

Bibliometric Analysis of miRNA Studies in the Field of Biophysics: Descriptive Study

Biyofizik Alanında miRNA Çalışmalarının Bibliyometrik Analizi: Tanımlayıcı Çalışma

¹Yasemin BERBEROĞLU^a, ²Yasemin ADALI^{a,b}, ³Veli Kaan AYDIN^a, ⁴Aylin KÖSELER^a

^aPamukkale University Faculty of Medicine, Department of Biophysics, Denizli, Türkiye

^bQueen's University Belfast, Faculty of Medicine, Department of Dentistry and Biomedical Sciences, Belfast, United Kingdom

ABSTRACT Objective: MicroRNAs (miRNAs) are small endogenous post-transcriptional regulators of gene expression found in eukaryotes. With Victor Ambros and Gary Ruvkun receiving the 2024 Nobel Prize, studies on miRNAs are expected to increase. The purpose of the bibliometric analysis is to determine the effectiveness of studies conducted in the field of biophysics on miRNAs. **Material and Methods:** The data collected from the Web of Science Core Collection (WoSCC) and advance search was conducted using keywords: "Micro RNA OR RNA, Micro OR MicroRNA OR miRNA* OR RNA, Small Temporal OR Temporal RNA, Small OR Small Temporal RNA OR stRNA OR Primary MicroRNA OR MicroRNA, Primary OR pri-miRNA OR pri miRNA OR Primary miRNA OR miRNA, Primary OR pre-miRNA OR pre miRNA*". Biophysics was selected among WoS Categories. As a result of these inclusion criteria, 3,369 documents. Among these documents, the first 500 articles were taken according to their relevance ranking. All bibliographic data were exported from the WoSCC database and analyzed using analytical bibliometric methods. **Results:** The annual growth rate between 1988-2025 was 1.89%. The number of articles increased exponentially after 2005. The most published source of articles on miRNAs in the Biophysics category is "Biochemical and Biophysical Research Communications". The affiliation with the most articles is Wuhan University in China. Recent trend topics are the keywords plus words "de-novo prediction, model, injury". **Conclusion:** This study is important in terms of analyzing studies on miRNAs in the field of biophysics and guiding future studies.

Keywords: MicroRNAs; biophysics; bibliometrics

ÖZET Amaç: MikroRNA'lar (miRNA'lar), ökaryotlarda bulunan gen ifadesinin küçük endojen transkripsiyon sonrası düzenleyicileridir. Victor Ambros ve Gary Ruvkun'un 2024 Nobel Ödülü'nü almasıyla, miRNA'lar üzerine yapılan çalışmaların artması bekleniyor. Bibliyometrik analizin amacı, biyofizik alanında yapılan çalışmaların miRNA'lar üzerindeki etkinliğini belirlemektir. **Gereç ve Yöntemler:** Web of Science Core Collection'dan (WoSCC) toplanan veriler ve gelişmiş arama, şu anahtar sözcükler kullanılarak yapıldı: "Micro RNA OR RNA, Micro OR MicroRNA OR miRNA* OR RNA, Small Temporal OR Temporal RNA, Small OR Small Temporal RNA OR stRNA OR Primary MicroRNA OR MicroRNA, Primary OR pri-miRNA OR pri miRNA OR Primary miRNA OR miRNA, Primary OR pre-miRNA OR pre miRNA*". Biyofizik, WoS Kategorileri arasından seçildi. Bu dâhil etme kriterlerinin bir sonucu olarak, 3.369 belge bulundu. Bu belgeler arasında, ilk 500 makale ilgililik sıralamasına göre alındı. Tüm bibliyografik veriler WoSCC veritabanından dışa aktarıldı ve analitik bibliyometrik yöntemler kullanılarak analiz edildi. **Bulgular:** 1988-2025 arasındaki yıllık büyüme oranı %1,89'du. Makale sayısı 2005'ten sonra katlanarak arttı. Biyofizik kategorisinde miRNA'lar hakkında en çok yayınlanan makale kaynağı "Biochemical and Biophysical Research Communications"dır. En fazla makaleye sahip olan kuruluş, Çin'deki Wuhan Üniversitesi'dir. Son trend topic kelimeler "de-novo prediction, model, injury" kelimeleridir. **Sonuç:** Bu çalışma, biyofizik alanında miRNA'lar üzerine yapılan çalışmaları analiz etmek ve gelecekteki çalışmalara rehberlik etmek açısından önemlidir.

