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Bibliometric analysis of publications on the use of herbal medicines for the treatment of type 2 diabetes (2004–2024)

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Abstract

The search for new hypoglycemic agents for the prevention and treatment of type 2 diabetes is driven by the severe burden of this disease on the global population. Type 2 diabetes affects over 500 million adults worldwide and is characterized by a steady increase, despite the impressive arsenal of synthetic hypoglycemic drugs that target various stages of diabetes pathogenesis. Interest in natural complex compounds found in medicinal plants is currently growing. This bibliometric analysis aims to examine the results of studies on the hypoglycemic potential of herbal medicines in the treatment of patients with type 2 diabetes. Data were extracted from the open-access PabMed database using an inclusive search strategy. The analysis included 379 relevant studies published in 180 different sources, involving 1,804 authors. The results show a marked increase in research on the efficacy of herbal remedies, indicating a growing interest in new sources of non-drug approaches to diabetes. Bradford's Law identified 13 key journals that played a significant role in disseminating research in this area, with Medicine emerging as the most prolific. The United States and China were particularly strong in collaborative research. The China Academy of Chinese Medical Sciences, Beijing University of Chinese Medicine, and the Hospital of Chengdu University of Traditional Chinese Medicine were the most productive institutions, and Tong X. and Zhang Y. were the lead authors. A chronological keyword analysis highlighted the significance of terms such

as "Humans, female, middle-aged, male, diabetes mellitus type 2, drug therapy." Overall, this study sheds light on the global landscape of research on the use of herbal remedies in patients with type 2 diabetes. The information obtained from this analysis is important for determining future research priorities and collaborative efforts in finding effective drugs or improving treatment outcomes for type 2 diabetes and its complications. However, the study acknowledges the limitations of using a single publication database and recommends that future studies include data from other sources.

Keywords: type 2 diabetes, herbal remedies, herbs, bibliometrics, co-occurrence, herbal.

1. Introduction

Diabetes mellitus (DM) is currently recognized as one of the most significant noncommunicable epidemics globally, attracting the attention of the United Nations (UN) and the healthcare systems of various countries. The disease is characterized by a steadily increasing prevalence and poses a serious threat to public health due to the high incidence of early disability and mortality associated with vascular complications [1].

According to the International Diabetes Federation (IDF), the number of people aged 20–79 years with DM has reached 537 million. By 2045, this number is projected to almost double, reaching 783 million people, representing a 46% increase [2–4].

The search for herbal remedies for the treatment of diabetes is of great scientific and practical importance. Despite advances in modern pharmacotherapy, a complete cure for diabetes remains elusive, and existing medications are often associated with side effects and high costs. This makes the search for natural alternatives with effective and safe hypoglycemic effects relevant [5–7].

Plant sources are a rich reservoir of biologically active compounds—flavonoids, alkaloids, terpenoids, saponins, and polyphenols—that can regulate blood glucose levels, increase tissue sensitivity to insulin, protect pancreatic β-cells, and reduce oxidative stress. They can exert a multicomponent effect, combining antioxidant, anti-inflammatory, lipid-lowering, and nephroprotective effects, which is particularly important in the complex treatment of diabetes and its complications [8–11].

Thus, the study and implementation of herbal remedies in the treatment of diabetes mellitus represents a promising direction that can expand therapeutic options, improve its safety and accessibility, and facilitate the development of a personalized approach to the treatment of this disease.

Bibliometric analysis is an effective method for the quantitative evaluation of scientific publications, allowing researchers to track the development of specific scientific areas. This approach is based on the application of mathematical and statistical tools to analyze the growth dynamics, productivity, and overall trends of publication activity on a specific topic [12,13].

In medical science, bibliometric analysis is particularly important, as it helps identify key research trends, leading countries and institutions, and points to areas requiring further development. This study can serve as an important basis for future comparative studies and analytical reviews. Its primary goal is to identify key trends and achievements in this field, as well as to identify promising areas for further research and improvement.

2. Materials and Methods

To ensure high-quality research data, journals were searched in the internationally recognized PabMed database (pubmed.ncbi.nlm.nih.gov) in September 2025 using the keywords: (Herbal AND type 2 diabetes mellitus). Bibliometric analysis was conducted using the Bibliometrix package for R[14]. The number of publications was taken into account to identify the most productive journals, and Bradford's law was applied to identify key journals that significantly contribute to citations in the field.

