Original Article

A bibliometric analysis of malignant pleural mesothelioma from 2010 to 2023

Sheng Chen[1], Ce Zhao[1], Ruiqi Liu[2], Wenjie Jiao[1]

[1]Department of Thoracic Surgery, The Affiliated Hospital of Qingdao University, Qingdao, China; [2]Department of Radiology, The First People's Hospital of Fuyang, Fuyang, China

Contributions: (I) Conception and design: S Chen; (II) Administrative support: W Jiao; (III) Provision of study materials or patients: C Zhao; (IV) Collection and assembly of data: S Chen, C Zhao, R Liu; (V) Data analysis and interpretation: S Chen; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Wenjie Jiao, MD. Department of Thoracic Surgery, The Affiliated Hospital of Qingdao University, 16 Jiangsu Road, Shinan District, Qingdao 266005, China. Email: jiaowj@qduhospital.cn.

Background: Malignant pleural mesothelioma (MPM) is an aggressive tumor originating from the mesothelial lining of the pleural cavity. It is characterized by extensive nodular pleural thickening and has a propensity to invade the pleural adipose tissue and adjacent chest structures. The prognosis is poor, with a median survival time rarely exceeding 12 months following diagnosis.

Methods: This bibliometric analysis systematically assessed global trends in MPM research from 2010 to 2023 using 6,487 publications indexed in PubMed. Quantitative evaluations of publication metrics, international collaboration, and keyword co-occurrence networks were conducted using R software with the bibliometrix package. Network construction and thematic mapping were employed to analyze the temporal evolution of research topics.

Results: The United States and Europe have played pivotal roles in this research, while contributions from China and Japan have been steadily increasing. Traditional treatment approaches and etiological studies are relatively well-established. Meanwhile, immunotherapy has emerged as a prominent focus of recent research.

Conclusions: Future global collaboration in this field should be enhanced, as precision medicine related to immunology and genetics has the potential to transform the treatment landscape of MPM.

Keywords: Bibliometrics; malignant pleural mesothelioma (MPM); immunotherapy

Submitted Oct 19, 2024. Accepted for publication Mar 07, 2025. Published online Apr 21, 2025.
doi: 10.21037/jtd-24-1778
View this article at: https://dx.doi.org/10.21037/jtd-24-1778

Introduction

Malignant pleural mesothelioma (MPM), a mesenchymal-derived thoracic malignancy originating from pleural mesothelial cells, is characterized by insidious clinical progression and high lethality (1). Clinical manifestations typically include intractable chest pain refractory to conventional analgesics and progressive dyspnea, significantly impacting quality of life. Clinical manifestations typically include intractable chest pain refractory to conventional analgesics and progressive dyspnea, significantly impacting quality of life (2). With a strong etiological association with occupational or environmental asbestos exposure, MPM disproportionately affects middle-aged male populations in industrialized settings, demonstrating persistent resistance to conventional therapeutic regimens and thereby emerging as a pressing occupational oncology challenge (3). Current epidemiological studies estimate a global prevalence of 3–5 cases per million population, yet a steady upward trend in incidence has been observed over recent decades (4-6). Notably, regions with historical asbestos utilization, particularly developed nations and high-income industrial zones, bear the highest disease burden, contrasting sharply

with lower baseline incidence in developing economies (7). However, accelerating industrialization in low- and middle-income countries is reshaping this epidemiological pattern. Furthermore, the protracted latency period of MPM (13–70 years) (8) and evolving industrial carcinogen exposure profiles suggest potential shifts in future disease dynamics, necessitating ongoing surveillance of emerging risk cohorts.

The exact mechanisms underlying the onset and progression of MPM remain poorly understood, and effective treatment options are currently lacking (9). The median survival for MPM patients is approximately 1 year, with a 5-year survival rate of only about 1% (10). Although the optimal treatment strategy remains contentious (11), studies have shown that a multimodal approach, incorporating surgery, chemotherapy, and radiotherapy, may provide a survival benefit (12,13). Furthermore, emerging therapeutic modalities, including immunotherapy (14), targeted therapy (15), and oncolytic virotherapy (16), offer promising potential for improving patient outcomes.

As a quantitative discipline within scientometrics, bibliometrics provides a systematic evaluation of academic productivity and scholarly impact through multi-level quantitative assessments encompassing individual investigators, institutional entities, and national research ecosystems (17). This methodology enables rigorous mapping of disciplinary evolution, identification of emerging frontiers, and detection of knowledge gaps through computational analysis of publication patterns. This article employs bibliometric analysis to systematically assess and discuss the existing body of research on MPM. The objective is to offer clinicians a comprehensive and nuanced understanding of the research landscape, current developments, and emerging trends in MPM studies. Such insights may guide future research, fostering more in-depth and clinically relevant investigations.

