

Research Article

Muammer Özdemir*, Sedat Abuşoğlu and Ali Ünlü

A bibliometric analysis of biochemistry theses in Türkiye: comparison with global trends

<https://doi.org/10.1515/tjb-2024-0296>

Received November 26, 2024; accepted August 8, 2025;

published online September 8, 2025

Abstract

Objectives: This study aims to examine the trends and distribution of research areas and methodologies in biochemistry theses over time by performing a bibliometric analysis in the CoHE database and comparing them with PubMed trends.

Methods: The study includes biochemistry theses from Türkiye spanning 1969 to 2023, totalling 5,543 theses in the CoHe database. Also, the PubMed database is used to compare the world's and our country's scientific trends. Google Sheets, AppSheets and Python are used for data analysis. The study employed various bibliometric techniques like performance analysis, cluster analysis, science mapping and co-occurrence analysis.

Results: Although several diseases exhibited insignificant associations, pregnancy demonstrated a significant positive correlation between CoHE and PubMed trends ($p=0.455$, $p=0.0022$). The noted negative associations for atherosclerosis ($p = -0.429$, $p=0.0041$) and hypertension ($p = -0.470$, $p=0.0015$) suggest that national trends in thesis production differ from international publication trends for these conditions. Furthermore, oxidant-antioxidant system studies at CoHe have held the first place for over 30 years, despite being decreasing after the 2000s and having a positive but statistically irrelevant connection with global trends ($p=0.100$; $p=0.873$).

Conclusions: We propose that biochemistry studies should prioritise diseases such as atherosclerosis and osteoarthritis in parallel with the findings in our work, particularly considering increasing life expectancy. Moreover, placing increased focus on microbiota studies and the utilisation of animal models within research methodologies will be crucial for advancing our understanding in the field.

Keywords: bibliography; theses; indexing; pubmed; biochemistry; residency

Introduction

On March 14, 1827, the Ottoman Empire established the first medical school in the Western style, called Tıphane (Medical House), where Chemistry was taught in the last year of education. The roots of modern chemistry in Türkiye can be traced to the publication of the “Usûl-i Kimya” [Elements of Chemistry] in 1848. Written by Dr. Mehmed Emin Dervish Pasha, it is the first independent chemistry book published in Türkiye, and it projects the level of chemistry of the period quite well [1].

Studies on speciality training in Biochemistry in Türkiye started in accordance with the “The Law on the Style of Practice of Medicine and Medical Specialities” dated 14.04.1928 and No. 1219, and the “Regulation on Medicine and Speciality Certificates” dated 29.06.1929 and No. 8034. In these regulations, speciality branches were defined into two groups: clinical and laboratory. The laboratory specialities consisted of 6: Bacteriology, Pathology, Chemistry of Medicine, Mental and Forensic Medicine, Radiology and Physical Therapy. Over the years, the speciality was named Chemistry Medical (1929), Vital Chemistry (1947), Vital and Medical and Nutritional Chemistry (1949), Vital and Medical Chemistry (1955), Medical Biochemistry (1961), Biochemistry (1962), Biochemistry and Clinical Biochemistry (1983), and Medical Biochemistry (2002) [2].

Like other science branches, biochemistry has been rapidly evolving in Türkiye, with a growing emphasis on

*Corresponding author: Muammer Özdemir, Department of Medical Biochemistry, Medical Faculty, Selcuk University, Konya, Türkiye, E-mail: drmuammerozdemir@gmail.com. <https://orcid.org/0000-0002-7524-5331>

Sedat Abuşoğlu and Ali Ünlü, Department of Medical Biochemistry, Medical Faculty, Selcuk University, Konya, Türkiye, E-mail: sedatabusoglu@yahoo.com (S. Abuşoğlu), aunlu@selcuk.edu.tr (A. Ünlü). <https://orcid.org/0000-0002-2984-0527> (S. Abuşoğlu). <https://orcid.org/0000-0002-9991-3939> (A. Ünlü)



research and education over the past few decades. Over the years, Türkiye has had approximately 1,555 Laboratories and 84 Public Health Laboratories, and these numbers are growing. The data indicate that there are more than 1,000 specialists in biochemistry, with the combined total of individuals holding master's and doctoral degrees potentially being twice that amount.

Bibliometric analyses provide a quantitative and objective approach, offering a broader perspective in a shorter time than other methods [3]. Bibliographic analysis involves using statistical analysis methods encompassing various laws and techniques to examine the characteristics of academic publications. It is used to study the aspects and processes of change in academic work in different scientific disciplines or sub-disciplines within the same field. Hence, well-executed bibliometric studies can establish solid foundations for advancing a field in new and meaningful ways. They enable and empower scholars to obtain a comprehensive overview, identify knowledge gaps, generate new ideas for further investigation, and position their intended contributions to the field [4].

Performance analyses and the science mapping method used in bibliometric studies visually illustrate the framework, connections, and trends present in a research area. It extends past conventional citation analysis by revealing patterns in academic literature, including the identification of clusters, the co-occurrence of terms, and the evolution of themes [4].

Reference works in the field show changes in topics that arise according to the necessities of the time. Due to this unpreventable change, there are no sharp boundaries among the research topics in Biochemistry. Key research areas in biochemistry have evolved over time, including study trends in diseases, emerging fields, and study materials, reflecting advancements in study techniques and the changing needs of the scientific community.

Our objective was to conduct a comprehensive analysis of the Master's, Doctorate, and Medical Specialty theses in the field of Biochemistry available in the National Thesis Center of the Council of Higher Education database. Hence illustrating the trends and distribution of research topics over the years and comparing them with PubMed trends. By doing so, we hope to provide insights into the evolution and current state of biochemistry research in Türkiye. We also aimed to illustrate the contribution rates of universities and institutes to serve to elucidate the dynamics of academic collaboration within the field.

Although research on a global scale has been thoroughly examined using indexed databases like PubMed, there is still a notable lack of insight into the national research dynamics in Türkiye, especially regarding the graduate-level academic

output. To the best of our knowledge, no detailed study has been conducted to systematically evaluate the distribution, thematic evolution, and institutional contributions of Master's, Doctorate, and Medical Specialty theses in biochemistry in Türkiye.