3. Results

3.1 General Description of Included Studies

Figure 1 shows the flowchart of the literature search and study selection. A total of 433 articles were identified and screened by title and abstract in accordance with the inclusion criteria for review and research articles in English published over the past 20 years (2004–2024). A total of 379 articles were selected. To visualize the data extraction process, Figure 1 shows a PRISMA flow chart[15] describing the selection process.

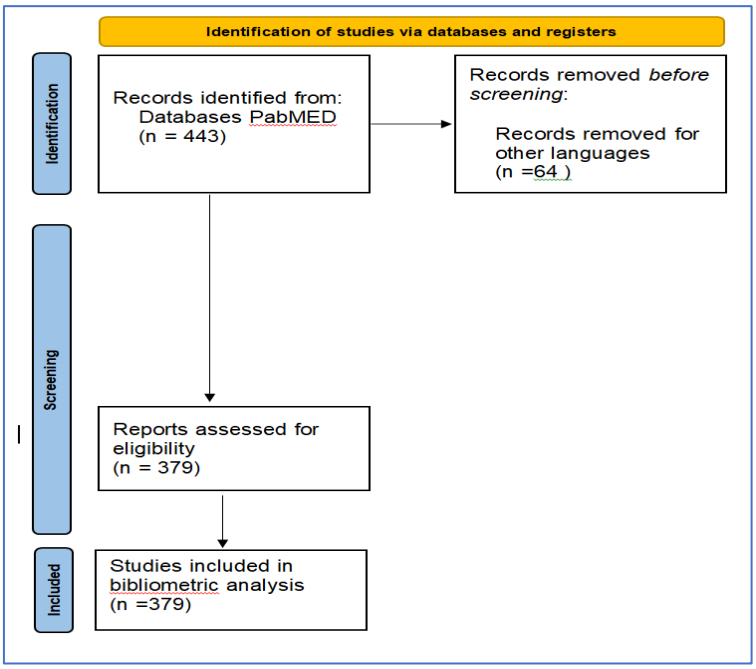

Figure 1 - Flowchart of the publication screening process using PRISMA

3.2 Publication trends by year

Figure 2 shows the publication trends by year. Before 2010, very few publications were found on the use of plants for type 2 diabetes. From 2004 to 2010, the number of publications did not exceed 10. Between 2017 and 2024, the number of published articles on the effects of herbal remedies on diabetes increased significantly. During this period, the number of publications varied, but the overall trend was relatively stable: the number of publications increased year after year, reaching a peak of 38 publications in 2022.

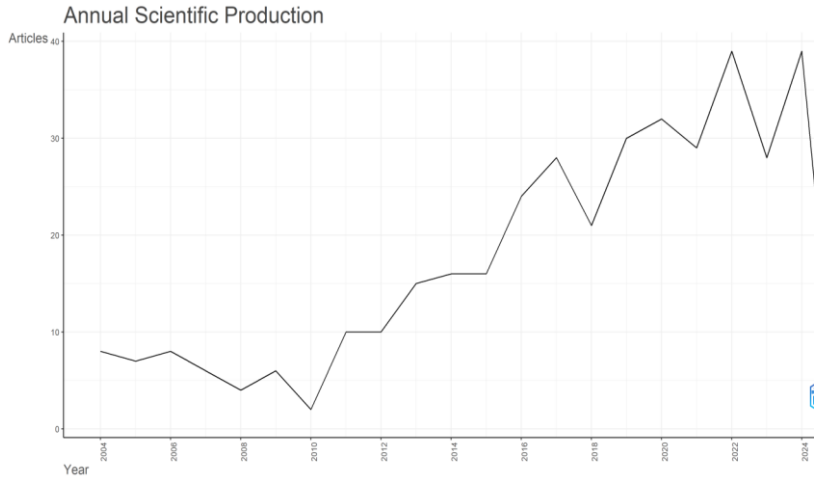

Figure 2 - Publication year trends for herbal medicine research in type 2 diabetes

3.3 Key Authors and Author Group

In this bibliometric analysis, we counted the first authors of all included articles and their corresponding number of publications on herbal medicines for type 2 diabetes (Figure 3). After counting, authors who published eight or more articles were defined as key authors in this topic area. The results of this study showed that 10 key authors published a total of 109 articles, representing 6% (109/1800) of all included articles. This percentage falls far short of Price's requirement for a key author group. Thus, a key author group in the field of herbal medicine research in type 2 diabetes was not identified.

