



Worldwide research productivity in the field of endocrinology and metabolism — a bibliometric analysis

Światowa produktywność badań w dziedzinie endokrynologii i metabolizmu — analiza bibliometryczna

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Abstract

Introduction: Recently, significant contributions to the study of endocrinology and metabolism have been made. The national contribution, however, has not been reported. The aim of this study was to assess national efforts in the field of endocrinology and metabolism.

Material and methods: A Web of Science search was performed using subject categories "endocrinology & metabolism" to identify articles published from 2010 to 2014. The total and per capita numbers of articles and citations were analysed for different countries.

Results: A total of 79,394 articles were published on endocrinology and metabolism from 2010 to 2014. Most were published in North America, East Asia, and Europe. The majority (82.28%) were reported by authors in high-income countries, 17.64% were published in middle-income countries, and only 0.08% were published in low-income countries. Authors in the United States published the most articles (27.38%), followed by China (7.22%), Italy (5.70%), the United Kingdom (5.6%), and Japan (5.54%). Articles published by authors in the United States had the most citations (260,934). A positive correlation was found between the number of publications and population/gross domestic product (GDP; $p < 0.01$). When normalised to population size, the ranking for the most publications was Denmark, Sweden, and the Netherlands; when normalised to GDP, the ranking was Denmark, Greece, and the Netherlands.

Conclusions: The majority of endocrinology and metabolism articles were published by authors from high-income countries with few from low-income countries. The United States was the most productive country. However, when population size and GDP were considered, some European countries were ranked higher. (*Endokrynol Pol* 2015; 66 (5): 434–442)

Key words: endocrinology; metabolism; bibliometric analysis; literature

Streszczenie

Wstęp: Ostatnio pojawiło się wiele znaczących publikacji na temat badań z dziedziny endokrynologii i metabolizmu. Narodowy wkład na tym polu został jednak pominięty. Celem niniejszego badania była ocena krajowych badań w dziedzinie endokrynologii i metabolizmu.

Materiał i metody: Wyszukiwanie za pomocą Web of Science przeprowadzono z wykorzystaniem kategorii podmiotowych „endokrynologia i metabolizm”, aby zidentyfikować artykuły opublikowane w latach 2010–2014. Analizie poddano łączną liczbę artykułów i cytowań, a także ich liczbę przypadającą na osobę w odniesieniu do różnych krajów.

Wyniki: W latach 2010–2014 opublikowano łącznie 79 394 artykułów na temat endokrynologii i metabolizmu. Większość artykułów pochodziła z Ameryki Północnej, Azji Wschodniej i Europy. Większość artykułów (82,28%) napisali autorzy z krajów o wysokich dochodach, 17,64% opublikowano w krajach średnio zamożnych, a jedynie 0,08% artykułów opublikowano w krajach o niskich dochodach. Najwięcej artykułów publikowali autorzy ze Stanów Zjednoczonych (27,38%), następnie z Chin (7,22%), Włoch (5,70%), Wielkiej Brytanii (5,6%) i Japonii (5,54%). Prace publikowane przez amerykańskich autorów zawierały największą liczbę cytowań (260 934). Stwierdzono pozytywny związek między liczbą publikacji i populacją/produktem krajowym brutto (PKB; $p < 0,01$). Po unormalizowaniu do liczebności populacji, w rankingu krajów o najwyższej liczbie publikacji znalazły się Dania, Szwecja oraz Holandia. Gdy znormalizowano wyniki pod względem PKB, w rankingu znalazły się Dania, Grecja oraz Holandia.

Wnioski: Większość artykułów z dziedziny endokrynologii i metabolizmu została opublikowana przez autorów z krajów o wysokich dochodach; w krajach o niskich dochodach ukazało się niewiele artykułów. Stany Zjednoczone wykazały największą produktywność, jednak kiedy brano pod uwagę liczebność populacji i PKB, niektóre kraje europejskie zajmowały wyższą pozycję. (*Endokrynol Pol* 2015; 66 (5): 434–442)

Słowa kluczowe: endokrynologia; metabolizm; analiza bibliometryczna; literatura

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Introduction

In recent years, the field of endocrinology and metabolism have grown significantly [1, 2]. This has been a worldwide effort; however, some countries have contributed more

than others. It should not be expected that each country produce the same amount of publications because different countries have very different capabilities in terms of financial research resources, scientific research programs, and established healthcare systems [3, 4].