This research seeks to address that gap by reviewing all biochemistry-related theses accessible in the National Thesis Centre of the Council of Higher Education database. We aim to reveal the research trajectory, pinpoint underexplored areas, and underscore institutional productivity by investigating topic trends over time and aligning them with international publication patterns through PubMed. We also aimed to establish a framework for evaluating national academic priorities, collaboration dynamics, and alignment with global trends.

Materials and methods

Study design

Our study is a cross-sectional descriptive research study. The research scope includes all master's, doctorate (PhD), and speciality theses (ST) (n=5,443) conducted in biochemistry departments of medical, pharmacy, veterinary, chemistry, nutrition and dietetics, and engineering faculties between 1969 and 2023.

Data collection

All postgraduate theses conducted in Türkiye are openly accessible at the Council of Higher Education (CoHE, also known as YÖK in Türkiye) Thesis Database system [5]. The metadata of these theses (including thesis number, title, author, advisor, year, thesis type, page count, and university) have been used. We excluded the theses that were missing even one of the metadata mentioned, resulting in the selection of 4,851 theses, which accounted for 89 % of the total database (5,443). We pruned the useless data like the thesis IDs and the download links. The global trends of diseases, topics, material types, and study techniques were obtained from PubMed, which also gives these data as open source, by using PubMed Advanced Search Builder [6].

Unfortunately, we were unable to segregate the data obtained from PubMed to exclusively focus on biochemistry; therefore, the data was retrieved as a general result of the search terms, including the entire database.

Since the data is publicly accessible, ethical approval was unnecessary for our study (Table 1).

Table 1: The diseases, study topics, materials, and techniques analysed in biochemistry theses.

Diseases (n=68)				Study topics (n=14)	Study materials (n=16)	Study techniques (n=17)
Anxiety	Gallstones	Leukemia	HIV ^a	DNA and genetics	Serum	Colorimetry
Cancer	Allergy	Herpes	Bronchitis	Cell signaling	Tissue	PCR
Pneumonia	Measles	Gastroenteritis	Sinusitis	Oxidant-antioxidant system	Plant extract	Routine biochemistry
Atherosclerosis	AIDS	Coronavirus	Diarrhea	Metabolism	Saliva	Chromatography
Hypothyroidism	Endometriosis	Asthma	Dysentery	Hormones	Cell culture	Spectrophotometry
URTI	Anorexia	Osteoporosis	Hepatitis	Lipids	Plasma	Cell culture
Ulcer	Glaucoma	Alcoholism	Cold	Apoptosis	Animal experiment	Sequencing
Diabetes	Pancreatitis	Psoriasis		Cell damage	Bone marrow	Western blot
Obesity	Autism	Angina		Vitamins and minerals	Urine	Flow cytometry
Cirrhosis	Fibromyalgia	Meningitis		Enzymes	Epidemiological study	Turbidimetry/Nephelometry
Hypertension	Reflux	Gout		Inflammation	Microbiome	Survey
Alzheimer	Headaches	Hepatitis		Nutritional biochemistry	Synovial fluid	Electrophoresis
Influenza	Arthritis	Stroke		Mitochondrial function	CSF ^b	Immunohistochemistry
Epilepsy	Anemia	Salmonella		Neurochemistry	Sweat	Microscopy
Pregnancy	Colitis	Malaria			Amniotic fluid	ELISA
Depression	Acidosis	Aneurysm			Pleural fluid	Southern blot
Tuberculosis	Gastritis	Schizophrenia				Extraction

^aHuman immunodeficiency virus. ^bCerebrospinal fluid.

Data analysis

Google Sheets and Flourish programs were used to analyse and obtain min, max, mean values, percentages, common subject and subtopic analysis, frequency tables, and visual graphics based on these data. Python is used to calculate rho and p values for Spearman analysis of the Turkish and global trends [7]. Due to the extensive size of the data, the article and graphics present the most crucial findings. Also, co-occurrence analyses and cluster analysis were performed on the data we extracted from the CoHE database, by Florish and VosWiever programs.

Results

5,443 theses were analysed in the CoHe database; master's theses ranked first with 2,743 (50.4 %), followed by medical speciality theses with 1,405 (25.8 %) and doctoral theses with 1,295 (23.8 %).

Out of these theses, 5,277 (96.95 %) were conducted in public universities, while 166 (3.05 %) were conducted in private universities.

The establishment of new universities in Türkiye during the 1990s led to a significant increase in the number of biochemistry theses. Before 2000, over 100 theses were produced annually, and currently, that number exceeds 300 (Figure 1).

While the number of institutions providing biochemistry master's, doctorate and medical speciality education in

Türkiye is 109, the five universities with the highest number of these studies are Istanbul University (408, 7.50 %), Ege University (363, 6.67 %), Marmara University (315, 5.79 %), Gazi University (259, 4.76 %) and Selçuk University (235, 4.32 %). Supplementary Table S1 shows the detailed version of the distribution of the top 10 universities with the most theses, dates of establishment and these types. Also, the publication years of the first public biochemistry theses and the founding years of the universities in Türkiye is shown in Supplementary Figure S1.

2,930 (53.8 %) theses were conducted in the Department of Biochemistry (2,340 of these theses were conducted in the Faculty of Medicine, Training and Research Hospitals and Institutes of Health Sciences, while the remaining 590 were conducted in the Institute of Science, Institute of Engineering and Science, Institute of Bio-Medical Engineering and Graduate Education Institutes.) 1816 (33.3 %) theses were conducted in the Department of Medical Biochemistry. There were many different uses of the department name in the database, like "Department of Biochemistry (Medicine)", "Department of Biochemistry and Clinical Biochemistry" and "Department of Medical Biochemistry". The authors have combined all these department names into a single title, "Department of Medical Biochemistry" for practical purposes.

