To cite this article: Güngör G. Bibliographic analysis of artificial intelligence-assisted publications used in abdominal ct imaging in the last 10 years. Turk J Clin Lab 2025; 1: 159-166

Research Article

Bibliographic analysis of artificial intelligence-assisted publications used in abdominal ct imaging in the last 10 years

Son 10 yılda abdomen bt görüntülemede kullanılan yapay zeka destekli yayınların bibliyografik analizi

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Abstract

Aim: This study presents a bibliometric analysis of artificial intelligence (AI)-assisted publications in abdominal computed tomography (CT) over the past decade. By examining publication trends, citation patterns, and research collaborations, this study offers insights into the evolving impact of AI in abdominal imaging.

Material and Methods: Data were retrieved from the Web of Science Core Collection using specific search criteria for 2014–2024. Bibliometric analysis was conducted using VOSviewer to generate co-occurrence networks, citation maps, and collaboration patterns. The study included keyword analysis, co-authorship analysis, co-citation analysis, and bibliographic coupling.

Results: A significant increase in AI-related publications in abdominal CT has been observed in recent years, with deep learning emerging as the dominant methodology. Citation network analysis identified key studies focused on image reconstruction, segmentation, and radiomics. Collaboration networks highlighted strong international and inter-institutional partnerships, particularly among institutions in the United States, China, and South Korea. Additionally, industry-academic collaborations, notably with GE Healthcare, have contributed to the advancement of AI in abdominal imaging.

Conclusions: AI-assisted abdominal CT imaging continues to expand as a critical area of research, demonstrating increasing interdisciplinary collaborations. Deep learning and radiomics have become focal points, influencing clinical decision support and quantitative imaging analysis. Future research should prioritize AI integration into routine radiology practice and explore its clinical effectiveness through large-scale validation studies.

Keywords: Artificial intelligence; deep learning; machine learning; abdominal CT; abdominal imaging; radiomics

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Doi: 10.18663/tjcl.1647005
Recevied: 25.02.2025 accepted: 20.03.2025

TJCL Volume 16 Number 1 p: 159-166

Öz

Amaç: Bu çalışma, son on yılda abdomen bilgisayarlı tomografi (BT) alanında yapay zeka (YZ) destekli yayınların bibliyometrik analizini sunmaktadır. Yayın eğilimleri, atıf modelleri ve araştırma iş birliklerini inceleyerek, YZ'nin abdomen görüntülemedeki gelişen etkisine dair içgörüler sağlamayı amaçlamaktadır.

Gereç ve Yöntemler: Veriler, 2014–2024 yılları için belirli arama kriterleri kullanılarak Web of Science Core Collection'dan alınmıştır. Bibliyometrik analiz, VOSviewer kullanılarak eş görülme ağları, atıf haritaları ve iş birliği modellerini oluşturmak amacıyla gerçekleştirilmiştir. Çalışma kapsamında anahtar kelime analizi, ortak yazarlık analizi, ortak atıf analizi ve bibliyografik eşleşme analizleri yapılmıştır.

Bulgular: Son yıllarda abdomen BT'de YZ ile ilgili yayınlarda önemli bir artış gözlenmiş ve derin öğrenme baskın metodoloji olarak öne çıkmıştır. Atıf ağı analizi, görüntü rekonstrüksiyonu, segmentasyon ve radyomikler üzerine odaklanan temel çalışmaları belirlemiştir. İş birliği ağları, özellikle Amerika Birleşik Devletleri, Çin ve Güney Kore'deki kurumlar arasında güçlü uluslararası ve kurumsal ortaklıkları ortaya koymuştur. Ayrıca, GE Healthcare gibi endüstri-akademi iş birlikleri, abdomen görüntülemede YZ'nin ilerlemesine önemli katkılar sağlamıştır.

Sonuçlar: YZ destekli abdomen BT görüntüleme, artan disiplinler arası iş birlikleri ile gelişmeye devam eden kritik bir araştırma alanıdır. Derin öğrenme ve radyomikler, klinik karar destek sistemleri ve kantitatif görüntüleme analizlerini şekillendiren temel odak noktaları haline gelmiştir. Gelecekteki araştırmalar, YZ'nin rutin radyoloji pratiğine entegrasyonunu ve geniş ölçekli doğrulama çalışmaları ile klinik etkinliğinin araştırılmasını önceliklendirmelidir.