Anahtar Kelimeler: MikroRNalar; biyofizik; bibliyometri

TO CITE THIS ARTICLE:

Berberoğlu Y, Adalı Y, Aydın VK, Köseler A. Bibliometric analysis of miRNA studies in the field of biophysics: Descriptive study. Türkiye Klinikleri J Med Sci. 2025;45(3):121-9.

Correspondence: Yasemin BERBEROĞLU

Pamukkale University Faculty of Medicine, Department of Biophysics, Denizli, Türkiye

E-mail: yasemins@pau.edu.tr

Peer review under responsibility of Türkiye Klinikleri Journal of Medical Sciences.

Received: 06 Jan 2025

Received in revised form: 04 Mar 2025

Accepted: 04 Mar 2025

Available online: 22 Aug 2025

2146-9040 / Copyright © 2025 by Türkiye Klinikleri. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).



MicroRNAs (miRNAs) are small endogenous post-transcriptional regulators of gene expression found in eukaryotes. ~22 nucleotides in length, miRNAs are involved in the regulation of many biological processes such as cell proliferation, differentiation, and apoptosis.^{1,2} The canonical role of these small noncoding RNAs is to affect messenger RNA (mRNA) through recognition sites in the 3' untranslated region, regulating their stability. miRNAs primarily target mRNA, affecting gene expression levels. Any changes in miRNA expression may affect the extent of target regulation and thus alter cell homeostasis.³ Circulating miRNAs are considered promising biomarkers for many human diseases, such as cancer, autoimmune diseases, neurodegenerative diseases, infectious diseases, and cardiomyopathies, including high specificity, easy accessibility, and sensitivity.^{4,5} With Victor Ambros and Gary Ruvkun receiving the 2024 Nobel Prize, miRNAs appear to be back in the spotlight.^{6,7}

The purpose of the bibliometric analysis is to determine the effectiveness of studies conducted in the field of biophysics on miRNAs. Bibliometric analysis, a common research method, uses quantitative tools to evaluate the impact of the research and analyze scientific data.⁸ Bibliometric analysis helps to understand the current state of research in the field under study by comparing and analyzing different authors, institutions, countries, journals, and cited literature. In this respect, it plays an important role in understanding the research content in a field quickly and accurately.⁹ In recent years, bibliometric analyses on miRNAs have maintained their place in the literature. Yan et al.'s study showed miRNAs with potential roles in the diagnosis, treatment and prognosis of diseases through miRNA-microbiome interactions.¹⁰ There are also current publications on miRNAs in different fields such as "pain", "spinal cord injury", "periodontology and dental implantology".¹¹⁻¹³ These publications are similar in terms of the method used. However, there is no study on miRNAs in the field of biophysics.

miRNAs are expressed at different expression levels in healthy and tumor cells, and even between tumor subtypes. The study of miRNA differences holds promise for improving cancer diagnosis and

treatment in the future.¹⁴ It is also aimed that miRNAs can be used in primary cancer therapeutics.¹⁵ miRNAs can be developed as new biomarkers or drug targets for diagnosis in patients with depression other than cancer. In addition, the molecules can be used as new molecular drugs that can provide new avenues for the treatment of depression.¹⁶

MATERIAL AND METHODS

ETHICS STATEMENT

Since this study did not use human subjects, informed consent was not obtained, or Institutional Review Board approval was not necessary.

SEARCH STRATEGY

The data collected from the Web of Science Core Collection (WoSCC) and advance search was conducted using keywords: "Micro RNA OR RNA, Micro OR MicroRNA OR miRNA* OR RNA, Small Temporal OR Temporal RNA, Small OR Small Temporal RNA OR stRNA OR Primary MicroRNA OR MicroRNA, Primary OR pri-miRNA OR pri miRNA OR Primary miRNA OR miRNA, Primary OR pre-miRNA OR pre miRNA*". Later, the results were refined in the (WoSCC) database according to the index for Science Citation Index Expanded and Emerging Sources Citation Index publication type. The search was set to include articles published between 1988-2025. Biophysics was selected among WoS Categories. As a result of these inclusion criteria, 3,369 documents. Among these documents, the first 500 articles were taken according to their relevance ranking. All bibliographic data were exported from the WoSCC database and analyzed using analytical bibliometric methods. The biophysics category includes theoretical, experimental and simulation studies aimed at understanding the physical properties of biological systems.

DATA ANALYSIS

The open-source web-based R package Bibliometrix codes was used to perform bibliometric analyses. Annual scientific production, most relevant sources, most cited local sources, most relevant authors, most relevant affiliations, corresponding author's coun-

tries, most global cited documents, most local cited documents, most frequent words, WordCloud, trend topics, and historiographs as a result of the analysis were used.