324 (5.9 %) theses studied in the Department of Biochemistry (Veterinary) (Considered as a single title together with Veterinary Biochemistry), 149 (2.7 %) theses studied in the Department of Pharmaceutical Biochemistry, 104 (1.9 %) theses studied in the Department of Molecular Biochemistry and Genetics, 40 (0.7 %) thesis studied in the

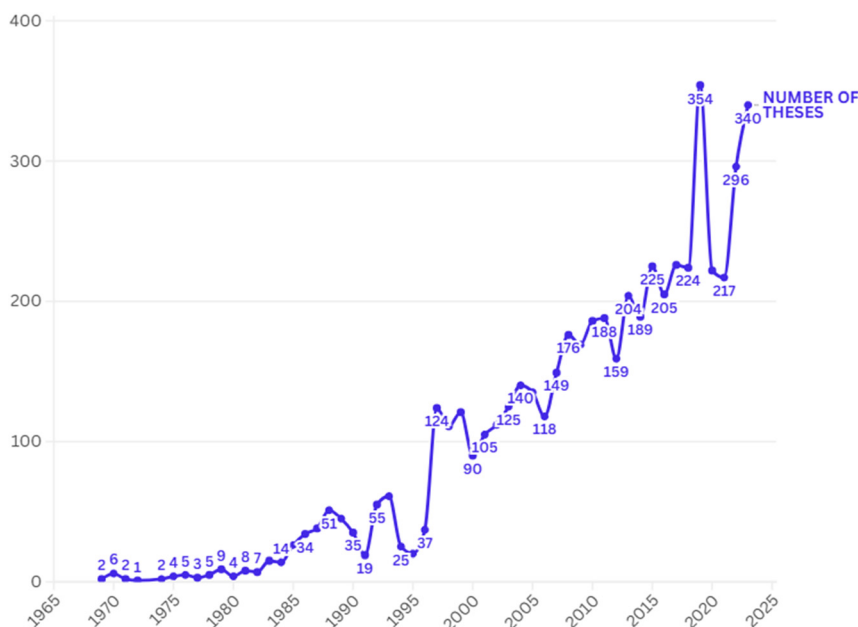


Figure 1: Yearly publication numbers of the theses in the CoHe database, from 1969 to 2023.

Department of Biochemistry Science and Technology, 38 (0.7 %) thesis studied in the Department of Biochemistry and Molecular Biology, 21 (0.4 %) thesis studied in the Department of Biochemical Engineering, 15 (0.3 %) thesis studied in the Department of Pharmaceutical Biochemistry, and 6 (0.1 %) thesis studied in the Department of Biochemistry and Physiology. Supplementary Table S2 shows the detailed number of contributions by faculty departments.

In terms of institutes (3,191 58.61 %) of the theses were conducted in the Institute of Health Sciences, 1,207 (22.17 %) in the Faculty of Medicine, 687 (12.62 %) in the Institute of Science, 237 (4.35 %) in Training and Research Hospitals, 104 (1.91 %) in the Institute of Graduate Education, 13 (0.24 %) in the Institute of Engineering and Science, 3 (0.06 %) in the International Institute of Biomedicine and Genome, and 1 (0.02 %) in the Institute of Bio-Medical Engineering. Supplementary Table S3 shows the detailed number of contributions by institutional departments.

The median page count for all theses was 84 (IQR: 67–106). The validity of page counts exceeding 200 is somewhat controversial, so they were considered as outliers. The distribution of the page numbers of the theses by type is shown in Supplementary Figure S2.

A minimum of one disease was referenced in 3,046 (62.8 % of the total available) of the theses. Cancer was the primary focus of research studies, followed by diabetes in the second position, and upper respiratory tract infections (URTI) ranked third. Global health trends at PubMed reveal that the leading disease studies are cancer, diabetes, and pregnancy (Figure 2).

We also conducted an analysis of diseases year by year. In addition, we have provided links to access an interactive race graph for further exploration, which can be found in the supplementary data.

Although several diseases exhibited weak or statistically insignificant associations between CoHE and PubMed trends, only pregnancy demonstrated a significant positive correlation ($p=0.455$, $p=0.0022$). The noted negative associations for atherosclerosis ($p = -0.429$, $p=0.0041$) and hypertension ($p = -0.470$, $p=0.0015$) suggest that national trends in thesis production differ from international publication trends for these conditions.

The 10 most studied topics are given below. Since the 2000s, there has been a relative increase in studies about inflammation, apoptosis, DNA and genetics and a decrease in studies on lipid metabolism, oxidant-antioxidant systems, and enzymes.

Global trends in the past 15 years show that energy metabolism studies have found a place with an increase. Studies related to enzymatic studies are in the second line and apoptosis is in the third (Figure 3).

In terms of Energy Metabolism, the data from CoHE demonstrates an upward trend, though there has been a slight decline over the past decade, its importance remains significant. In contrast, the information from PubMed reveals a subtle decrease in the global studies on energy metabolism, although the total percentage is higher than CoHE (%9.9 vs. %6.95, respectively).

In the context of hormones, the CoHE data reveals a positive trend; in contrast, the PubMed dataset reflects a steady decline in hormone-related publications and a weak