Anahtar Kelimeler: Yapay zekâ; derin öğrenme; makine öğrenmesi; abdomen BT; abdomen görüntüleme; radyomikler

Introduction

Artificial intelligence (AI) has transformed medical imaging, introducing advanced computational techniques that enhance diagnostic accuracy, automate image interpretation, and optimize radiology workflows [1]. Over the past decade, AI applications in computed tomography (CT) imaging have gained significant traction, particularly in abdominal imaging [2]. The integration of deep learning, machine learning, and radiomics has facilitated precise segmentation, improved image reconstruction, and enhanced lesion detection, contributing to more efficient clinical decision-making [3].

Abdominal CT serves as an essential imaging modality for diagnosing oncological, inflammatory, and metabolic conditions. However, conventional imaging techniques demand substantial radiologist expertise, are time-consuming, and are susceptible to inter-observer variability. AI-driven approaches mitigate these limitations by offering automated, standardized, and efficient image analysis tools [4]. Recent developments in convolutional neural networks (CNNs) and transformer-based architectures have further enhanced AI applications in abdominal imaging [5].

Bibliometric analysis provides a structured framework for assessing research productivity, citation trends, and influential contributions in a specific field. Analyzing AI-assisted abdominal CT literature allows for the identification of key contributors, thematic research trends, and global collaboration patterns. Understanding these elements is crucial for bridging knowledge gaps, shaping future research trajectories, and fostering interdisciplinary collaborations [6].

This study aims to systematically evaluate AI-assisted abdominal CT publications from the past decade. By analyzing keyword distributions, co-citation networks, co-authorship trends, and institutional collaborations, this bibliometric analysis will offer a comprehensive overview of emerging research directions [7]. The findings are expected to provide a strategic foundation for the future development of AI applications in abdominal imaging.

Material and Methods

Data Collection

This study utilized the Web of Science Core Collection (WoSCC), a well-established database for high-impact scientific publications. The search strategy was designed to retrieve publications from 2014 to 2024, focusing on AI applications in abdominal CT imaging. The Boolean search strategy included:

- TS=("Artificial Intelligence" OR "Deep Learning" OR "Machine Learning")
- AND TS=("Abdominal CT" OR "Abdominal Imaging")

• NOT TS=("Ultrasound" OR "Magnetic Resonance Imaging")

• AND WC=("Radiology, Nuclear Medicine & Medical Imaging")

• AND PY=(2014-2024)

Only peer-reviewed journal articles were included, excluding conference proceedings, book chapters, and editorials to ensure the analysis focused on high-impact research.

Data Processing and Analysis

Data cleaning and pre-processing were conducted using Microsoft Excel and VOSviewer to remove duplicates and incomplete records [8]. The final dataset included:

• Publication details (title, authors, year, journal)

• Abstracts and keywords

• Citation metrics (total citations, h-index, impact factor)

• Collaboration details (co-authorship, institutional affiliations, country of origin)

Bibliometric Techniques

To analyze the dataset, the following bibliometric methods were applied:

• Keyword Co-occurrence Analysis: This method has been widely applied in bibliometric studies to visualize keyword networks and research hotspots [9]. Identified frequently used keywords and their interconnections, revealing thematic research areas and emerging trends. The threshold value was set at 5 to include only significant keywords.

• Co-authorship Analysis: Bibliometric studies commonly use this technique to assess collaboration intensity and global research networks [10]. Assessed collaboration networks among authors, institutions, and countries to determine leading contributors. The threshold value was 3 co-authored publications per researcher.

• Co-citation Analysis: Co-citation networks help identify key intellectual foundations in a field, providing insights into citation dynamics [9]. Citation relationships between studies were evaluated to determine basic research in the field. The threshold value was set at 5 for co-cited studies.

• Bibliographic Coupling: This method is frequently employed in bibliometric research to group thematically similar studies based on shared references [10] Examined thematic similarities between research clusters using a threshold value of 5.