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Scientific progress can be assessed according to the number of publications that are produced by scientific research groups. Progress in the field of endocrinology and metabolism worldwide can be analysed by assessing the numbers of publications produced by authors in different countries. Also, bibliometric analysis can be used to investigate trends in scholarly publications and the relative importance of articles on a specific topic. Bibliometric analysis has been used to determine national contributions to research fields including oncology [4], cardiovascular disease [5], rheumatology [6], nutrition and dietetics [7], diabetic retinopathy [8], emergency medicine [9], critical care medicine [10], anaesthesia [11], plastic and reconstructive surgery [12], foot and ankle research [13], and arthroscopy [14].

Research productivity in the field of endocrinology and metabolism, however, has not been assessed to date. The aim of this study was to analyse research productivity worldwide to uncover national differences in contributions to the study of endocrinology and metabolism from 2010 to 2014.

Material and methods

In Journal Citation Reports (JCR) for the year 2013 established by the Institute for Scientific Information [15] a total of 124 journals in the subject categories of "endocrinology & metabolism" were included in this study (Supplement 1).

The Web of Science database was searched on 8 April 2015 to identify publications in the field of endocrinology and metabolism. The Web of Science is the world's leading database for scientific publications, and citations and other academic impact information is included in this database, which makes it a widely used source for studies on scientific productivity [7–10, 12]. Articles published in 124 journals from January 2010 to December 2014 were identified. The search was conducted for original articles and reviews, and articles that were letters, editorials, or corrections were excluded. The titles of the journals were used to perform a literature search in Web of Science. For each article, the source nation was considered as the nation of the institutional affiliation, unless there was more than one institution, in which case the institution of the corresponding authors was considered as the source nation.

Quantification of research productivity was based on the number of published articles. The total number of citations of some articles was a quality indicator. The primary outcome of the study was the number of original articles originating from each country. Countries were then ranked according to their productivity as expressed by the number of publications. Countries were labelled as high income, upper mid-

dle income, lower middle income, and low income according to the categories set by the World Bank [16]. Gross national income per capita determined the income levels, and \$12,746 or more was considered high income, \$4,125 to \$12,745 was considered upper middle income, \$1,046 to \$4,125 was considered lower middle income, and \$1,045 or less was considered low income. The percentages of articles for each category were then calculated.

Countries producing at least 1% of the total publications were considered as the main productive countries, and further analysis of these countries was performed including the total number of publications, publications per capita, total citations (the number of articles multiplied by the number of citations), and the mean citation number. Statistics on population sizes and gross domestic product (GDP) from the Central Intelligence Agency of the United States and the World Bank for the most recent report were used in the study [17]. The top five countries in terms of publications and the top five journals were listed.

Since we were not employing hypothesis testing but were only describing trends, only descriptive statistics were used, e.g. sum, average, and percentage. A Spearman's test was used for correlation analysis [10,13,14]. SPSS version 19.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses and $p < 0.05$ was considered as significant.

Results

In the years 2010–2014 the total number articles on endocrinology and metabolism identified in the database of Web of Science was 79,394. In 2010 14,905 articles were published, and in 2014 16,201 articles were published. This was a 1.09-fold increase in the publication rate.

Based on the number of publications, 124 countries contributed to the science of endocrinology and metabolism. Authors in the United States published the most articles (21,740/79,394, or 27.38%), authors in China published the second most (5,736/79,394, or 7.22%), and this was followed by Italy (4,529/79,394, or 5.70%), the United Kingdom (4,446/79,394, or 5.60%), and Japan (4,397/79,394, or 5.54%). Figure 1 shows the productive regions on a world map, and North America, East Asia, and Europe are clearly most prominent. A total of 65,323 (82.28%) articles were published in high-income countries, 14,006 (17.64%) articles were published in high middle- and low middle-income countries combined, and only 65 (0.08%) articles were published in low-income countries (Fig. 2). There was a significant correlation ($p < 0.01$) between the number of publications and population size and GDP ($r = 0.442$ and $r = 0.834$, respectively, Fig. 3).