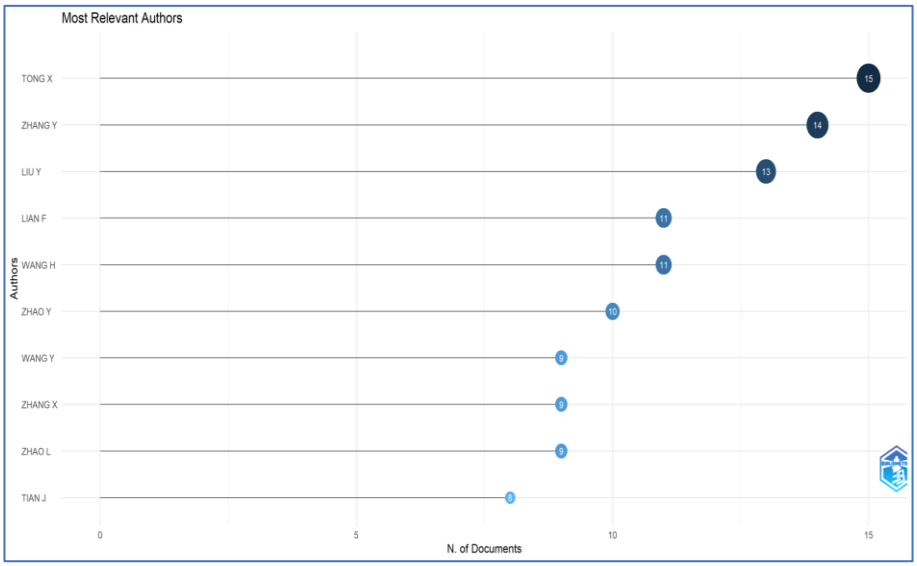

Figure 3(a) - Most productive authors: ten most significant authors and their contribution to the study of herbal remedies for the treatment of type 2 diabetes (2004–2024)

3.4 Major journals

Using Bradford's law, which describes the distribution of scientific articles among journals, we identified ten key journals of greatest interest to researchers in this field (Figure 4). According to this law, these journals form the core of publications on the effectiveness of herbal remedies for type 2 diabetes. The analysis showed (Figure 5) that the journal "Medicine" is the most productive, with 14 articles published. Among the key publications on this topic, the journals "Molecules" stand out - 13 articles, "Frontiers in Pharmacology" - and "Journal of Ethnopharmacology" - 12 articles each, which publish a significant number of studies devoted to natural compounds and their pharmacological effects.