Highlight box

Key findings

- The United States and Europe dominate malignant pleural mesothelioma (MPM) research, with increasing contributions from China and Japan. Immunotherapy has emerged as a key focus, alongside traditional treatments like chemotherapy and surgery.
- MPM publications peaked in 2021 but declined in 2023, possibly due to shifting research priorities. Citation rates have decreased since 2017, suggesting newer studies need more time for recognition.
- International collaboration, particularly between the US, Europe, and Asia, has advanced MPM research. Key authors like Anna K. Nowak and Takashi Nakano have driven global cooperation.

What is known and what is new?

- MPM is strongly linked to asbestos exposure, with poor prognosis and limited treatment options. Multimodal therapies (surgery, chemotherapy, radiotherapy) are standard, but outcomes remain suboptimal.
- This study is the first bibliometric analysis of MPM, highlighting the rise of immunotherapy and precision medicine.

What is the implication, and what should change now?

- Future research should prioritize understanding molecular mechanisms and developing personalized therapies, while enhancing global collaboration—particularly in underrepresented regions—through increased funding, expanded international multi-center trials, and the inclusion of non-English publications to better capture global contributions.

Methods

Data source

PubMed was selected as the database for this study due to its extensive collection of medical and life sciences literature and its use of standardized documentation methods (18). It is frequently utilized by researchers for its open-access features and robust search capabilities, making it particularly suitable for bibliometric research in the medical field (19). Following extensive discussions within our research team and consultations with senior experts in literature retrieval, a comprehensive search of the PubMed database was conducted for relevant literature on MPM from 2010 to 2023. The search strategy employed was ('Mesothelioma'[Mesh] OR 'mesothelioma' OR 'pleural mesothelioma' OR 'malignant pleural mesothelioma') AND ('2010/01/01'[PDAT]: '2023/12/31'[PDAT]). For further content analysis, only conventional articles written in English, including original research articles, reviews, case reports, clinical studies, and meta-analyses, were included in this study.

Research methods and statistical analysis

The analysis was primarily conducted using R software version 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria) and RStudio. The 'bibliometrix' package (version available at https://www.bibliometrix.org) was employed for data analysis. Initial data interpretation was performed using the 'biblioAnalysis()' command and the 'summary()' function, which included an analysis of

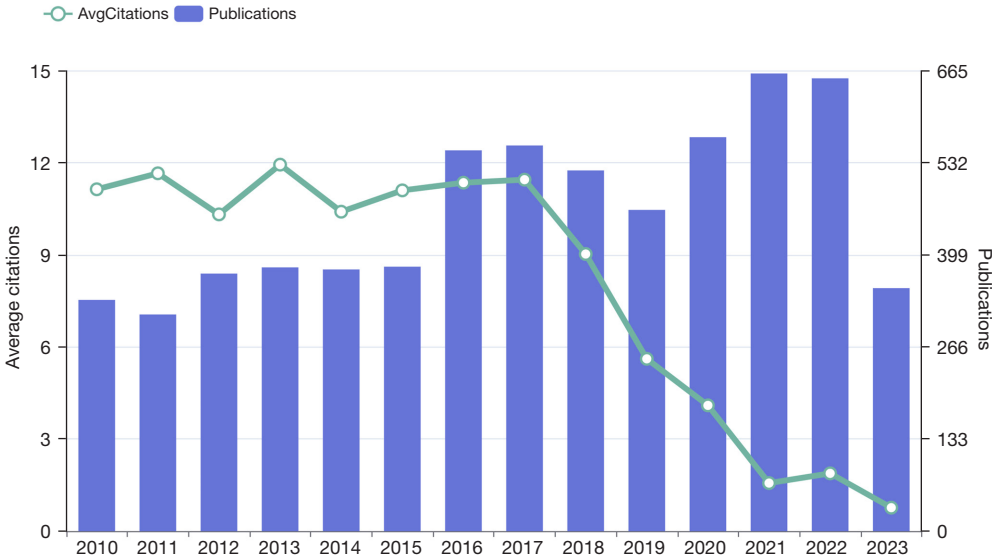

Figure 1 Trends in publications and average citations per article (2010–2023).

the time distribution of articles, the number and types of documents, average publication year, average citations per document, author metrics (such as the number of authors, single and multiple co-authors, and co-authors per document), the most prolific authors, the most highly cited manuscripts, corresponding author country, and single/multiple country publications, total citations per country, most relevant sources, and most relevant keywords. Further analysis of collaboration networks was conducted using the 'metaTagExtraction', 'networkPlot', and 'biblioNetwork' commands. The 'Biblioshiny()' function facilitated analyses of national scientific cooperation, institutional collaboration networks, keyword analysis, co-occurrence network synthesis, and thematic mapping. In addition, we also utilized CiteSpace (version 6.2.4) to analyze and verify the hot trends. In the last, the thematic search on 'MPM' yielded 6,487 articles published between January 1, 2010 and December 31, 2023, with an average annual publication count of 463 articles.