RESULTS

Table 1 shows an overview of bibliographic data. There are a total of 3,369 publications in the biophysics category in the WoSCC database according to the selected criteria between 1988-2025. Of the 500 articles with an annual growth rate of 1.89%, 2 were found as early access and 4 as proceedings papers. The average age of the publications is 9.09 years, and the average number of citations per publication is 46.05. 2,439 authors were identified, of which only 4 had single-authored articles. The articles had an average of 7.05 co-authors, and the international co-authorship rate was 14.6%.

Figure 1 shows the annual scientific production on miRNAs in the biophysics category in the WoSCC database between 1993-2024. There were continuous increases and decreases in the number of publications

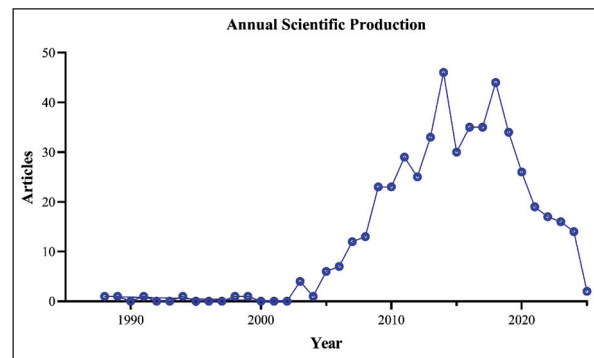


FIGURE 1: Annual scientific production

until 2005. After 2005, the number of publications increased exponentially. According to **Figure 1**, the years in which the most articles were published are 2014 (46), 2018 (44), 2016 (35) and 2017 (35), respectively. There has been a decrease in the number of articles since 2019.

The 500 articles used in the analysis were published in 40 different journals. **Figure 2** shows the most relevant sources graph. The most published source of articles in the biophysics category related to miRNAs were found to be “Biochemical and Biophysical Research Communications”, “Biosensors & Bioelectronics”, and “FEBS Letters”.

The most cited local sources are shown in **Figure 3**. “Cell, Nature, and Proceedings of the National Academy of Sciences” are among the most cited sources.

The most relevant authors are shown in **Figure 4**. Zhang Y. (23), Zhang X. (20), and Wang Y. (16) are the authors with the most articles on miRNAs in the biophysics category.

The most relevant affiliations are shown in **Figure 5**. The top three universities with the most articles in this field include Wuhan (49), Zhejiang (38) and Fudan (30) Universities in China.

Figure 6 shows the countries of the corresponding author. China ranks first with 249 articles, while the USA (76) and Japan (34) are also among the top countries.

Most global cited documents and most local cited documents are shown in **Table 2** and **Table 3**,

TABLE 1: An overview of bibliographic data

Description	Results
Main information about data	
Timespan	1988-2025
Sources (journals, books, etc)	40
Documents	500
Annual growth rate %	1.89
Document average age	9.09
Average citations per doc	46.05
References	16,479
Document contents	
Keywords plus (ID)	1,730
Author's keywords	1,654
Authors	
Authors	2,439
Authors of single-authored docs	4
Authors collaboration	
Single-authored docs	4
Co-authors per doc	6.57
International co-authorships %	14.6
Document Ttypes	
Article	494
Article; early access	2
Article; proceedings paper	4