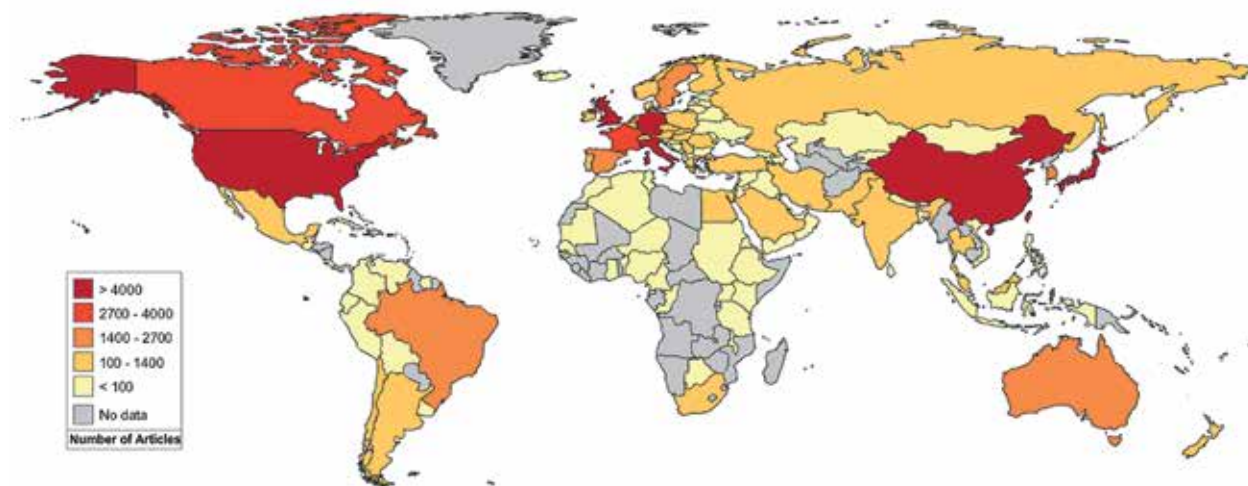


Figure 1. World map of the worldwide research productivity 2010 to 2014

Rycina 1. Mapa świata ukazująca światową produktywność badań w latach 2010–2014

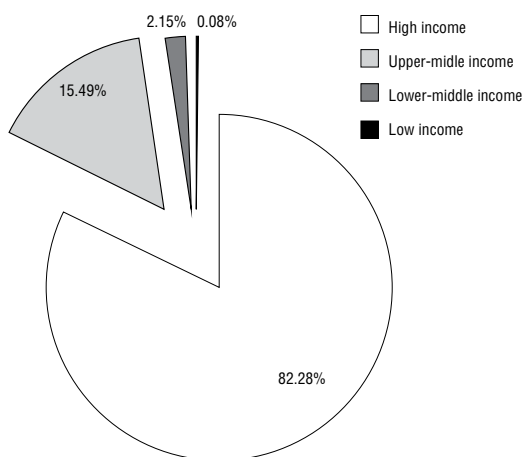


Figure 2. Publications grouped by gross national income 2010 to 2014

Rycina 2. Publikacje pogrupowane według produktu krajowego brutto w latach 2010–2014

Twenty-one countries were seen as main productive countries (producing at least 1% of the total number of articles). These 21 countries published 70,782 of the 79,394 (89.15%) articles (Table I). Of all the main productive countries, the United States had the highest number of citations (260,934); the United Kingdom had 52,068 citations, and Italy had 37,340 citations. Regarding the mean number of citations, the ranking was as follows: the United States (12), the United Kingdom (11.71), and Switzerland (11.67). Most of the articles had authors from high-income countries (17). Upper middle-income countries were the second, twelfth, and sixteenth (China, Brazil, and Turkey, respectively) ranked nations. India, which is a lower middle-income country, was the 18th ranked nation.