• Network Visualization and Interpretation

All bibliometric networks were visualized using VOSviewer to identify clusters and research hotspots. The networks were color-coded based on:

• Temporal trends (e.g., early foundational studies vs. recent emerging topics)

• Research themes (e.g., segmentation, image enhancement, radiomics)

• Collaborative groups (e.g., key institutions and global partnerships)

Statistical Analysis

Descriptive statistics were performed to quantify:

The number of publications per year.

The most frequently cited articles and authors.

The distribution of research topics over time.

The impact of collaborations on citation rates.

All statistical calculations were conducted using Python (Pandas, Matplotlib) and SPSS, ensuring a robust quantitative assessment of bibliometric data [11].

This methodological framework ensures a comprehensive evaluation of AI applications in abdominal CT research, facilitating deeper insights into research dynamics and future directions.

Results

Publication Trends

AI-assisted abdominal CT publications have grown exponentially over the past decade [7]. Research activity was relatively limited before 2019 but has since expanded significantly, peaking in 2023 with over 100 published articles (Figure 1 and 2). This trend highlights the growing interest and rapid advancements in AI applications within abdominal imaging [12, 13].

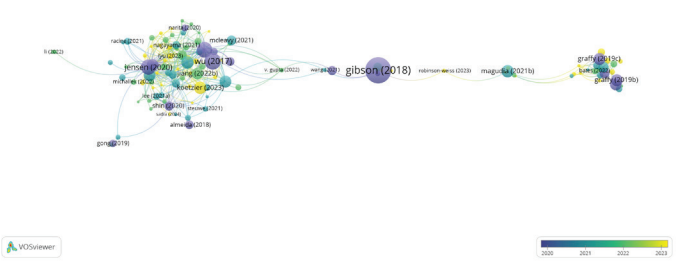

Figure 1. Citation Analysis Overlay Map. This figure presents a citation network analysis of AI-assisted publications in abdominal CT imaging. The network was generated using VOSviewer with a minimum citation threshold of 5, meaning only studies cited at least five times were

included. Each node represents a publication, with its size reflecting the number of citations received. The links between nodes indicate citation relationships, demonstrating intellectual connections among influential studies. The color gradient (blue to yellow) represents the chronological distribution of publications, where blue denotes older studies (2020 and earlier), and yellow highlights more recent contributions (2023 and beyond). Gibson (2018) and Jensen (2020) emerge as key citation hubs, signifying their foundational impact on AI applications in abdominal imaging [12, 13]. The clustering of newer studies suggests an increasing focus on deep learning, radiomics, and image reconstruction in recent years. This analysis provides insights into the evolution of research trends, identifying major contributors and thematic shifts in AI-driven abdominal imaging.

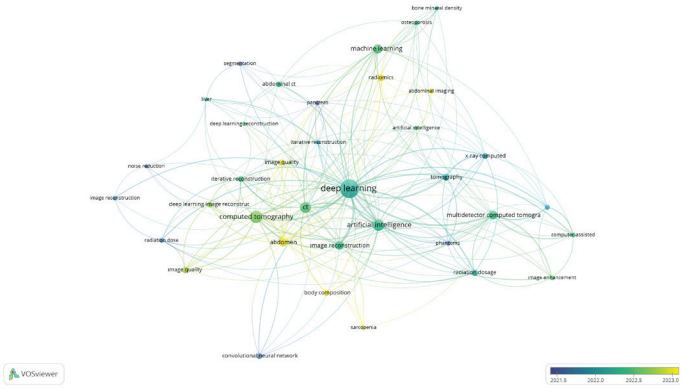

Figure 2. Keyword Co-occurrence Overlay Map. This figure illustrates the keyword co-occurrence network of AI-assisted publications in abdominal CT imaging. The network was generated using VOSviewer with a minimum threshold of 5 occurrences, meaning only keywords appearing in at least five studies were included. Each node represents a keyword, with larger nodes indicating more frequently used terms. The connections between keywords signify their co-occurrence in the same publications, highlighting thematic relationships. The color gradient (blue to yellow) represents the chronological distribution of keywords, where blue denotes older research focus areas (2021 and earlier), and yellow highlights more recent topics (2023 and beyond). The most prominent keywords include "deep learning," "artificial intelligence," "computed tomography," and "radiomics," indicating the dominant research themes in AI-assisted abdominal imaging. Emerging keywords such as "image enhancement," "body composition," and "transformer networks" suggest evolving research trends in quantitative imaging and AI-driven analysis. This visualization provides insights into the shifting research focus in AI-assisted abdominal CT imaging, emphasizing the increasing role of deep learning and radiomics in clinical applications.