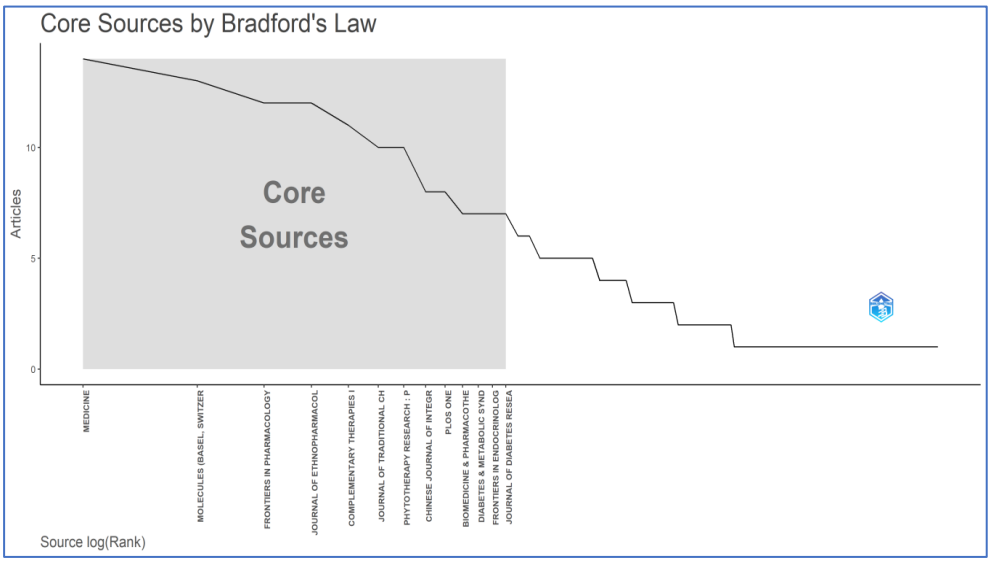

Figure 4 - Bradford's Law Graph - Main Journals

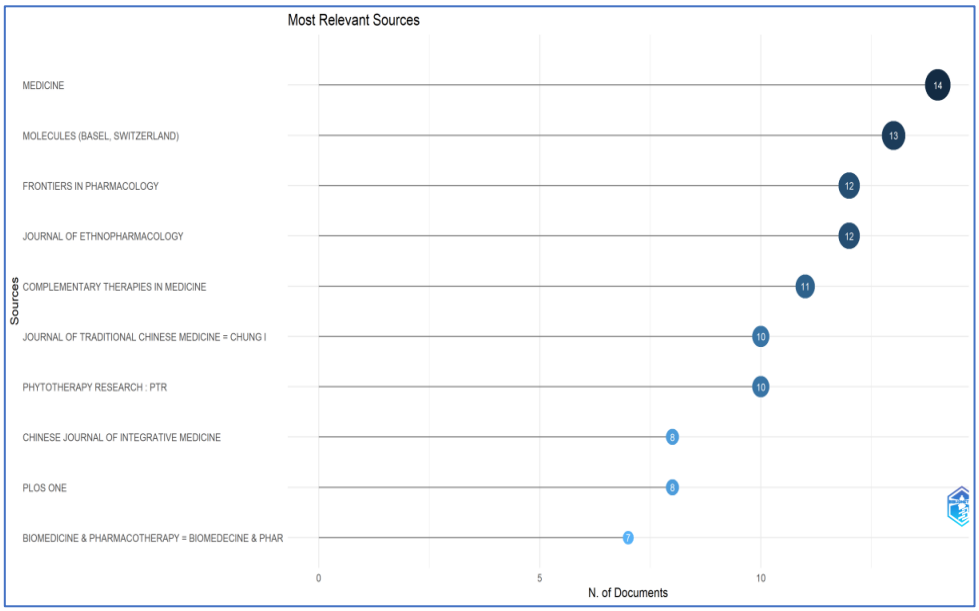

Figure 5 - Top 10 most cited journals

3.5 Key Organizations and Countries, Their Collaborations the most productive organizations by number of publications in the field under study.

The diagram shows the distribution of the number of articles by the authors' primary affiliations. The leading institutions are the China Academy of Chinese Medical Sciences (105 articles), Beijing University of Chinese Medicine (65), and the Hospital of Chengdu University of Traditional Chinese Medicine (57). Organizations in China make the largest contribution to publication activity, indicating their leading role in scientific research in this area (Figure 6).

Figure 7 shows the geographic distribution and areas of collaboration between countries involved in publications on the topic under study. The most intensive collaboration is observed in China, which is highlighted in the darkest shade of blue, indicating its leading position in the number of publications and international collaborations. China actively collaborates with the United States, Canada, Iran, Australia, and European countries. The light blue areas represent countries with less publication activity but engaged in international collaborations.