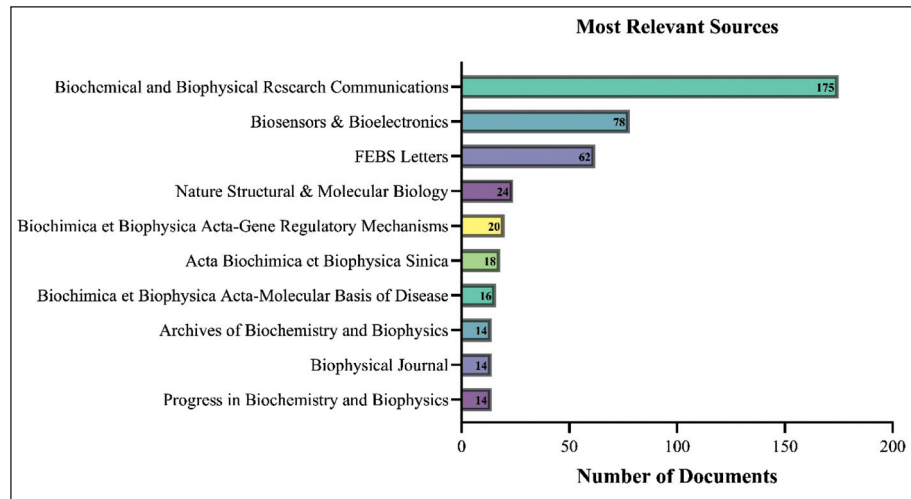


FIGURE 2: Most relevant sources

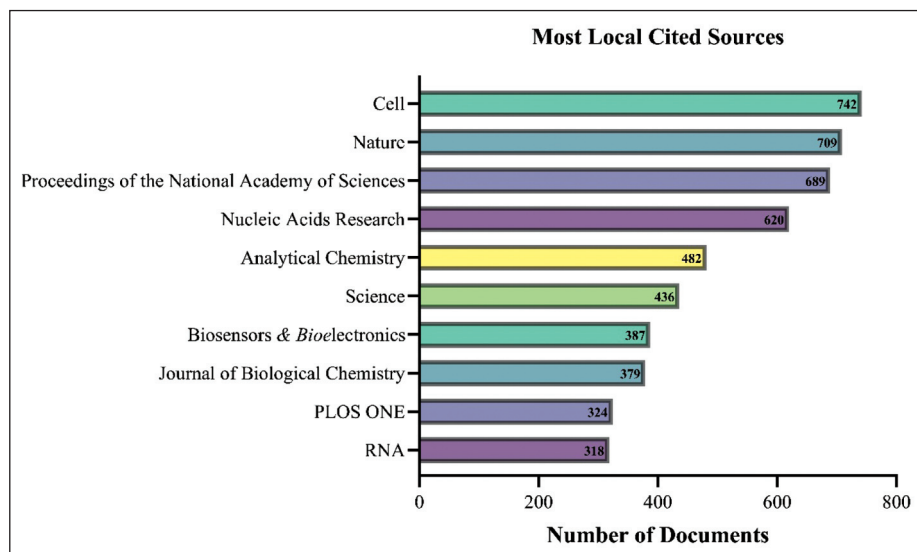


FIGURE 3: Most local cited sources

respectively. Ciafrè et al. article titled “extensive modulation of a set of miRNAs in primary glioblastoma” ranked first among “Most Global Cited Documents” with 914 total citations.¹⁷ Tan and Chen, 2011 article titled “salt contribution to RNA tertiary structure folding stability” ranked first among “Most Locally Cited Documents” with 6 local citations.²¹

The most frequently used words and their frequency of use in the titles of articles written in the

field of biophysics related to miRNA are shown in Table 4. “Cell lung cancer”, “microRNA detection based” and “non-small cell lung” were the most frequently used words.

The WordCloud obtained using Keyword plus is shown in Figure 7. Frequently used words over 30 repetitions include “expression (168), cancer (75), identification (45), micrnas (41), cells (39), activation (36), apoptosis (33), dna (33), gene (33), gene-expression (32) and biogenesis (31)”.

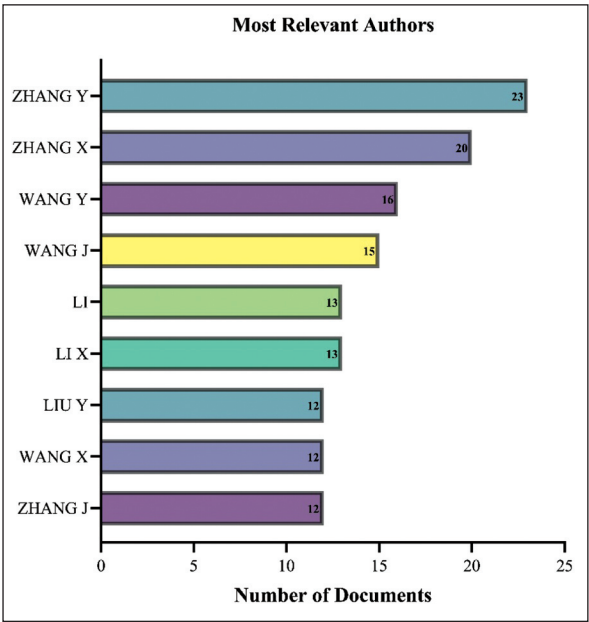


FIGURE 4: Most relevant authors

The trend topics list created using keyword plus words is shown in Figure 8. The words “interference, methylation, system” used in the first years have recently been replaced by the words “de-novo prediction, model, injury”.