Keyword and Citation Analysis

Frequently occurring keywords included "Deep Learning," "Artificial Intelligence," "Computed Tomography," "Radiomics," and "Image Reconstruction." The keyword co-occurrence network revealed distinct research clusters, with deep learning dominating the field (Figure 3 and 4). Emerging topics such as "Transformer Networks" and "Explainable AI" have gained prominence in recent years, reflecting ongoing advancements in AI-driven image analysis [11, 14-16].

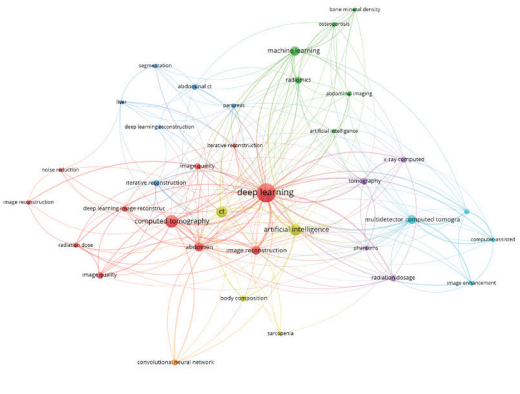

Figure 3. Keyword Co-occurrence Network Map. This figure represents the keyword co-occurrence network of AI-assisted publications in abdominal CT imaging, visualized using VOSviewer with a minimum occurrence threshold of 5 (i.e., only keywords appearing in at least five publications are included). Each node represents a keyword, and its size corresponds to the frequency of its occurrence. The links between nodes indicate co-occurrence relationships, highlighting thematic connections among different research topics. The color-coded clusters group related keywords based on their research focus, revealing distinct thematic areas. The red cluster, centered around "deep learning" and "computed tomography," represents core research themes, including image reconstruction, segmentation, and noise reduction. The green cluster focuses on "machine learning" and "radiomics," suggesting an emphasis on AI-driven feature extraction and quantitative imaging. The blue cluster includes terms related to image quality, iterative reconstruction, and liver imaging, reflecting AI applications in organ-specific imaging. The purple cluster groups terms like "multidetector computed tomography" and "X-ray computed tomography," indicating developments in AI-enhanced CT hardware and acquisition techniques. This network analysis highlights the interdisciplinary nature of AI applications in abdominal imaging, demonstrating strong interconnections between deep learning, radiomics, and image enhancement techniques.

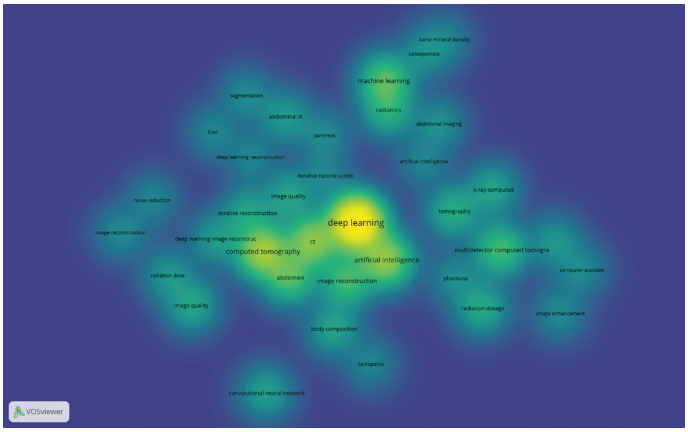

Figure 4. Keyword Density Map. This figure displays the keyword density map of AI-assisted publications in abdominal CT imaging, generated using VOSviewer with a minimum occurrence threshold of 5. The heatmap represents the concentration and frequency of keywords within the analyzed dataset. Brighter regions (yellow) indicate high-frequency keywords that appear more frequently in publications. Darker regions (blue/purple) represent less frequently occurring but still relevant terms. The most dominant keywords include "deep learning," "artificial intelligence," "computed tomography," and "image reconstruction," reflecting the core research themes in AI-assisted abdominal imaging. The distribution pattern shows a high concentration of studies focused on deep learning applications, radiomics, and quantitative imaging techniques, while emerging topics such as "body composition," "sarcopenia," and "computer-assisted imaging" indicate expanding research areas. This heatmap provides a visual representation of thematic focus areas, identifying hotspots in AI-driven abdominal imaging research and potential directions for future studies.