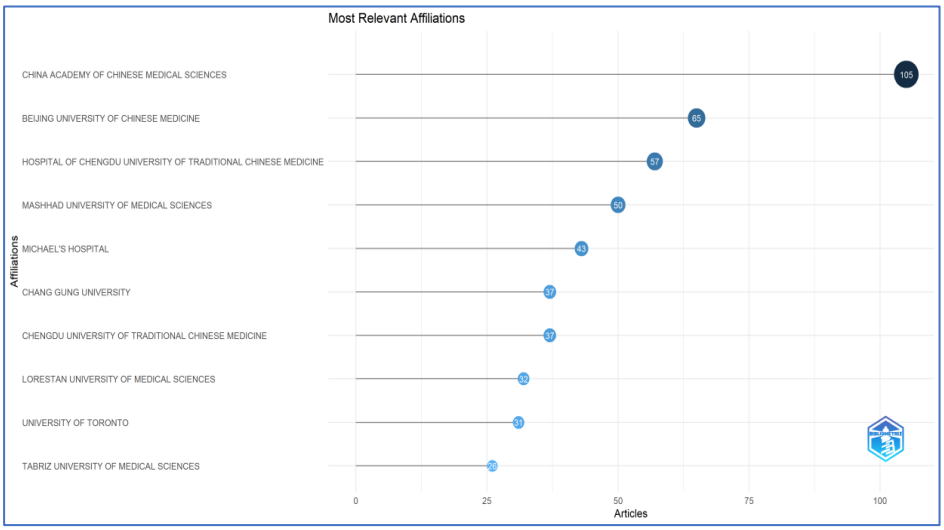

Figure 6 - The most productive organizations in the study area

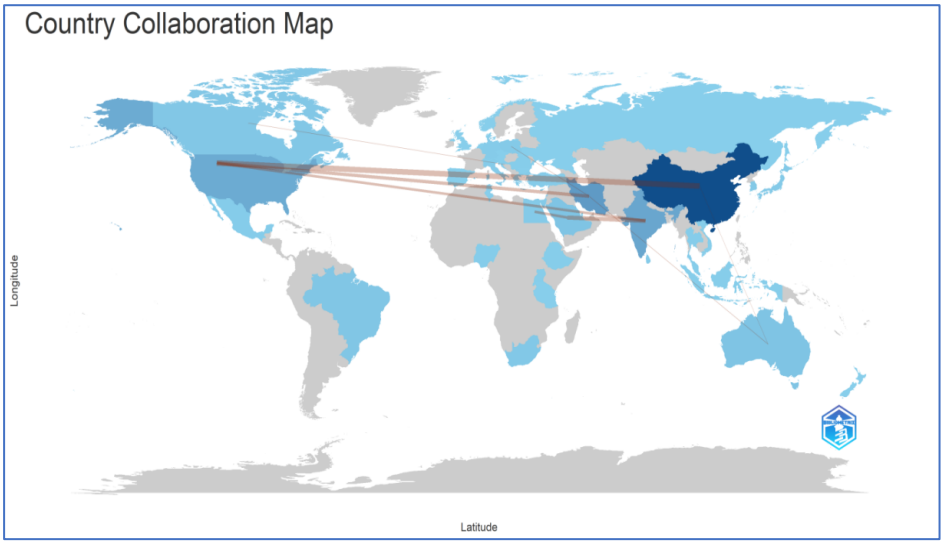

Figure 7 - Country Collaboration Map

In summary, this study analyzed the results of global research on the efficacy and use of herbal remedies in patients with type 2 diabetes over the past 20 years. Leading journals, influential articles, and collaborative projects between institutions, authors, and countries were identified. The results provide valuable insights into the research landscape and point to potential directions for future research.

4. Discussion

In recent years, bibliometric analysis and scientific mapping have rapidly developed, driven by growing interest among researchers in systematizing and evaluating scientific advances in herbal medicine and diabetology [16]. Using a bibliometric approach allows us to identify key trends in the study of herbal remedies for diabetes, identify the most productive authors, countries, and scientific organizations, and assess the impact of the most cited publications. This analysis contributes to a deeper understanding of the intellectual landscape of this field and helps identify promising areas for further research [17, 18]. Recent studies have shown that high consumption of "healthy" plant-based foods is associated with a lower risk of hyperglycemia, while "unhealthy" plant-based diets (high in processed plant foods) may actually increase the risk of diabetes [19].