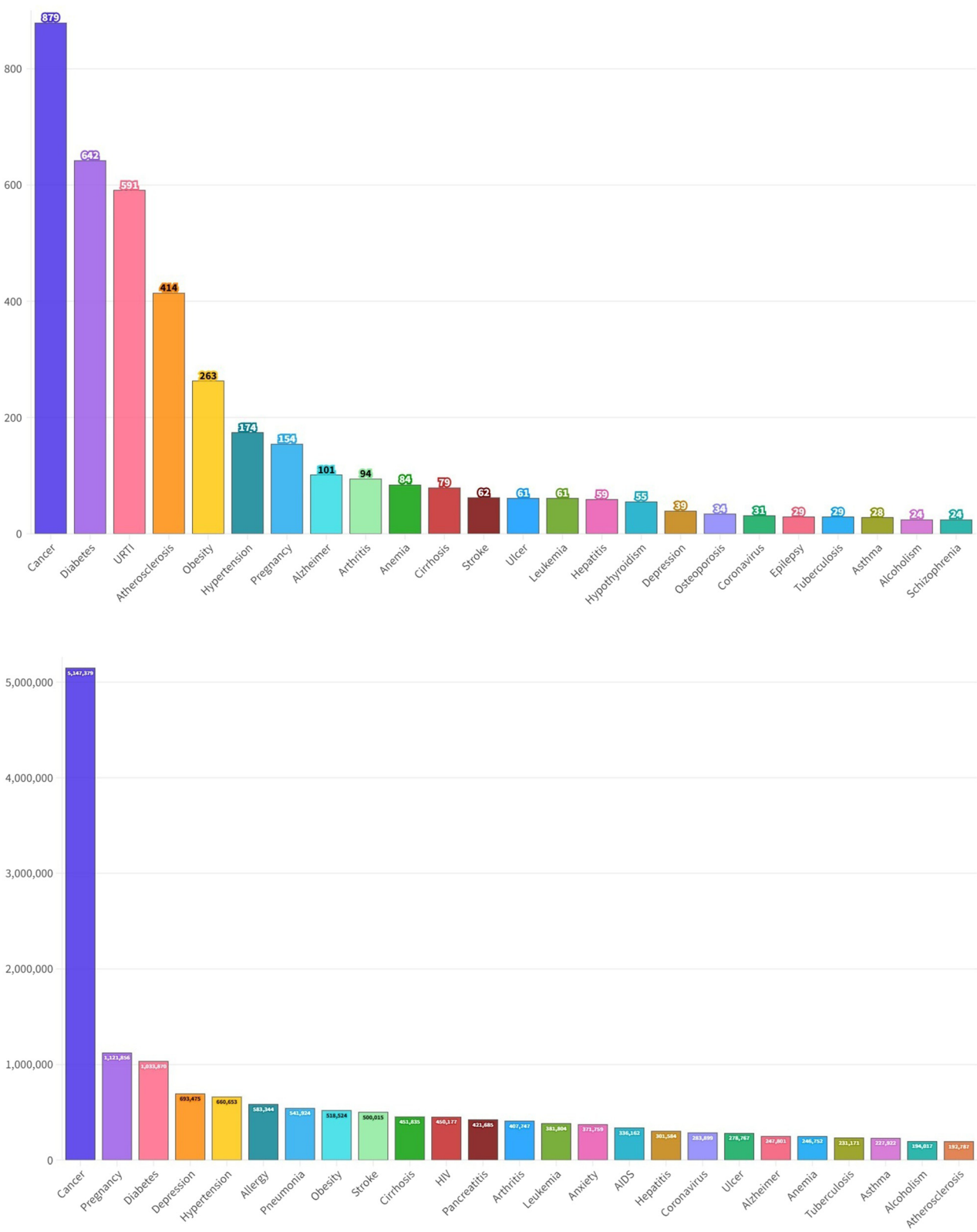


Figure 2: Distribution of various diseases reported in the reviewed theses and the PubMed database, respectively, showing the frequency of each disease across the datasets.

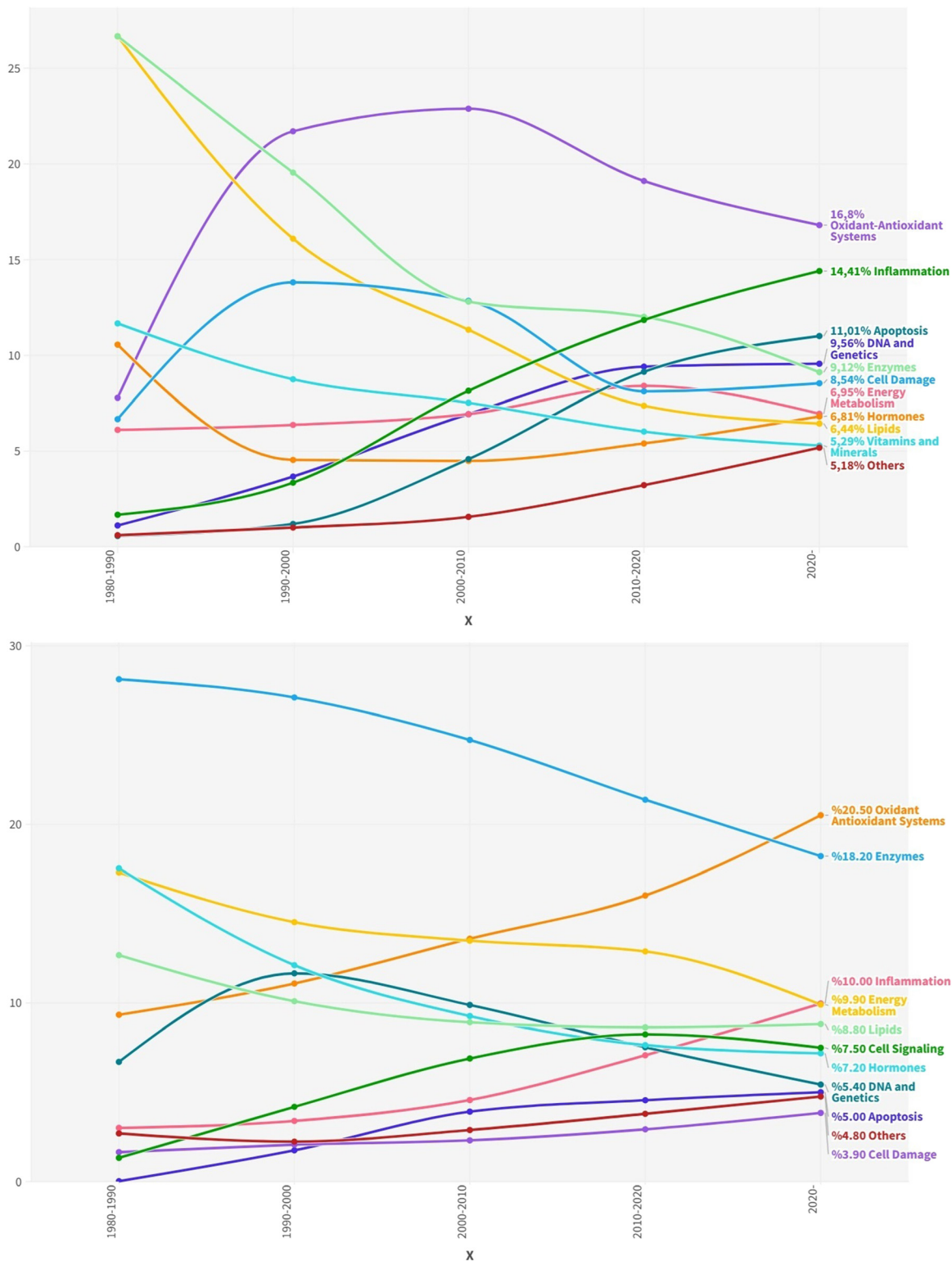


Figure 3: The top 10 most frequently studied research topics per decade, according to data from the CoHE and PubMed, respectively.

correlation ($p=0.100$, $p=0.8729$). This indicates a globally consistent downward trajectory in research on both energy metabolism and hormones, whereas the national data

reveals a weaker and more variable local increase. Subjects including Cell Signalling, Apoptosis, Enzymes, and Inflammation exhibited a perfect positive correlation ($\rho=1.000$,

$p < 0.001$), indicating a strong alignment between thesis output and worldwide publication trends (Table 2).