DISCUSSION

The aim of the bibliometric analysis was to determine the effectiveness of studies conducted in the field of biophysics on miRNAs. When the articles published since 1988 were evaluated in order of relevance, an annual increase of 1.89% was observed in studies conducted on miRNAs. Considering this growth rate, it can be said that the popularity of the field of biophysics is increasing steadily. The presence of over

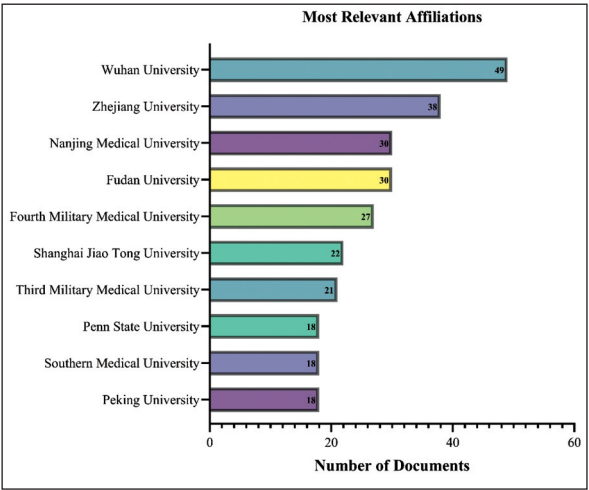


FIGURE 5: Most relevant affiliations

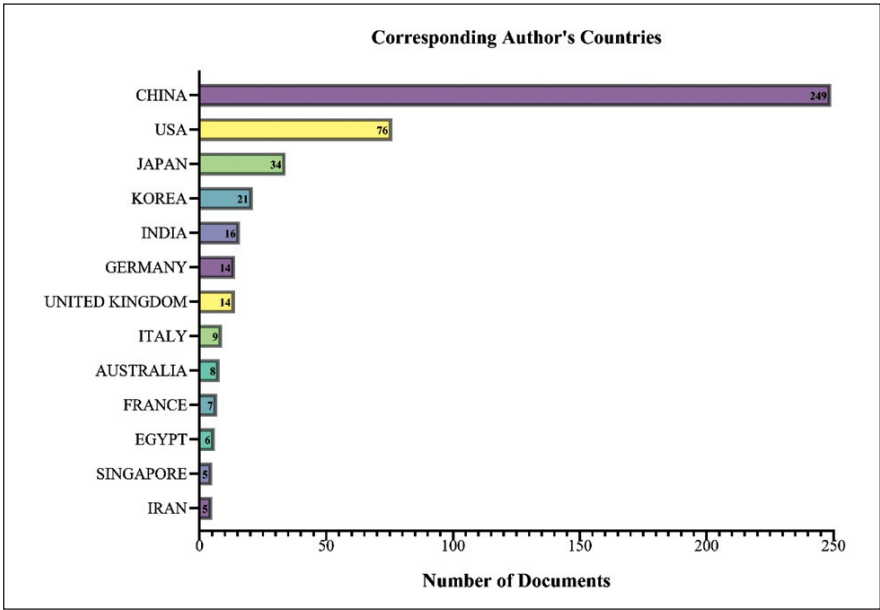


FIGURE 6: Corresponding author's countries

TABLE 2: Most Global Cited Documents

Most Global Cited Documents	Article Title	Doi	Total Citations
Ciafrè SA, 2005, Biochemical and Biophysical Research Communications	Extensive modulation of a set of microRNAs in primary glioblastoma	10.1016/j.bbrc.2005.07.030	914
Yang Wd, 2006, Nature Structural&Molecular Biology ¹⁸	Modulation of microRNA processing and expression through RNA editing by ADAR deaminases	10.1038/nsmb1041	628
Zhao C, 2009, Nature Structural&Molecular Biology ¹⁹	A feedback regulatory loop involving microRNA-9 and nuclear receptor TLX in neural stem cell fate determination	10.1038/nsmb.1576	450
Song JJ, 2003, Nature Structural&Molecular Biology	The crystal structure of the Argonaute2 PAZ domain reveals an RNA binding motif in RNAi effector complexes	10.1038/nsb1016	442
Guil S, 2007, Nature Structural&Molecular Biology	The multifunctional RNA-binding protein hnRNP A1 is required for processing of miR-18a	10.1038/nsmb1250	435
Morlando M, 2008, Nature Structural&Molecular Biology	Primary microRNA transcripts are processed co-transcriptionally	10.1038/nsmb.1475	297
Ito T, 2010, Biochemical and Biophysical Research Communications	MicroRNA-34a regulation of endothelial senescence	10.1016/j.bbrc.2010.07.012	289
Faller M, 2007, Nature Structural&Molecular Biology	Heme is involved in microRNA processing	10.1038/nsmb1182	240
Cui Y, 2016, FEBS Letters	Exosomes derived from mineralizing osteoblasts promote ST2 cell osteogenic differentiation by alteration of microRNA expression	10.1002/1873-3468.12024	230
Liu AM, 2010, Biochemical and Biophysical Research Communications	MicroRNA-375 targets Hippo-signaling effector YAP in liver cancer and inhibits tumor properties	10.1016/j.bbrc.2010.03.036	215

