Radiological research trends in the use of convolutional neural networks for breast cancer detection, diagnosis and classification: A bibliometric analysis of the 100 most-cited articles

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Purpose

Over two million cases of breast cancer are diagnosed worldwide annually (1). Recent advances in medical imaging and artificial intelligence such as convolutional neural networks (CNNs) have emerged as a powerful multi-layered tool for image classification and computer vision tasks (2-4). CNNs' ability to automatically learn and extract features from images has shown promise in enhancing diagnostic accuracy and supporting radiologists in clinical decision-making (5,6).

This bibliometric analysis aims to evaluate the quality and characteristics of the 100 most-cited articles in the application of CNNs for breast cancer detection, diagnosis and classification. Our objectives are to identify significant contributions to the field, highlight influential radiological research trends, and provide an overview of the evolving landscape of CNN research in breast cancer diagnostics.

Methods

Keywords were used to extract literature from the Web of Science (WoS) Core Collection. Research articles, reviews and conference papers in all languages from 1995 to 2024 were included. Titles and abstracts were screened for CNNs focusing on radiology, and relevance to breast cancer detection, diagnosis and classification. Extracted metadata from the 100 most-cited relevant articles was analysed and visualised using Bibliometrix (an open-source R tool; 7). Further data from the full-text was manually extracted to analyse trends in study design.

Results

The original search yielded 2230 articles. The top 100 cited articles had 7249 citations (mean = 121.78, range 49-639, H-index = 71). Increased citations can be seen following increased publications in the last decade (Figure 1).

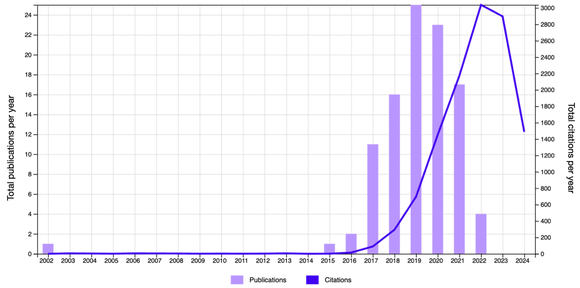


Figure 1. The publication and citation timeline shows that 2019 was the most productive year for the top 100 cited papers (n = 25). Graph produced using Web of Science's Citation Report.

Social knowledge structure analysis

Authors from China and the USA have collaborated on 9 articles, forming the strongest inter-country collaboration network (Figure 2). However, intra-country exceeded inter-country collaboration (57 vs 43 publications).

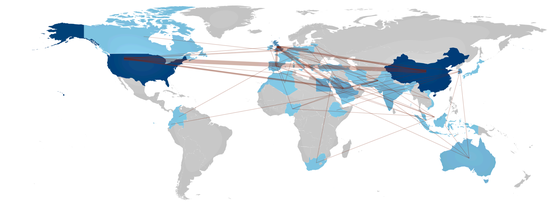


Figure 2. A collaboration world map of the top 100 cited papers. Graph produced using Bibliometrix.

Intellectual knowledge structure analysis

Bradford's law identified six core journals - IEEE Transactions on Medical Imaging is the most published (publications = 8).



Figure 3. The co-citation network graph shows that Lecture Notes in Computer Science is a core source that is often cited by the top 100 cited papers. Graph produced using Bibliometrix.

Conceptual knowledge structure analysis

Trigram keyword analysis shows that the term "convolutional neural network" demonstrated dynamic growth between 2016 to 2019, reaching over 50 occurrences in 2019. This aligns with the recent surge in cancer research focused on this area.

The term "receiver operating characteristic" commonly occurred with "convolutional neural network", indicating that CNN models are being evaluated or validated on tasks where accurate distinction between classes is critical (Figure 4).

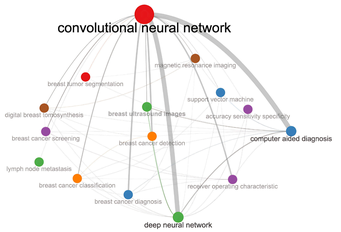


Figure 4. A co-occurrence network analysis of keywords used in the abstracts of the top 100 cited papers. Graph produced using Bibliometrix.

Study design analysis

85 articles were diagnostic accuracy studies, with 11 comparing accuracy scores against human readers.

Most common imaging modality	Mammogram	Ultrasound	Magnetic resonance
Frequency (out of 85)	49	27	10

	Most common datasets			Most common origins of CNN architectures		
	DDSM	MIAS	INBreast	ResNet	VGG	GoogLeNet
Frequency (out of 85)	24	15	9	24	23	10

Conclusion

Further research ideally evaluates CNN models against human readers and uses newly gathered datasets. Extensive collaboration networks between stakeholders are desirable for increasing CNN quality and reliability.

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