Denmark produced the highest number of publications per million population (249.95), Sweden had

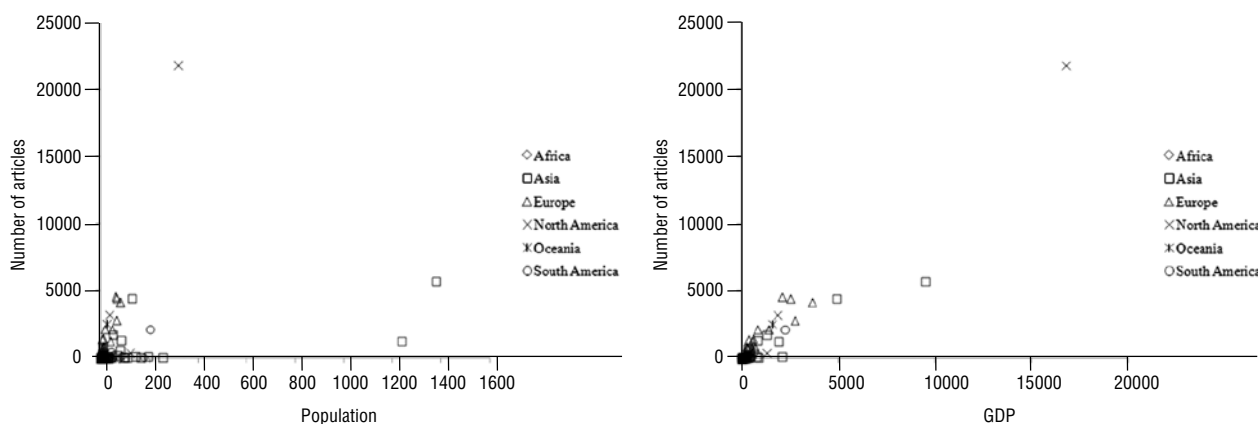


Figure 3. Scatter plot showing the association of publication activity in the field of endocrinology and metabolism with population and GDP from different countries

Rycina 3. Wykres punktowy ilustrujący związek aktywności publikacji w dziedzinie endokrynologii i metabolizmu z populacją i PKB dla różnych krajów

Table I. Publications in the most productive countries 2010 to 2014

Tabela I. Publikacje w najbardziej produktywnych krajach od 2010 do 2014 roku

| Country | N | % | N per million population | N per 10 billion US \$ GDP | Total citation | Mean citation |
|-------------|-------|--------|--------------------------|----------------------------|----------------|---------------|
| USA | 21740 | 27.38% | 68.17 | 12.94 | 260934 | 12.00 |
| China | 5736 | 7.22% | 4.16 | 6.03 | 32920 | 5.74 |
| Italy | 4529 | 5.70% | 73.43 | 21.87 | 37340 | 8.24 |
| UK | 4446 | 5.60% | 69.75 | 17.63 | 52068 | 11.71 |
| Japan | 4397 | 5.54% | 34.59 | 8.97 | 28894 | 6.57 |
| Germany | 4158 | 5.24% | 51.34 | 11.44 | 37052 | 8.91 |
| Canada | 3193 | 4.02% | 91.66 | 17.48 | 30757 | 9.63 |
| France | 2774 | 3.49% | 41.87 | 10.14 | 22885 | 8.25 |
| Australia | 2538 | 3.20% | 112.76 | 16.26 | 28165 | 11.10 |
| Netherlands | 2143 | 2.70% | 126.97 | 26.78 | 23657 | 11.04 |
| Spain | 2117 | 2.67% | 44.35 | 15.59 | 18524 | 8.75 |
| Brazil | 2099 | 2.64% | 10.36 | 9.35 | 9458 | 4.51 |
| South Korea | 1754 | 2.21% | 35.77 | 13.45 | 11686 | 6.66 |
| Sweden | 1483 | 1.87% | 152.51 | 26.53 | 14832 | 10.00 |
| Denmark | 1392 | 1.75% | 249.95 | 42.10 | 13952 | 10.02 |
| Turkey | 1307 | 1.65% | 16.01 | 15.94 | 4697 | 3.59 |
| Poland | 1277 | 1.61% | 33.30 | 24.67 | 4425 | 3.47 |
| India | 1240 | 1.56% | 1.00 | 6.61 | 6551 | 5.28 |
| Switzerland | 841 | 1.06% | 104.32 | 12.93 | 9811 | 11.67 |
| Greece | 825 | 1.04% | 76.56 | 34.13 | 5056 | 6.13 |
| Belgium | 793 | 1.00% | 75.89 | 15.61 | 9193 | 11.59 |

N — number, GDP — gross domestic product

152.51 publications per million population, and the Netherlands had 126.97. When GDP was considered, Denmark ranked the highest with 42.10 publications, Greece had 34.13, and the Netherlands had 26.78. After adjustment for GDP, the United States, China, and Japan ranked relatively low, even though they have large economies.