Citation analysis identified foundational studies on deep learning architectures, segmentation methodologies, and radiomics applications (Figure 5). The most cited works were published in prominent journals such as Radiology, European Radiology, and American Journal of Roentgenology [14-17].

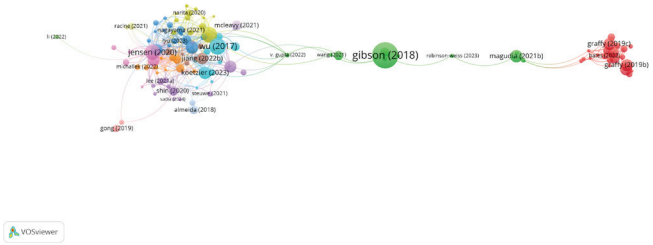

Figure 5. Citation Network Map. This figure illustrates the citation network of AI-assisted publications in abdominal CT imaging, created using VOSviewer with a minimum citation threshold of 5. Each node represents a publication, with its size corresponding to the number of citations received. The links between nodes indicate citation relationships, reflecting how studies are interconnected. Color-coded clusters group studies based on their citation patterns, revealing distinct research domains. Gibson (2018) and Wu (2017) emerge as key citation hubs, signifying their foundational impact on AI applications in abdominal imaging [12, 17]. The rightmost cluster (red) represents a distinct research line with a different thematic focus, likely emphasizing alternative AI applications or methodologies. The green cluster in the center suggests a bridge between early foundational studies and more recent research directions. This visualization provides insights into the evolution of citation relationships, identifying core studies and thematic shifts in AI-driven abdominal imaging research.

Collaboration Networks

Co-authorship analysis revealed that the United States, China, and South Korea are the most active countries in AI-assisted abdominal imaging research. Notably, Harvard Medical School, Seoul National University, and GE Healthcare emerged as key institutional collaborators (Figure 6). These findings highlight the increasing role of international and industry-academic partnerships in advancing AI applications in radiology [14, 16].

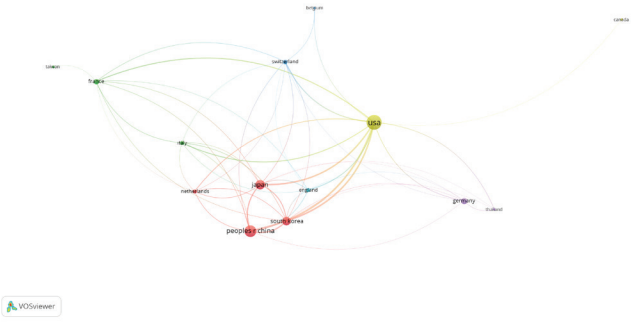

Figure 6. Co-authorship Network Map by Country. This figure presents the international co-authorship network in AI-assisted abdominal CT imaging research, visualized using VOSviewer with a minimum co-authorship threshold of 3 (i.e., only countries with at least three co-authored publications are included). Each node represents a country, and its size reflects the number of publications originating from that country. Lines between nodes indicate collaborative research efforts between countries, with thicker lines representing stronger collaborations. The USA appears as the most influential research hub, engaging in widespread collaborations with multiple countries, including China, Japan, and European nations. Clusters highlight regional collaboration patterns, such as: Red cluster: Strong research ties between China, Japan, and South Korea. Green cluster: European collaboration network led by France and Italy. Blue cluster: Switzerland, Belgium, and England forming a separate research group.