A bibliometric analysis revealed that scientific interest in studying herbal remedies for type 2 diabetes has increased significantly over the past two decades. Until 2010, publication activity in this area remained extremely low, likely due to the limited clinical and experimental data on the mechanisms of action of herbal remedies. Since 2017, there has been a significant increase in the number of publications, peaking in 2022. This trend reflects a global trend toward searching for alternative and adjuvant approaches to diabetes treatment based on the principles of evidence-based herbal medicine and integrative medicine. The absence of a distinct "core group of authors" according to the Price criterion indicates the fragmentation of the research field and the absence of stable scientific schools specializing exclusively in herbal remedies for T2DM. This may be a consequence of the multidisciplinary nature of the topic, combining pharmacology, endocrinology, botany, and biochemistry. At the same time, the presence of ten of the most productive authors indicates the formation of an active scientific community, around which closer collaborations may develop in the future. An analysis of leading journals showed that the main core of publications is concentrated in publications focused on the pharmacology of natural compounds and traditional medicine: Medicine, Molecules, Frontiers in Pharmacology, and the Journal of Ethnopharmacology. This confirms that research in this area is predominantly conducted in the context of assessing the biological activity and mechanism of action of natural compounds. A recent review conducted in 2023 shows that dietary therapy research encompasses a wide range of interventions, and not just individual herbal remedies" [20, 21]. In terms of research geography, China's dominance is clear, consistent with the high degree of institutional support and traditionally strong scientific schools in the field of Chinese medicine. Leading universities and academies in China (China Academy of Chinese Medical Sciences, Beijing University of Chinese Medicine, Chengdu University of Traditional Chinese Medicine) form the core of publication activity. China's expanding international collaboration with the United States, Iran, Canada, and European countries indicates the globalization of herbal medicine research and a growing interest in interdisciplinary approaches. Overall, the obtained results demonstrate the rapid development of research aimed at identifying new plant compounds with hypoglycemic activity and studying their pharmacological properties. However, the fragmented nature of research relationships, the limited number of clinical trials, and the heterogeneity of methodological approaches indicate the need for standardization of research, increased international collaboration, and the integration of experimental and clinical data. This bibliometric study has several limitations that should be considered when interpreting the results. First, the search and selection of publications was conducted exclusively in the PubMed database, which may have resulted in incomplete coverage of the literature on the

topic. As a result, some relevant publications presented in other sources (e.g., Scopus, Web of Science, Embase, Dimensions) may have been missed. This limits the comprehensiveness of the analysis and may, to a certain extent, bias the results toward journals indexed primarily in PubMed. Second, due to differences in journal indexing and metadata structuring, some publications may have been duplicated or incompletely captured when visualized in VOSviewer. Despite data verification measures taken, such errors cannot be completely eliminated. Nevertheless, using the PubMed database ensures high scientific reliability and standardization of the data, making the obtained results a reliable basis for subsequent comparative and multicenter bibliometric analyses.

5. Conclusions

Thus, the bibliometric analysis allowed us to identify key trends, leading research centers, and key development areas in the field. In the future, it is advisable to increase attention to the clinical aspects of the use of herbal remedies, as well as to assessing their safety, interactions with drugs and cost-effectiveness in the treatment of type 2 diabetes mellitus.

Conflicts of interest. None to declare.

Financing. None.

Author contributions. Conceptualization - A.S.; methodology – A.S.; writing (original draft preparation) – A.S., A.T., A.Z; writing (review and edition) – A.S. All authors have read, agreed to release version of a manuscript and signed the Author's right transfer form.

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2 түрлі қант диабетін емдеуге арналған шөптік дәрілерді қолдану туралы басылымдарды библиометриялық талдау (2004–2024 жж.)