The primary materials utilised in the theses are serum, plasma, and animal tissues as depicted in the supplementary data section. For the global research, epidemiological studies take precedence as the first investigation stage. Animal studies follow them, and serum comes third, similar to Türkiye's studies in the PubMed database, except for the animal studies. Distribution of material types used in the studies in CoHe and PubMed is shown in Supplementary Figure S3.

A minimum of one study method was referenced in 4,456 (91.9 % of the total available) of the theses included in our research. Spectrophotometry is the most used technique with a number of 1921 (43.1 %). Routine biochemistry techniques (complete blood count, renal and liver function tests, hormone panels, etc.) are the second most used with 1847 (41.44 %). The third is cell culture, which is 754 times (16.9 %) (Figure 4).

Also, co-occurrence analyses were performed in our research. An overview of the interconnections related to research can be seen in Figure 5.

The Cluster Analysis of the extracted data and the research topics can be seen in Figure 6.

Table 2: Spearman analysis of the frequencies of the top 10 studied diseases and topics, CoHe vs. PubMed.

	Spearman's rho	p-Value
Disease		
Cancer	0.034	0.8305
Diabetes	0.197	0.205
Urti	−0.011	0.9444
Atherosclerosis	−0.429	0.0041
Obesity	0.231	0.1360
Hypertension	−0.470	0.0015
Pregnancy	0.455	0.0022
Alzheimer	−0.208	0.1801
Arthritis	0.074	0.6371
Anemia	−0.268	0.0819
Topics		
Cell signaling	1.000	<0.0001
Apoptosis	1.000	<0.0001
Enzymes	1.000	<0.0001
Inflammation	1.000	<0.0001
Lipids	0.900	<0.0374
Oxidant antioxidant systems	0.100	0.8729
Hormones	0.100	0.8729
Cell damage	0.100	0.8729
Others	−0.200	0.7471
Energy metabolism	−0.359	0.5528
Dna and genetics	−0.400	0.5046

Significant relationships denoted as bold.

Discussion

This research comprehensively analyses master's, doctoral, and speciality theses completed between 1969 and 2023. This 53-year longitudinal study comprehensively examines the entirety of theses available in the CoHe database and certain topics for PubMed, focusing on emerging trends related to diseases, thematic areas, research methodologies, and materials utilised within these academic works.

Similar studies on this subject in our country were conducted in various medical fields, such as pediatrics, anaesthesia, history of medicine, Emergency Medicine, and Covid-19. On the other hand, as we examine the literature for bibliographic studies of theses in Türkiye, we find works in chemistry, Dermatology and Public Health [8–15]. In the global context, there are bibliographic studies from recent years with topics like stroke and microbiota, circular RNA and health sciences [16–18].

According to the National Science Foundation, the Biology and Biomedical departments in the United States have grown by 10.8 % over the last decade, graduating 9,218 PhD students in 2022. Of this number, 465 PhD theses were studied in biochemistry and 326 in biochemistry and molecular biology [19].

Although specific biochemistry department statistics across Europe are inaccessible, in 2021, 28,147 individuals graduated with a postgraduate degree in Germany, 13,729 in France and 10,889 in Spain. Overall, this represents a rate of 21.9 graduates per 1,000 people aged 21 to 29 across the EU (European Union), while our country has a rate of 14.2 graduates per 1,000 people in the same age group [20].

Even though the quality of research is more important than quantity, studies in biochemistry are increasing much more in our country than in the US (United States) when we look at population percentage. Although there seems to be some decrease due to restrictions during the Covid-19 pandemic period, the number of these in the field of biochemistry in 2022 was 296 and in 2023 was 340, which is quite promising compared to the US statistics given above. A study analysing medical articles retained by Web of Science and published by Turkish universities in 2010–2012 determined that biochemistry was the field with the most contributions among basic medical sciences, with 337 studies [21]. We could barely say that the number is almost parallel to the thesis production. However, in the comparison of all post-graduate statistics given above, it can be seen that we are slightly behind, considering the high potential of our country.

In the mentorship of students regarding the selection of thesis topics and methodologies, it is crucial for educators to

