demonstrates that authors who are creating new content and responding to current needs in science or clinics have typically accrued a significant number of citations in a shorter period of time [15].

The list of most-cited papers included papers from 29 unique journals. Further, some of them, such as *diabetes care*, *The New England Journal of Medicine*, and *The Lancet*, appear in 50% of the publications. These journals all exhibit a high impact factor, a peer-review process for additional scrutiny, and are valued for any research published; they reach a wider audience and may hold or advance any aspect of diabetes research that has high

readership [15]. The frequently cited journals indicate the affiliation between the location of publication and citation frequency. Other journals published, for example, included JAMA, Nature, Cell, and Journal of Clinical Investigation, indicating that diabetes-related research has attracted a wide range of interest [16].

The United States ($n = 45$) was the largest contributor of articles in the top-cited articles list, followed by the United Kingdom ($n = 20$) and Canada ($n = 8$). This reflects a larger picture of funding and the research infrastructure around the world, which is largely accounted for by high-income countries. Nonetheless, contributions from other high-income countries including Germany ($n = 3$), Sweden ($n = 2$), and Australia ($n = 3$), as well as from middle-income economies such as China ($n = 3$), indicate that high-impact diabetes research extends beyond the US and UK. The near-total absence of contributions from low- and middle-income countries with high diabetes burden reflects structural inequities in research capacity and publishing access [16,17]. The literature being cited represented a bias from low- and middle-income countries, in spite of the larger diabetes burden these countries carry with them, implying bias against research support, visibility, and access to high-impact publishing spaces [18].

Most of the articles ($n = 68$; 68%) were original research studies, which have previously been shown to be influential for future work due to new and novel findings. Review articles represented 27%, while the remaining 5% included editorials, letters and chapters. Original research studies were dominated by randomised controlled trials (RCTs), observational studies and basic science studies. Notably, the most-cited studies included key RCTs such as EMPA-REG OUTCOME, LEADER and CANVAS. These RCTs were frequently cited, likely due to their clinical impact and influence on recommendations for care [19,20]. It was the findings of the above trials that provided cardiovascular and renal benefit with new antidiabetic drugs that transitioned to practice [21].

There was also substantial representation of basic science studies that examined potentially important mechanisms such as insulin resistance, inflammation, and β -cell dysfunction. Therefore, early studies on the pathogenesis of diabetes provided notable insight and helped to define possible targets for therapy. In the most-cited articles, we observe a consistent link between highly cited clinical findings and the underlying mechanistic and preclinical research that has shaped the field [22–24].

The correlation findings revealed a very strong and positive association between total citations and PubMed Central (PMC) citations, indicating that articles with substantial citation records in Web of Science also registered a substantial number of citations in the biomedical database (PMC). However, we also observed a poor correlation between high citation counts and author h-indexes, elucidating that high-impact papers are not exclusively limited to a corpus of prolific authors or high authorship counts [25]. These findings contribute to existing literature that considers quality, novelty, and relevance of content as significant contributors to article-level impact [26].

Surprisingly, 41 out of the 100 top-cited articles were cited in patents, indicating their significant translational potential. The 5 most-cited articles in patents were published by Zinman et al. [7], Marso et al. [10], Saeedi et al. [11], Cho et al. [12], and the ADA [8]. Most of the articles are either basic science articles or large clinical trials, suggesting both exploratory science and applied science are complementary paths to achieve better practical uses of research and to build new intellectual properties. Our findings support their significant value, which we show using moderate correlation values to indicate a correlation across both sources for citation counts between Web of Science and patent citations. Academic groups with substantial citation records tend to register patents that can have implementation recommendations to take advantage of their strong citation count [27].

Citation density provided further context to the impact of scientific work on the academic community. The most recently published articles (2018–2020) had high citation densities, indicating that those articles had been quickly assimilated into the knowledge base of the academic community. These publishing opportunities highlight this need for timely, high-impact articles about a hot topic (epidemiology of diabetes, newer medications for diabetes, and their impact on cardiovascular outcomes). A high density of citations (despite a relatively short period of time for the studies, which were completed within only two years) suggests that good, relevant clinical research continues to be integrated into the knowledge base in a timely manner [28,29].

Temporal analysis showed that the period from 2011 to 2015 had the highest representation among the top-cited articles rather than the highest citation density. This period could be considered an optimal period for citation accumulation: sufficient time had elapsed for citations to accrue, while the research itself had attained a degree of scientific maturity. The limited number of articles published >2020 (only four articles were published from that time) could simply reflect that not enough time has passed for citation accumulation [30]. This lag in citation density may be relevant when interpreting the impacts of recent articles.

Funding information indicated that 77 of the top 100 cited articles reported at least one funding source, while 23 articles did not report funding. The National Institute for Health Research (NIHR) was the most frequently reported funder ($n = 17$), followed by AstraZeneca ($n = 6$), Boehringer Ingelheim ($n = 4$), Janssen Research and Development ($n = 3$), and Lilly Diabetes ($n = 3$). Other funding sources appeared in one or two articles and included public agencies, charitable foundations, academic institutions, and industry sponsors. Overall, the findings show that highly cited diabetes research was supported by a mixed funding profile, with both public-sector and industry funders represented among the most influential articles [31].

Examination of authorship showed that three or more authors were listed for 80% of the articles, indicating the collaborative nature of highly cited diabetes research. Only three articles had a single author (Saklayen, Hu, and Hotamisligil), while 17 articles had two authors. Seventeen articles had more than 20 authors, which is consistent with large multicentre trials and international collaborative research networks [32]. In addition, eight articles were recorded as group-authored articles and three as anonymous-authored articles [33]. Overall, these findings show that collaborative and consortium-based authorship was a common feature of the most-cited diabetes literature.