Figure 7. Institutional Co-authorship Network Map. This figure illustrates the institutional co-authorship network in AI-assisted abdominal CT imaging research, visualized using VOSviewer with a minimum co-authorship threshold of 4 (i.e., only institutions with at least four co-authored publications are included). Each node represents an institution, and its size corresponds to its research output in this field. Links between nodes indicate collaborative research relationships, with thicker lines representing stronger collaborations. Harvard Medical School, Seoul National University, and GE Healthcare emerge as major research hubs, engaging in extensive international and industry-academic collaborations. Clusters highlight institutional partnerships, such as: Green cluster: Strong collaborations among the University of Wisconsin, NIH Clinical Center, and Massachusetts General Hospital. Red cluster: Close research ties between Seoul National University, GE Healthcare, and Shanghai Jiao Tong University. Blue cluster: A distinct collaboration network centered around Nagoya University. This analysis provides insights into leading institutions and their collaboration patterns, demonstrating the growing role of industry-academic partnerships in AI-assisted abdominal CT imaging research.

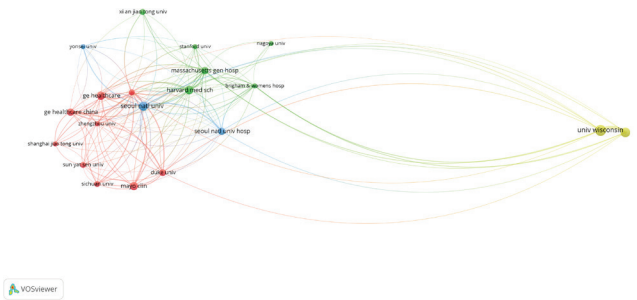

Figure 8. Institutional Co-authorship Network Map. This figure visualizes the institutional co-authorship network in AI-assisted abdominal CT imaging research, created using VOSviewer with a minimum co-authorship threshold of 5 (i.e., only institutions with at least five co-authored publications are included). Each node represents an institution, and its size corresponds to the number of publications produced by that institution. Links between nodes indicate collaborative relationships, where thicker lines represent stronger institutional collaborations. Major research hubs include Harvard Medical School, Seoul National University, and GE Healthcare, which exhibit extensive global and industry-academic partnerships. Clusters highlight regional and institutional collaborations, such as: Green cluster: Strong connections among the University of Wisconsin, Stanford University, and Massachusetts General Hospital. Red cluster: Intense collaborations among Seoul National University, GE Healthcare, and major Chinese universities. Blue cluster: A separate research network centered around Nagoya University. Compared to the lower-threshold version (Figure 7), this figure provides a more refined view of the strongest institutional collaborations, filtering out institutions with fewer connections. It offers a focused perspective on the leading research centers shaping AI applications in abdominal imaging.

Discussion

The findings of this study highlight the rapid growth and evolving landscape of AI applications in abdominal CT imaging. The increasing number of publications, particularly after 2019, reflects the expanding interest in AI-driven methodologies [18]. The dominance of deep learning-based approaches underscores their effectiveness in segmentation, image reconstruction, and quantitative imaging analysis [15].

The co-citation and bibliographic coupling analyses revealed that foundational AI research, such as deep learning architectures (e.g., U-Net) and radiomics methodologies, continues to influence contemporary studies [19]. While early AI applications focused on image enhancement and denoising, recent research emphasizes clinical decision support and explainable AI models [20].

Collaboration network analysis demonstrated strong inter-institutional and international partnerships. The United States, China, and South Korea emerged as leading contributors, with major institutions such as Harvard Medical School, Seoul National University, and GE Healthcare playing key roles [14, 16]. These collaborations indicate that AI in radiology is increasingly becoming a global effort, integrating expertise from multiple disciplines.

Despite advancements, several challenges remain. The standardization of AI models, ensuring generalizability across diverse patient populations, and addressing regulatory considerations are critical areas for future research [21]. Furthermore, the seamless integration of AI into routine radiological workflows necessitates rigorous validation through large-scale, multi-center clinical studies [22].

Conclusion

This bibliometric study comprehensively analyzes AI applications in abdominal CT imaging, highlighting key research trends and collaboration networks. The increasing prominence of deep learning and radiomics underscores the paradigm shift toward AI-assisted imaging analysis. Future research should focus on improving model transparency, obtaining regulatory approvals, and implementing real-time AI applications in clinical settings.

Financial Support and Conflict of Interest

This study received no financial support, and the authors have no conflicts of interest to declare.

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