Table II shows the publications from the five top ranked countries. The most popular journal for the United States was the *Journal of Clinical Endocrinology & Metabolism*; the most popular journal for China was *Biological Trace Element Research*, and the *Journal of Endocrinological Investigation* was popular in Italy. The journal *Diabetic Medicine* was the most popular in the United Kingdom, and *Endocrine Journal* was popular in Japan. The *Journal of Clinical Endocrinology & Metabolism* was popular in three of the top five countries.

The top five journals and the five most productive countries are listed in Table III. Regarding publication in the top five journals, the United States was most productive. Also, the United States was one of the top

five countries represented in the top five journals. The United Kingdom was one of the top five countries represented in four of the five top journals, and Italy was represented in three of the five top journals.

Discussion

Developments in science and technology have produced great advances in the field of endocrinology and metabolism, and the scientific contributions to this advancement have been from researchers throughout the world. Scientific publications report new knowledge in the field and also indicate the productivity of the researchers. Bibliometric methods can be used to evaluate research productivity, and contributions from various areas in the world can be assessed [4–14]. Our study was the first to use bibliometric evaluation to analyse the contributions of various countries to research in endocrinology and metabolism.

We found that authors in the United States published the greatest number of articles on endocrinology

Table II. Ranking journals in the top 5 countries**Tabela II. Ranking czasopism w pięciu krajach zajmujących najwyższe pozycje w rankingu**

| Rank | United States (21740) | China (5736) | Italy (4529) | UK(4446) | Japan (4397) |
|------|-----------------------|----------------------------|----------------------------|-----------------------|---------------------------|
| 1 | JCEM (1375) | Biol Trace Elem Res (566) | J Endocrinol Invest (367) | Diabetic Med (332) | Endocr J (472) |
| 2 | Endocrinology (1085) | Diabetes Res Clin Pr (220) | JCEM (288) | JCEM (285) | J Endocrinol Invest (246) |
| 3 | Obesity (1078) | Free Radical Bio Med (200) | Nutr Metab Cardiovas (256) | Clin Endocrinol (195) | Endocrinology (193) |
| 4 | Diabetes Care (1053) | Endocrine (179) | J Biol Reg Homeos Ag (240) | Diabetologia (194) | J Bone Miner Metab (166) |
| 5 | Diabetes (812) | Mol Cell Endocrinol (163) | Eur J Endocrinol (182) | Diabetes Care (185) | Gen Comp Endocr (148) |

JCEM — Journal Of Clinical Endocrinology & Metabolism; Biol Trace Elem Res — Biological Trace Element Research; Diabetes Res Clin Pr — Diabetes Research And Clinical Practice; Free Radical Bio Med — Free Radical Biology And Medicine; Mol Cell Endocrinol — Molecular And Cellular Endocrinology; J Endocrinol Invest — Journal Of Endocrinological Investigation; Nutr Metab Cardiovas — Nutrition Metabolism And Cardiovascular Diseases; J Biol Reg Homeos Ag — Journal Of Biological Regulators And Homeostatic Agents; Eur J Endocrinol — European Journal Of Endocrinology; Diabetic Med — Diabetic Medicine; Clin Endocrinol — Clinical Endocrinology; Endocr J — Endocrine Journal; J Bone Miner Metab — Journal Of Bone And Mineral Metabolism; Gen Comp Endocr — General And Comparative Endocrinology; UK — United Kingdom

Table III. Top 5 countries in the top 5 journals**Tabela III. Ranking krajów według pięciu najlepszych czasopism**

| Rank | JCEM (3895) | Diabetes Care (2476) | Endocrinology (2467) | Free Radical Bio Med (2013) | Obesity (1895) |
|------|----------------------|----------------------|----------------------|-----------------------------|----------------------|
| 1 | United States (1375) | United States (1053) | United States (1085) | United States (770) | United States (1078) |
| 2 | Italy (288) | United Kingdom (185) | Japan (193) | China (200) | Canada (89) |
| 3 | United Kingdom (285) | Italy (146) | Canada (168) | Italy (90) | United Kingdom (71) |
| 4 | France (210) | Netherlands (113) | United Kingdom (138) | Japan (89) | Australia (70) |
| 5 | Netherlands (205) | Canada (111) | Australia (125) | Germany (81) | Netherlands (67) |

JCEM — Journal Of Clinical Endocrinology & Metabolism; Free Radical Bio Med — Free Radical Biology And Medicine

and metabolism compared to other countries. This result indicates that the United States plays an important role in scientific endeavours on endocrinology and metabolism. The United States has been a leader in biomedical research for decades, including endocrinology metabolism as well as other subfields in biomedical research [9–14].