TABLE 3: Most Local Cited Documents

Most Local Cited Documents	Doi	Local Citations
Tan ZJ, 2011, Biophysical Journal ²¹	10.1016/j.bpj.2011.05.050	6
Shi YZ, 2015, Biophysical Journal ²⁰	10.1016/j.bpj.2015.11.006	6
Yang WD, 2006, Nature Structural&Molecular Biology ¹⁸	10.1038/nsmb1041	5
Sohn SY, 2007, Nature Structural&Molecular Biology	10.1038/nsmb1294	5
Guil S, 2007, Nature Structural & Molecular Biology	10.1038/nsmb1250	5
Tan ZJ, 2010, Biophysical Journal	10.1016/j.bpj.2010.06.029	5
Morlando M, 2008, Nature Structural & Molecular Biology	10.1038/nsmb.1475	4
Yang SW, 2010, Structure	10.1016/j.str.2010.02.006	4
Jin L, 2018, Biophysical Journal	10.1016/j.bpj.2018.08.030	4
Faller M, 2007, Nature Structural & Molecular Biology	10.1038/nsmb1182	3

15,000 references indicates that there is comprehensive knowledge of miRNAs. The presence of 1,730 different keywords draws attention to the fact that miRNAs are a versatile research topic in the field of biophysics.

There was an increase in research on miRNAs in the 2000s, a period when molecular studies gained momentum with the development of research methods. However, with the coronavirus disease-2019 pandemic that affected the whole world, there were changes in research topics and areas, and there has been a decrease in research on miRNAs since 2019.

TABLE 4: Most frequent words

Words	Occurrences
Cell lung cancer	6
MicroRNA detection based	6
Non-small cell lung	6
Lung cancer cells	5
Inhibits cell proliferation	4
Mesenchymal stem cells	4
Brown adipose tissue	3
Cancer cell proliferation	3
Embryonic stem cells	3
Squamous cell carcinoma	3



FIGURE 7: WordCloud

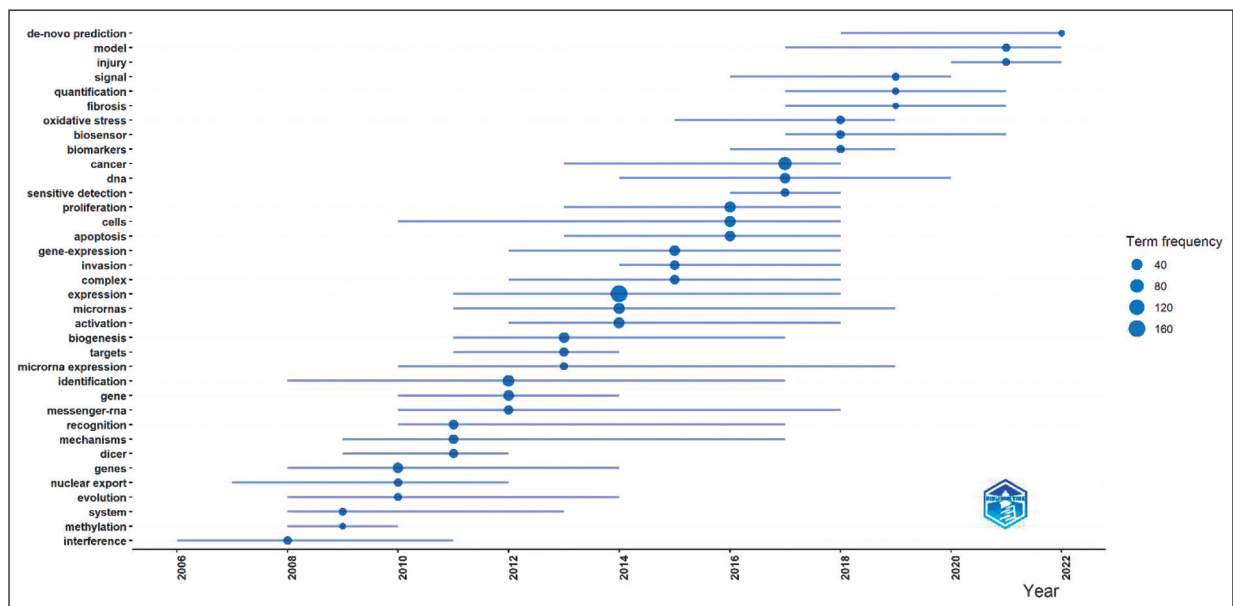


FIGURE 8: Trend topics

The inclusion of journals from different disciplines showed that miRNAs are examined in different branches of biophysics and that research requires an interdisciplinary approach. Articles on miRNA

were published in journals in the field of basic sciences such as biophysics, genetics, and biochemistry, as well as in journals focusing on specific areas such as biosensors and molecular biology.