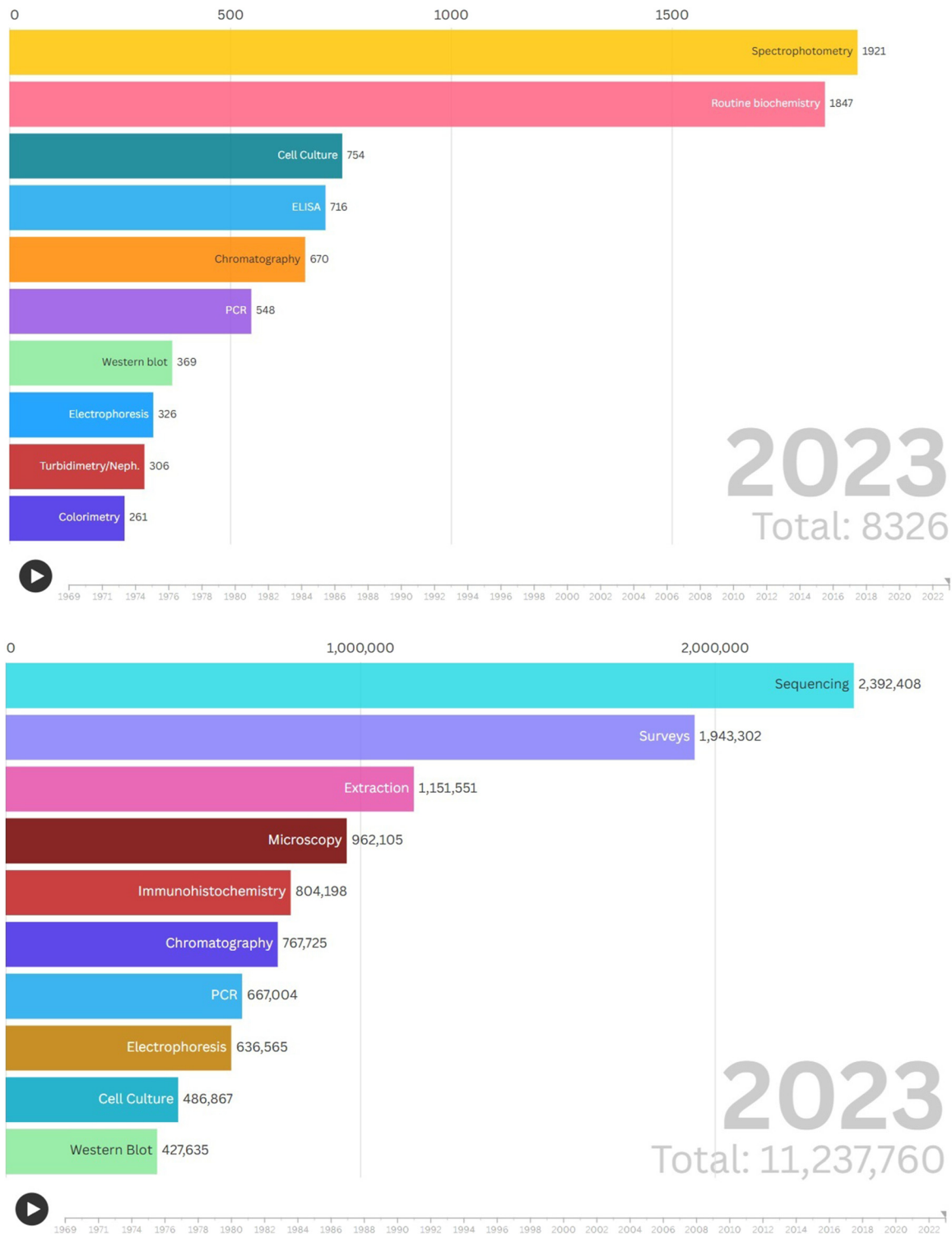


Figure 4: Yearly distribution of study techniques – the changing trends in methodological approaches over time in the database of the CoHE and the PubMed, respectively.

stay informed about prevailing trends in academia. This understanding enables them to offer relevant and practical guidance, thereby enhancing the overall academic

experience for their students. For example, in 2014, before the passing of cancer, diabetes was the No. 1 research topic of the theses for a long time. Atherosclerosis is the No. 4, and

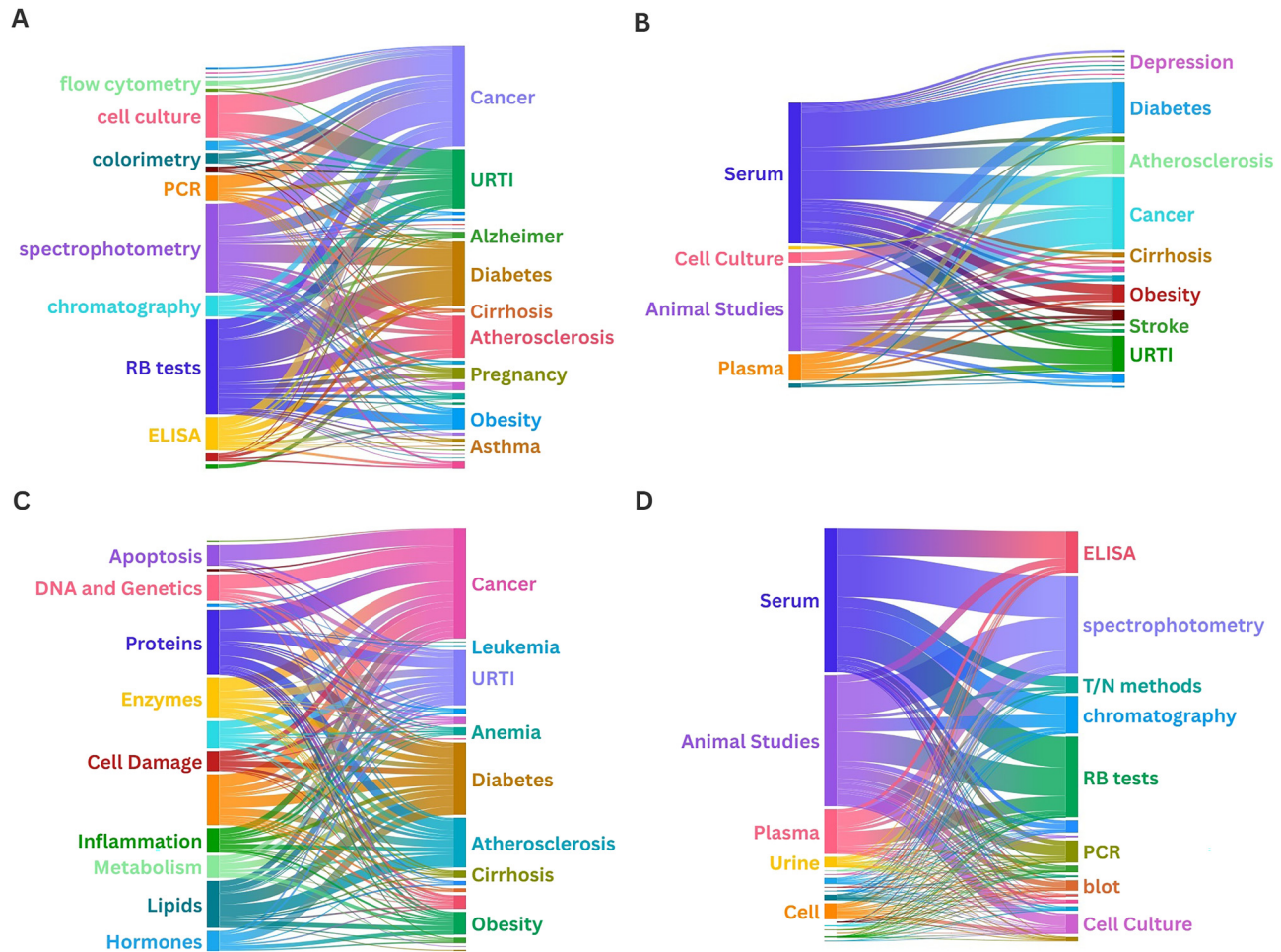
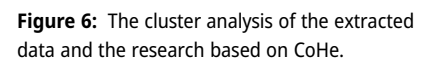


Figure 5: Co-occurrence network analyses of research keywords based on CoHE. (A) Overview of the study techniques in disease-related research, (B) overview of study materials in disease-related research, (C) overview of study topics in disease related research, and (D) overview of study materials in research on study techniques. Nodes are sized based on frequency of occurrence and edges represent the strength of co-occurrence between them. RB tests: Routine Biochemistry, TN methods: Turbidimetry/Nephelometry.

obesity is the No. 5 topic among diseases. While the incidence of Alzheimer's disease is relatively low, it has become one of the top 10 diseases since 2017. Upon comparing these findings with the PubMed results (even though we could not separate these data into biochemistry and others), Cancer, Diabetes, and Pregnancy share the first three places, respectively, and are similar to our country. Depression is the 4th most studied case globally, and although the pandemic is over, Coronavirus comes fifth. As of 2023, depression is not included among the top ten most-researched diseases in our country.