In addition to producing the most articles overall, articles from the United States have the most citations (260,934) of endocrinology and metabolism publications, as well as one of the highest mean number of citations (12). This suggests that the United States is very productive but also produces high quality publications. The per capita number of articles produced in the United States is also very high (68.17 per million persons). The results of our study demonstrated that the United States is the most productive country in the world in the field of endocrinology and metabolism.

A “10/90” divide has been used to describe the ratio of contributions from non-high- versus high-income countries [18]. This ratio has been identified in many medical fields [9–12]. In our study, we found a slightly higher proportion for middle-income countries. This difference may be attributed to four middle-income

countries, i.e. China, Brazil, Turkey, and India [5, 9, 11]. An increasing importance in biomedical research has been recognised for these countries [9, 11, 19, 20]. The significant development that has occurred in these middle-income countries should be recognised [9, 11]. With further economic development, these countries could improve their rank in the future by improving their endocrinology and metabolism research. Government policy, poor medical infrastructure, lack of research funds, and few researchers may be the root causes of poor research productivity in endocrinology and metabolism in low-income countries, which only produced 65 articles during the period of this study.

Some European countries, such as Denmark, Sweden, the Netherlands, and Greece, were seen to be very productive when the results were normalised to population size and GDP. The productive countries are nearly all developed. Although China is the second productive country in the number of total articles, the number per million population is rather small, which is followed by India. This indicates that the relative productivity remains very low in these countries and further growth is needed. It may be more informative to normalise by the number of researchers in each country

rather than population size, but it is very difficult to obtain information on the number of researchers in the field of endocrinology and metabolism in each country.

For the five top ranked countries, the most popular journal in the United States was the *Journal of Clinical Endocrinology & Metabolism*, for Italy it was the *Journal of Endocrinological Investigation*, for the United Kingdom it was *Diabetic Medicine*, and for Japan it was *Endocrine Journal*. Each of these journals is published in the associated country, which means that there are probably more submissions from researchers in that country. Both the United States and the United Kingdom were represented at least four times as of the top five countries in the top five journals. This indicated the influence of these countries in the field of endocrinology and metabolism.

This study had some limitations. The first limitation is the inclusion of medical journals based on JCR criteria. Non-JCR-cited journals were not included in the article search, even though non-JCR-cited journal articles contributed to scientific production. Second, basic science and general internal medicine journals in categories of the JCR other than "endocrinology & metabolism" may have published endocrinology and metabolism-related articles, but they were not included in this study. However, our bibliometric analysis included 124 endocrinology and metabolism journals, and these journals represent the major journals reporting research in the field of endocrinology and metabolism.

Conclusions

In summary, we evaluated the national research productivity in the field of endocrinology and metabolism during a five-year recent period in this study. The results of the present study showed that the majority of publications were published by high-income countries, while relatively few publications were from low-income countries. When considering the number of publications produced overall, the United States is the most productive country in the world regarding endocrinology and metabolism. However, when the results were normalised to population size and GDP, some European countries might be considered to be more productive.

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Supplement 1. List of considered journals under the topic heading "endocrinology & metabolism" on Web of Science**Supplement 1. Lista rozpatrywanych czasopism pod względem nagłówka tematycznego „endokrynologia i metabolizm” w Web of Science**