Zhang, Zhang, and Wang, who are the authors with the most relevant articles in the field of miRNA studies related to biophysics, not only make significant contributions to the literature but also guide future research. Therefore, the relevant authors can be cited. After the bibliometric analysis, the fact that the most cited sources on miRNAs include journals with very high impact factors such as “Cell” and “Nature” reveals the importance of the field. The universities with the most publications are Wuhan, Zhejiang and Fudan Universities in China. China is the country that contributes the most to this field, while the USA and Japan also have a high number of articles.

In terms of the most global cited articles, we see that “Ciafrè et al.” investigated miRNA subclasses in glioblastoma, “Yang et al.” investigated the modulation of miRNA expression, and “Zhao et al.” investigated the role of miRNAs in stem cell biology.¹⁷⁻¹⁹ On the other hand, in the most local cited articles, it was seen that “Tan” and “Chen” investigated the folding stability of RNA, and Shi and colleagues investigated the three-dimensional structure of RNA.^{20,21} These publications can be used to determine the research area and generate hypotheses or as references in literature searches.

The frequent use of the words “cell lung cancer”, “non-small cell lung”, and “lung cancer cells” indicates that miRNA studies in the field of biophysics focus on lung cancer. It can also be considered that lung cancer is used as an important model system in miRNA studies or that the potential efficacy of miRNAs in diagnosis and treatment of lung cancer is investigated. The words “inhibits cell proliferation” and “cancer cell proliferation” indicate the roles of miRNAs in regulating cell growth and proliferation and that they can be used as potential biomarkers. The words “mesenchymal stem cells”, “brown adipose tissue”, and “embryonic stem cells” indicate that miRNAs can affect different types of stem cells and that miRNAs may have potential applications in the field of stem cell biology. The word “squamous cell carcinoma” indicates that squamous cell carcinoma, a common type of skin cancer, is frequently used in miRNA studies. In summary, miRNA research in the field of biophysics is mostly focused on cancer types, especially lung cancer, because miRNAs have roles

in cell growth and differentiation processes and are used as biomarkers in both personalized medicine and new therapeutic strategies.

In addition, words such as “gene expression”, “regulation”, “protein” emphasize the central role of miRNAs, as miRNAs play a role in the regulation of mRNAs of target genes. The inclusion of words such as “biogenesis”, “pathway”, “mechanisms” shows that miRNAs are aimed at understanding the role of various biological processes in the cell. Words such as “identification” and “target” support the idea that miRNAs can be used as biomarkers in the diagnosis or treatment of diseases and that they can be potential targets in the development of new treatment methods.

Trend topics in miRNA research in the field of biophysics are important in determining how both scientific interests and research methods have changed over time. The frequent use of terms such as “interference”, “methylation”, and “system” in the early years indicates that research focused more on the cellular functions and basic mechanisms of action of miRNAs. Over time, these basic concepts have given way to terms such as “de novo prediction”, “model”, and “injury” belonging to more specific and advanced research areas. In this direction, the knowledge gained with miRNAs has been combined with bioinformatics tools and advanced modeling methods.

CONCLUSION

This study demonstrates the effectiveness of studies in the field of biophysics on miRNAs. It is important in terms of analyzing studies on miRNAs and guiding future studies.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or mem-

bers of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Yasemin Berberoğlu, Aylin Köşeler; **Design:**

Yasemin Adalı; **Control/Supervision:** Aylin Köşeler; **Data Collection and/or Processing:** Yasemin Berberoğlu, Veli Kaan Aydın; **Analysis and/or Interpretation:** Yasemin Adalı, Veli Kaan Aydın; **Literature Review:** Yasemin Berberoğlu; **Writing the Article:** Yasemin Berberoğlu, Yasemin Adalı, Veli Kaan Aydın; **Critical Review:** Yasemin Adalı, Aylin Köşeler.