These changes are clearly driven by the expansion of cancer and obesity screening programs, coupled with a surge in public awareness regarding these critical issues. Furthermore, the aging population and the increasing diagnoses of Alzheimer's disease are undeniable factors that contribute to this trend.

Biochemistry departments may not receive adequate funding for these diseases; a larger share of resources may instead be directed toward family medicine, internal medicine, and cardiology departments. Additionally, there exists a government program in Türkiye titled the "Cardiovascular Diseases Prevention and Control Program" (T.C. Sağlık Bakanlığı 2021), which provides insight into the matter by emphasising "prevention and control" rather than focusing on "research." We assert that local project sponsors, including research institutions and organisations such as TÜBİTAK (Scientific and technological research council of Türkiye), should play a prominent role in disseminating substantial research funding initiatives within Türkiye. Although the incidence of hypertension in Türkiye isn't markedly greater than in other nations, key factors such as obesity, significantly higher salt intake habit and urban lifestyle lead us to believe that hypertension and



are the top three categories in PubMed. In particular, research related to microbiota has nearly increased sixfold in the last 10 years. It has risen to the sixth most studied area among the studies we examined. It would not be incorrect to state that the research conducted in this field will become even more significant in the upcoming years.

Upon examining the year-by-year distribution, it is evident that there has been a noticeable increase in the use of cell culture, plant studies, and animal experiments following the year 2000. Spectrophotometry is the first, basic biochemistry techniques (Complete blood count, AST, ALT, urea, creatinine, amylase lipase etc.) the second, and cell culture is the third most studied technique in the theses. According to PubMed trends, sequencing is first, and surveys and extractions come after worldwide. Chromatographic techniques have declined to fifth place since 2018. In comparison with PubMed, we see that ELISA (Enzyme linked immunosorbent assay), spectrophotometry, and chromatography have drawn a plateau in the last few years, even with a slight decrease, possibly due to the Covid-19 pandemic. It could be said that these findings are in conflict with the changes in the selection of study techniques around the world.

In the context of research related to diseases, especially in cancer studies, it is clear that cell culture, polymerase chain reaction (PCR), and spectrophotometric analysis are

According to various types of materials, epidemiological studies, studies on different tissues, and animal experiments

commonly utilised. Additionally, significant subjects in cancer research encompass cell signalling, apoptosis, DNA and genetics, as well as oxidant-antioxidant systems, highlighting the mechanisms explored in oncology. The favoured methodologies for studies on upper respiratory tract infections (URTI) are PCR, oxidant systems, and routine biochemistry. In diabetes research, the most frequently selected techniques include routine biochemistry, spectrophotometric methods, and chromatography. Diabetes research is closely associated with all of the study topics, mostly in enzymes, metabolism, and oxidative stress.

Serum is the most commonly used specimen in nearly all disease categories, similar to plasma. Serum is also strongly linked with techniques like spectrophotometry, ELISA, routine biochemistry, and chromatography. Animal studies also play a significant role, especially in studies related to cancer, obesity, and diabetes, highlighting their emerging trend in experimental disease modelling. Animal studies are particularly associated with ELISA, chromatography, and blotting techniques. Although urine is less frequently utilised overall, it's used in nearly every method and is employed explicitly in studies like diabetes and pregnancy.

Surveys serve as a crucial method for gathering health and social science data from a selected group of individuals in a consistent manner to gain insights about a broader population. Research involving surveys enables scholars to obtain empirical information within a relatively short timeframe. Nonetheless, as a key finding of our study, the number of surveys conducted in the biochemistry field has been quite limited, presenting a considerable study area for the future advancement of the discipline.

Although the industry is at the forefront of information, directing science and various technological fields, breakthroughs in the fields of diseases, medicines, study techniques and chemicals are emerging from research laboratories, and science fields are adapting to these advances [24]. There is an obvious necessity to boost R&D and R&D plant funding for biochemical research.

While Türkiye isn't among the countries receiving the most funds, the National Institutes of Health (NIH) website lists 811 grants totalling \$340 million, and more than 60 countries use them. It's easy to predict that there will be even more challenging times for global funding, particularly since the US is planning to decrease its financial backing for the NIH and has suggested lowering grant approval rates from 40 to 15 % [25]. Nonetheless, this presents an opportunity for us to turn the crisis into an opportunity by enhancing local funding sources. Our country may even be preferred over countries like the United States, where people leave the country due to delayed payments [26]. As a result of

significant local investment in its research and academic institutions, China, as the largest member of the union driven by Brazil, Russia, India, China and South Africa (BRICS), has emerged as the leading nation in scientific output, surpassing the United States [27]. It is estimated that China produces 27 % of the world's publications, and 60–65 % of the publications within the BRICS countries [28].

Conclusions

We aimed to examine the changing trends in biochemistry research, emphasising critical methodologies and their alignment with PubMed trends. Our results indicate an increasing focus on microbiota and cell culture, and a gap in studies in pregnancy and surveys, mirroring the overall shift in scientific research. We propose that studies in biochemistry should prioritise diseases such as atherosclerosis and osteoarthritis in parallel with the findings in our work, particularly considering increasing life expectancy. Moreover, placing increased focus on microbiota studies and the utilisation of animal models within research methodologies will be crucial for advancing our understanding in this field.

Although this study offers significant insights, future investigations might enhance these trends by incorporating real-time data analysis. Grasping these patterns is crucial for guiding future biochemistry research and fostering ongoing scientific advancement.

Limitations

The primary limitation of our study is the absence of analysis from universal thesis databases such as ProQuest, Connecting REpositories (CORE) or Elton B. Stephens Company (EBSCO Open) Dissertations. We were unable to segregate the data obtained from PubMed to exclusively focus on biochemistry; therefore, the data was considered a general summary of search terms. Additionally, the CoHE database encompasses theses from 1967 onward; hence, our study excludes any theses published prior to this date. There is also a temporal disparity between the completion times of academic theses and the publication times of corresponding articles indexed in PubMed; this incalculable lag is another limitation for our longitudinal trend comparisons. Also, some of the theses that we know of regrettably do not exist in the database.