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Түйіндеме

2 типті қант диабетінің алдын алу және емдеу үшін жаңа гипогликемиялық агенттерді іздеу бұл аурудың әлемдік халыққа түсетін ауыр жүктемесімен байланысты. 2 типті қант диабеті бүкіл әлемде 500 миллионнан астам ересек адамға әсер етеді және қант диабеті патогенезінің әртүрлі кезеңдерін нысанаға алатын синтетикалық гипогликемиялық препараттардың әсерлі арсеналына қарамастан, тұрақты өсумен сипатталады. Дәрілік өсімдіктерде кездесетін табиғи кешенді қосылыстарға қызығушылық қазіргі уақытта артып келеді. Бұл библиометриялық талдау 2 типті қант диабетімен ауыратын науқастарды емдеуде шөптік дәрілердің гипогликемиялық әлеуетін зерттеу нәтижелерін зерттеуге бағытталған. Деректер ашық қолжетімді PabMed дерекқорынан инклюзивті іздеу стратегиясын қолдана отырып алынды. Талдауға 180 түрлі дереккөзде жарияланған 379 тиісті зерттеу кірді, оған 1804 автор қатысты. Нәтижелер шөптік дәрілердің тиімділігі бойынша зерттеулердің айтарлықтай өскенін көрсетеді, бұл қант диабетін емдеудің дәрілік емес тәсілдерінің жаңа көздеріне қызығушылықтың артуын көрсетеді. Брэдфорд заңы осы саладағы зерттеулерді таратуда маңызды рөл атқарған 13 негізгі журналды анықтады, оның ішінде «Медицина» ең көп таралған болып шықты. Америка Құрама Штаттары мен Қытай бірлескен зерттеулерде ерекше күшті болды. Қытай медициналық ғылымдары академиясы, Пекин медицина университеті және Чэнду дәстүрлі қытай медицина университетінің ауруханасы ең өнімді мекемелер болды, ал Тонг Х. мен Чжан Ү. жетекші авторлар болды. Хронологиялық кілт сөздерді талдауда «Адамдар, әйелдер, орта жастағы, ер адамдар, 2 типті қант диабеті, дәрілік терапия» сияқты терминдердің маңыздылығын атап өтті. Жалпы алғанда, бұл зерттеу 2 типті қант диабетімен ауыратын науқастарда шөптік дәрілерді қолдану бойынша зерттеулердің жаһандық ландшафтына жарық түсіреді. Бұл талдаудан алынған ақпарат болашақ зерттеу басымдықтарын және тиімді дәрілерді табу немесе 2 типті қант диабеті мен оның асқынуларын емдеу нәтижелерін жақсарту бойынша бірлескен күш-жігерді анықтау үшін маңызды. Дегенмен, зерттеу бірыңғай басылым дерекқорын пайдаланудың шектеулерін мойындайды және болашақ зерттеулерге басқа көздерден алынған деректерді қосуды ұсынады.

Түйін сөздер: 2 типті қант диабеті, шөптік дәрілер, шөптер, библиометрия, бірге кездесетін, шөптік.

Библиометрический анализ публикаций по использованию растительных препаратов для лечения сахарного диабета 2 типа (2004–20245 гг.)

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Резюме

Поиск новых сахароснижающих препаратов для профилактики и лечения сахарного диабета 2 типа обусловлен тяжелым бременем данного заболевания на население планеты. Сахарный диабет 2 типа поразил более 500 миллионов взрослых людей в мире и характеризуется неуклонным ростом,несмотря на внушительный арсенал синтетических гипогликемических лекарств, воздействующих на различные звенья патогенеза диабета. В настоящее время растет интерес к природным комплексным соединениям в составе лекарственных растений. Этот библиометрический анализ направлен на изучение результатов исследований сахаронижающего потенциала растительных препаратов в лечении пациентов с сахарным диабтом 2 типа. Данные были извлечены из базы данных открытого доступа PabMed с использованием инклюзивной стратегии поиска. Анализ включал 379 соответствующих исследования, опубликованных в 180 различных источниках, с участием 1804 авторов. Результаты показывают заметный рост исследований эффективности растительных препаратов, что указывает на возрастающий интерес к новым источникам немедикаментозного подхода в диабете. Закон Брэдфорда определил 13 основных журналов, которые сыграли важную роль в распространении исследований в этой области, причем «Медицина» оказалась самым плодовитым журналом. Самыми сильными в совместных исследованиях оказались США и Китай. China Academy Of Chinese Medical Sciences, Beijing University Of Chinese Medicine, Hospital Of Chengdu University Of Traditional Chinese Medicine были наиболее продуктивными учреждениями, а Tong X. И Zhang Y. были ведущими авторами. Хронологический анализ ключевых слов подчеркнул значимость таких терминов, как «Humans, female, middle aged, male, diabetes mellitus type 2, drug therapy». В целом, это исследование проливает свет на глобальный ландшафт исследований использования растительных препаратов у пациентов с сахарным диабетом 2 типа. Информация, полученная в результате этого анализа, имеет важное значение для определения будущих приоритетов исследований и совместных усилий в поиске эффективных лекарств или улучшению результатов лечения сахарного диабета 2 типа и его осложнений. Однако в исследовании признаются ограничения, связанные с использованием одной только базы данных публикаций, и рекомендуется в будущие исследования включать данные из других источников.

Ключевые слова: сахарный диабет 2 типа, растительные препараты, травы, Bibliometric, Co-Occurrence, Herbal.