REFERENCES

1. Starega-Roslan J, Koscińska E, Kozłowski P, Krzyżosiak WJ. The role of the precursor structure in the biogenesis of microRNA. *Cell Mol Life Sci*. 2011;68(17):2859-71. [Crossref] [PubMed] [PMC]
2. Diener C, Keller A, Meese E. Emerging concepts of miRNA therapeutics: from cells to clinic. *Trends Genet*. 2022;38(6):613-26. [PubMed]
3. Hill M, Tran N. miRNA interplay: mechanisms and consequences in cancer. *Dis Model Mech*. 2021;14(4):dmm047662. [Crossref] [PubMed] [PMC]
4. Ho PTB, Clark IM, Le LTT. MicroRNA-based diagnosis and therapy. *Int J Mol Sci*. 2022;23(13):7167. [PubMed] [PMC]
5. Kargutkar N, Hariharan P, Nadkarni A. Dynamic interplay of microRNA in diseases and therapeutic. *Clin Genet*. 2023;103(3):268-76. [Crossref] [PubMed] [PMC]
6. Lee RC, Feinbaum RL, Ambros V. The *C. elegans* heterochronic gene *lin-4* encodes small RNAs with antisense complementarity to *lin-14*. *Cell*. 1993;75(5):843-54. [PubMed]
7. Wightman B, Ha I, Ruvkun G. Posttranscriptional regulation of the heterochronic gene *lin-14* by *lin-4* mediates temporal pattern formation in *C. elegans*. *Cell*. 1993;75(5):855-62. [Crossref] [PubMed]
8. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: An overview and guidelines. *Journal of business research*. 2021;133:285-96. [Link]
9. Chen H, Xu Z, Zhao H, Cao J, Wang R, He J, Li T. Global research states and trends of micro RNA in irritable bowel syndrome: a bibliometric analysis. *Clinical and Experimental Medicine*. 2024;24(1):149. [Crossref]
10. Yan XY, Yao JP, Li YQ, Zhang W, Xi MH, Chen M, et al. Global trends in research on miRNA-microbiome interaction from 2011 to 2021: a bibliometric analysis. *Front Pharmacol*. 2022;13:974741. [Crossref] [PubMed] [PMC]
11. Wang H, Li Q, Zou J, Shu J, Zhang A, Zhang H, et al. Mapping the research landscape of microRNAs in pain: a comprehensive bibliometric analysis. *Front Mol Neurosci*. 2024;17:1493822. [PubMed] [PMC]
12. Hu B, Zhao Y, Chen C, Wu B, Zhang H, Liu B, et al. Research hotspots and trends of microRNAs in spinal cord injury: a comprehensive bibliometric analysis. *Front Neurol*. 2024;15:1406977. [Crossref] [PubMed] [PMC]
13. Gao K, Dou Y, Lv M, Zhu Y, Hu S, Ma P. Research hotspots and trends of microRNA in periodontology and dental implantology: a bibliometric analysis. *Ann Transl Med*. 2021;9(14):1122. [Crossref] [PubMed] [PMC]
14. Nelson KM, Weiss GJ. MicroRNAs and cancer: past, present, and potential future. *Mol Cancer Ther*. 2008;7(12):3655-60. [Crossref] [PubMed]
15. Liang L, He X. A narrative review of microRNA therapeutics: understanding the future of microRNA research. *Precision Cancer Medicine*. 2021;4. [Link]
16. Miao C, Chang J. The important roles of microRNAs in depression: new research progress and future prospects. *J Mol Med (Berl)*. 2021;99(5):619-36. [Crossref] [PubMed]
17. Ciafrè SA, Galardi S, Mangiola A, Ferracin M, Liu CG, Sabatino G, et al. Extensive modulation of a set of microRNAs in primary glioblastoma. *Biochem Biophys Res Commun*. 2005;334(4):1351-8. [PubMed]
18. Yang W, Chendrimada TP, Wang Q, Higuchi M, Seeburg PH, Shiekhattar R, et al. Modulation of microRNA processing and expression through RNA editing by ADAR deaminases. *Nat Struct Mol Biol*. 2006;13(1):13-21. [Crossref] [PubMed] [PMC]
19. Zhao C, Sun G, Li S, Shi Y. A feedback regulatory loop involving microRNA-9 and nuclear receptor TLX in neural stem cell fate determination. *Nat Struct Mol Biol*. 2009;16(4):365-71. [Crossref] [PubMed] [PMC]
20. Shi YZ, Jin L, Wang FH, Zhu XL, Tan ZJ. Predicting 3D structure, flexibility, and stability of RNA hairpins in monovalent and divalent ion solutions. *Biophys J*. 2015;109(12):2654-65. [Crossref] [PubMed] [PMC]
21. Tan ZJ, Chen SJ. Salt contribution to RNA tertiary structure folding stability. *Biophys J*. 2011;101(1):176-87. [PubMed] [PMC]