4.2. Study Strengths and Limitations

This study has several strengths. It provides an updated bibliometric overview of the 100 most-cited diabetes-related records published between 2011 and 2022. In addition to total Web of Science citation counts, the analysis considered citation density, PubMed Central citations, first-author h-index, and patent citations. These additional metrics provide a broader view of academic visibility and potential translational relevance than citation count alone. The study also examined journal representation, country of origin, funding sources, document type, and authorship patterns, allowing a more detailed description of highly cited diabetes-related research during the study period.

Another strength is the inclusion of patent citation data. This component distinguishes the present analysis from many previous diabetes bibliometric studies, as it provides an additional indication of whether highly cited academic work has also been cited in technological or translational contexts. Manual screening was also used to assess topic relevance, which helped reduce inclusion of records in which diabetes was mentioned only incidentally.

This study also has limitations. First, the analysis was based on the Web of Science Core Collection, SCI-Expanded database. Although Web of Science provides standardised citation indexing and is commonly used in bibliometric analyses, citation counts may differ from those reported in Scopus, Google Scholar, or other databases. Therefore, some highly cited diabetes-related records indexed differently across databases may not have been captured. Second, the search strategy used the broad topic term “diabetes” and screened the highest-cited records retrieved from this search. This approach was appropriate for identifying highly cited diabetes-related records, but it may have missed articles that were relevant to diabetes but did not use this term prominently in the title, abstract, author keywords, or Keywords Plus.

Third, citation counts are time-dependent and may change as articles continue to accumulate citations. Citation density partly addresses this issue, but it cannot fully remove time-related citation bias. Fourth, citation frequency does not necessarily reflect methodological quality, scientific rigour, or clinical importance. Highly cited articles may reflect visibility, publication venue, clinical relevance, controversy, or research trends as well as scientific merit. Finally, self-citations were not comprehensively removed from all citation counts; therefore, the citation data should be interpreted as total Web of Science citation counts rather than citation counts corrected for self-citation. However, a post hoc sensitivity check of the ten highest-ranked records using current Web of Science citation reports showed minimal differences between total citation counts and citation counts excluding self-citations, with no substantive change in the interpretation of the highest-ranked records (Supplementary Table S3).

4.3. Recommendations for Future Research and Policy

This research presents important considerations for researchers, academic institutions, journal editors, and funding organisations. Understanding the properties of high-citation papers can provide researchers with the ability to design and report research that has an increased opportunity for academic reach. High-impact original research, in particular papers that report on clinically relevant questions or describe mechanistic understanding, remains at the forefront of scientific influence. Journal selection, clear reporting, and interdisciplinary collaboration also matter greatly to impact and visibility.

In terms of recommendations for institutions and funders, this study indicates a need to support collaborative, innovative, and translational research. As such, funding mechanisms that support interdisciplinary, large trials, and international collaboration are expected to yield high-impact outcomes. Further, strategies to address the dearth of specific geographic regions and demographics always underrepresented in high-impact research, such as fair access to resources, mentorship, and publishing, must be considered.

Moreover, journal editors and publishers can take advantage of the information provided when planning special issues to highlight developing areas of research as well as highlight research with high translational impact. Breaking down the linguistic and access barriers may end in improved global equitable access to impactful research.

As the global burden of diabetes continues to rise, it is extremely important to identify and understand the characteristics of impactful research. This bibliometric study could provide a launching point for future research initiatives aimed at evaluating and enhancing the impact, accessibility, and quality of diabetes literature and to inform strategic decision-making for research initiatives, publication and funding, all of which can assist in current efforts to advance scientific knowledge and improve health outcomes for people with diabetes worldwide.

5. Conclusions

The 100 most-cited diabetes-related records published from 2011 to 2022 were identified and characterised through a structured bibliometric analysis. This study provides an updated list of highly cited diabetes-related records and places them in the context of citation patterns, study type, journal of publication, funding support, country contribution, authorship, and possible translational relevance. The findings highlight records that gained substantial academic attention during the study period, while also describing broader publication and citation patterns in diabetes research.

Most of the top-cited records were original research articles, including randomised controlled trials, observational studies, and mechanistic studies examining cardiovascular outcomes, pharmacological agents, epidemiology, and diabetes-related biological pathways. Review articles, guidelines, and position statements also contributed substantially, reflecting the importance of evidence synthesis and clinical guidance in highly cited diabetes research. Many of these records were published in highly visible journals, including *Diabetes Care*, *The New England Journal of Medicine*, and *The Lancet*, suggesting that journal readership and visibility may have contributed to citation reach.

The findings also show that collaborative and multicentre research, particularly large clinical trials and international organisational reports, was commonly represented among highly cited records. Patent citation data provided an additional measure of possible translational relevance for some highly cited records, although this should not be interpreted as direct evidence of clinical or technological impact. Contributions from different countries were observed, but highly cited records were still mainly concentrated in high-income settings. This indicates the need for broader visibility and representation of diabetes research from low- and middle-income countries, where the burden of diabetes is substantial.

Overall, this study describes the main characteristics of highly cited diabetes-related research over the study period. These findings may be useful for researchers, institutions, funding agencies, and policymakers interested in understanding citation patterns and identifying areas for future bibliometric work, evidence mapping, and more inclusive diabetes research.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/data11080194/s1>, Table S1: Characteristics of the 100 most-cited diabetes-related records; Table S2: Article-level Web of Science citation, PubMed Central citation, and first-author h-index data; Table S3: Sensitivity analysis comparing total citation counts with citation counts excluding self-citations for the ten highest-ranked records.

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