| Journals | |
|---|--|
| Acta Diabetologica | Endocrine Practice |
| Acta Endocrinologica-Bucharest | Endocrine Research |
| Aging Male | Endocrine Reviews |
| American Journal of Physiology-Endocrinology and Metabolism | Endocrine |
| Annales D Endocrinologie | Endocrine-Related Cancer |
| Annals of Nutrition and Metabolism | Endocrinology |
| Antioxidants & Redox Signaling | Endocrinology and Metabolism Clinics of North America |
| Arquivos Brasileiros de Endocrinologia e Metabologia | Endokrynologia Polska |
| Best Practice & Research Clinical Endocrinology & Metabolism | European Journal of Endocrinology |
| Biofactors | Experimental and Clinical Endocrinology & Diabetes |
| Biological Trace Element Research | Experimental Diabetes Research |
| BMC Endocrine Disorders | Free Radical Biology and Medicine |
| Bone | Frontiers in Neuroendocrinology |
| Calcified Tissue International | Frontiers of Hormone Research |
| Canadian Journal of Diabetes | General and Comparative Endocrinology |
| Cardiovascular Diabetology | Growth Factors |
| Cell Metabolism | Growth Hormone & IGF Research |
| Clinical Endocrinology | Gynecological Endocrinology |
| Comparative Biochemistry and Physiology C-Toxicology & Pharmacology | Hormone and Metabolic Research |
| Correspondances en Metabolismes Hormones Diabetes et Nutrition | Hormone Research in Paediatrics |
| Current Diabetes Reports | Hormones and Behavior |
| Current Opinion in Clinical Nutrition and Metabolic Care | Hormones-International Journal of Endocrinology and Metabolism |
| Current Opinion in Endocrinology Diabetes and Obesity | International Journal of Diabetes in Developing Countries |
| Current Opinion in Lipidology | International Journal of Endocrinology |
| Diabetes & Metabolism | International Journal of Obesity |
| Diabetes & Vascular Disease Research | Islets |
| Diabetes Care | Journal of Biological Regulators and Homeostatic Agents |
| Diabetes Educator | Journal of Bone and Mineral Metabolism |
| Diabetes Obesity & Metabolism | Journal of Bone and Mineral Research |
| Diabetes Research and Clinical Practice | Journal of Cerebral Blood Flow and Metabolism |
| Diabetes Stoffwechsel und Herz | Journal of Clinical Densitometry |
| Diabetes Technology & Therapeutics | Journal of Clinical Endocrinology & Metabolism |
| Diabetes | Journal of Diabetes |
| Diabetes-Metabolism Research and Reviews | Journal of Diabetes and its Complications |
| Diabetic Medicine | Journal of Diabetes Investigation |
| Diabetologe | Journal of Diabetes Research |
| Diabetologia | Journal of Endocrinological Investigation |
| Diabetologie und Stoffwechsel | Journal of Endocrinology |
| Diabetology & Metabolic Syndrome | Journal of Inherited Metabolic Disease |
| Domestic Animal Endocrinology | Journal of Mammary Gland Biology and Neoplasia |
| Endocrine Journal | Journal of Molecular Endocrinology |
| Endocrine Pathology | Journal of Neuroendocrinology |
| | Journal of Pediatric Endocrinology & Metabolism |

cd. →

Supplement 1 (cd.). *List of considered journals under the topic heading "endocrinology & metabolism" on Web of Science*
Supplement 1 (cd.). *Lista rozpatrywanych czasopism pod względem nagłówka tematycznego „endokrynologia i metabolizm” w Web of Science*

| Journals | |
|---|---|
| Journal of Pineal Research | Obesity Research & Clinical Practice |
| Journal of Steroid Biochemistry and Molecular Biology | Obesity Reviews |
| Journal of Trace Elements in Medicine and Biology | Obesity |
| Magnesium Research | Osteoporosis International |
| Metabolic Brain Disease | Pediatric Diabetes |
| Metabolism-Clinical and Experimental | Pituitary |
| Metabolomics | Primary Care Diabetes |
| Minerva Endocrinologica | Prostaglandins Leukotrienes and Essential Fatty Acids |
| Molecular and Cellular Endocrinology | Prostate |
| Molecular Endocrinology | Psychoneuroendocrinology |
| Nature Reviews Endocrinology | Regulatory Peptides |
| Neuroendocrinology Letters | Reproductive Biology and Endocrinology |
| Neuroendocrinology | Reviews in Endocrine & Metabolic Disorders |
| Neuroimmunomodulation | Steroids |
| Neuropeptides | Stress: |
| Nutrition & Diabetes | The International Journal on the Biology of Stress |
| Nutrition Clinique et Metabolisme | Thyroid |
| Nutrition Metabolism and Cardiovascular Diseases | Trace Elements and Electrolytes |
| Obesity and Metabolism-Milan | Trends in Endocrinology and Metabolism |
| Obesity Facts | Vitamins and Hormones |