Acknowledgements: We honour all our colleagues and senior professionals who have dedicated their hard work and

passion to biochemistry. We also acknowledge their contributions before 1969, which we could not include in our study due to limitations in the database. Also, I would like to extend my sincere gratitude to my esteemed colleague, M. Yunus Tunca, for providing invaluable data codes that facilitate our data retrieval processes.

Research ethics: Not applicable.

Informed consent: Not applicable.

Author contributions: All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Use of Large Language Models, AI and Machine Learning Tools: None declared.

Conflict of interest: Authors state no conflict of interest.

Research funding: None declared.

Data availability: Not applicable.

References

- Günergun F. Chemical nomenclature in nineteenth-century Turkey. *Stud Ottoman Science* 2003;5:1–32.
- Ömer B. Developments in medical biochemistry specialization training. In: *International Laboratory Medicine and 19th National Clinical Biochemistry Congress 2019*. Bodrum, Muğla, Turkey: Conference Proceedings of International Laboratory Medicine & National Clinical Biochemistry Congress; 2019.
- Zupic I, Čater T. Bibliometric methods in management and organization. *Organ Res Methods* 2014;18:429–72.
- Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: an overview and guidelines. *J Bus Res* 2021;133: 285–96.
- CoHe_Thesis_Center [Internet]. c2024 [cited 02.04.2025]. Available from: <https://tez.yok.gov.tr/UlusalTezMerkezi/>.
- Pubmed [Internet]. c2024 [cited 25/05/2025]. Available from: <https://pubmed.ncbi.nlm.nih.gov/advanced/>.
- Wisniewski SJ, Brannan GD. Correlation (coefficient, partial, and spearman rank) and regression analysis. *StatPearls*. Treasure island (FL): StatPearls publishing. Copyright © 2025. StatPearls Publishing LLC; 2025.
- Kaba İ, Aydoğdu G. A bibliometric analysis of publications on pediatrics from Turkey between 1980-2022: contribution to global productivity and publication trends: bibliometric analysis of pediatrics. *Med Sci Discovery* 2023;10:564–74.
- Güc ZHV, Özbilgin S, Özbilgin S. Thesis studies of universities in anaesthesiology and reanimation between 1970 and 2016: retrospective evaluation of work areas, publishing rates and evidence levels. *Turk J Anaesthesiol Reanim* 2021;49:379–88.
- Özaydın Z. Bibliography of Turkish medical history (medicine, pharmacy, dentistry, veterinary medicine, nursing, midwifery) (19th–21st centuries): in commemoration of the 90th anniversary of the Republic. *Istanbul: Istanbul Univ Cerrahpaşa Fac Med Publ*; 2012.
- Güzcelce MC, Orhan E, Özgür S. A bibliometric analysis of publications on emergency medicine in Türkiye. *Turk J Emerg Med* 2024;24:145–50.
- Yıldız Gülhan P, Kurutkan MN. Bibliometric analysis of COVID-19 publications in the field of chest and infectious diseases. *Duzce Med J* 2021;23:30–40.
- Dölen EA. Short history of chemical education in Turkey. *Chem Int* 2013; 35:11–12.
- Bostan E, Uçar MT, Tunca MY. Bibliometric analysis of Dermatology and venereology residency dissertations in Türkiye between 1968 and 2023: a cross-sectional retrospective study. *Turk J Dermatology* 2024;18:86–93.
- Denizli Y, Uçar A, Uçar MT, Tunca MY. Bibliometric analysis of PhD, residency dissertations and master's theses in public health departments in Türkiye between 1970–2022. *ESTUDAM Public Health J* 2024;9:142–53.
- Wang C, Zhu H, Li Y, Zhang Y, Ye Y, Zhong Y, et al. Bibliometric analysis of the gut microbiota and stroke from 2002 to 2022. *Heliyon* 2024;10: e30424.
- Yehui L, Zhihong L, Fang T, Zixuan Z, Mengyuan Z, Zhifang Y, et al. Bibliometric analysis of global research on circular RNA: current status and future directions. *Mol Biotechnol* 2024;66:2064–77.
- Li J, Deacon C, Keezer MR. The performance of bibliometric analyses in the health sciences. *Curr Med Res Opin* 2024;40:97–101.
- NCSES NCFsES [Internet]. c2023 [cited 01.09.2024]. Available from: <https://ncses.nsf.gov/pubs/nsf24300/data-tables>.
- Eurostat [Internet]. c2024 [cited September 8, 2024].
- Koçak Z. Bibliometric analysis of clinical medicine publications in Turkey [Ph.D. thesis]. Ankara, Turkey: Middle East Technical University (METU), Graduate School of Informatics Publishing; 2014.
- Collaboration NRF, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet* 2021;398:957–80.
- Erdem Y, Akpolat T, Deric Ü, Şengül Ş, Ertürk Ş, Ulusoy Ş, et al. Dietary sources of high sodium intake in Turkey: SALTURK II. *Nutrients* 2017;9: 933.
- Khanmohammadi R, Kaur S, Smiley CH, Alhanai T, Brugere I, Nourbakhsh A, et al. The influence of biomedical research on future business funding: analyzing scientific impact and content in industrial investments. *IEEE Trans Comput Soc Syst*. 2024. In press.
- Mallapaty S, Naddaf M. NIH turmoil sparks anxiety over future of its global grants. *Nature* 18–19. <https://doi.org/10.1038/d41586-025-00595-1>.
- Tham WY, Staudt J, Perlman ER, Cheng SD. *ArXiv*. [Internet]. c2024 Available from: <https://arxiv.org/abs/2402.07235>.
- Charani E, Abimbola S, Pai M, Adeyi O, Mendelson M, Laxminarayan R, et al. Funders: the missing link in equitable global health research? *PLOS Glob Public Health* 2022;2:e0000583.
- Aparna N, Chogtu B, Janodia M, Venkata SK. A bibliometric study on the research outcome of Brazil, Russia, India, China, and South Africa. *F1000Res* 2021;10:213.

Supplementary Material: This article contains supplementary material (<https://doi.org/10.1515/tjb-2024-0296>).