Results

Overall status of publications

Figure 1 presents a time-series analysis illustrating the relationship between the average citations per article (green line) and the number of publications (blue bars) in MPM research from 2010 to 2023. The x-axis represents the respective years, with the left y-axis corresponding to the average citation count per article, and the right y-axis indicating the number of publications per year. From 2010 to 2021, the number of publications exhibited a general upward trend, peaking in 2021 with over 650 articles, reflecting an increase in research activity in the MPM field during this period. However, a significant decline was observed in 2023, with only 351 publications, potentially attributed to external factors such as a shift in research priorities or changes in resource allocation. Regarding the average citation rate, there was a stable and relatively high citation count (approximately 10–12 citations per article) from 2010 to 2016, indicating that the research outcomes during this period had a substantial impact within the academic community. In contrast, since 2017, the average citation rate has gradually decreased, falling to less than 1 citation per article by 2023. This trend may suggest that recent publications have not garnered the same level of impact as earlier works, or that newer articles require more time to achieve recognition and citations. These findings underscore the importance of systematically evaluating the methodological rigor and innovation density of contemporary MPM research to ensure the continued academic relevance and clinical applicability of future studies.

Distribution and quantity of publications

Country distribution, output and citation analysis

Figure 2A illustrates the global distribution of authors

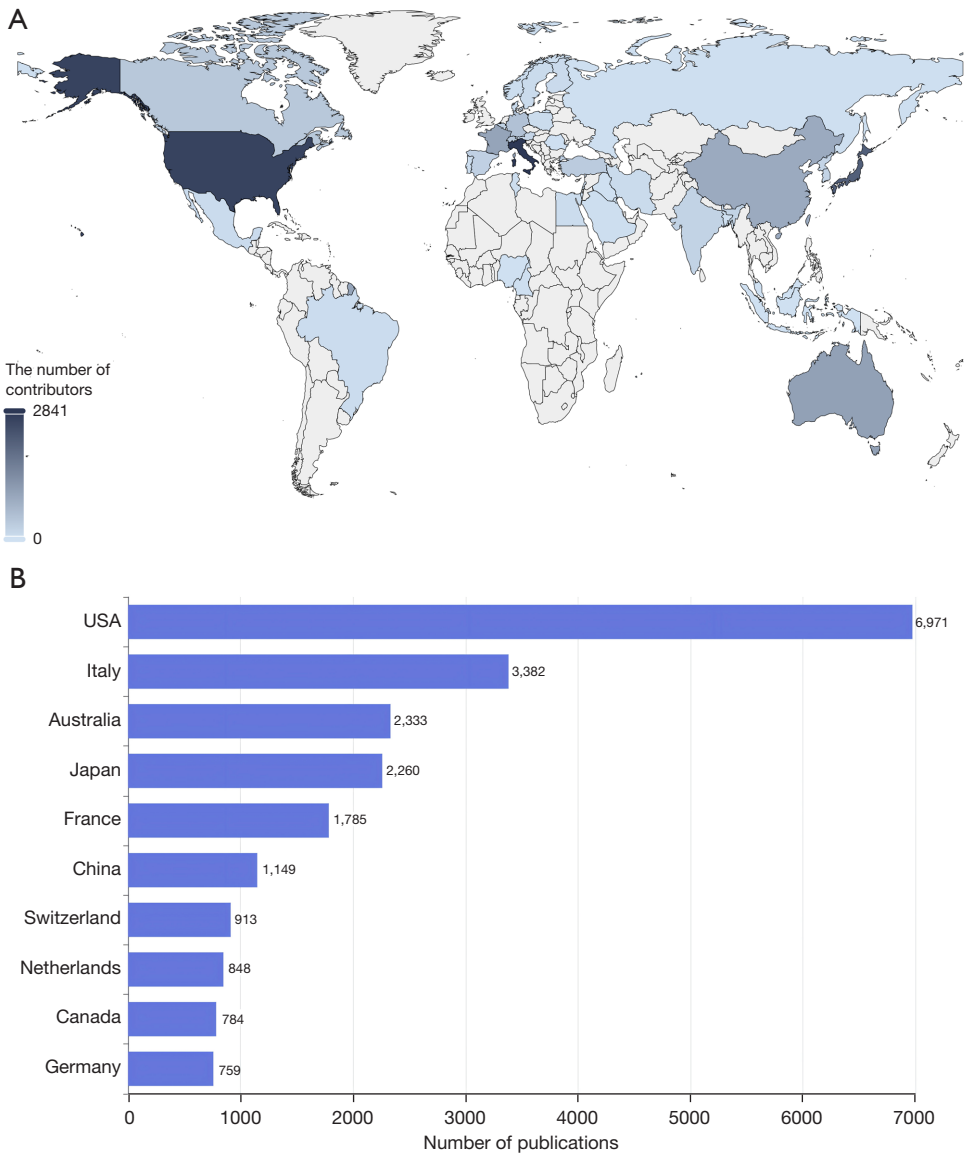

Figure 2 Global overview of MPM research: leading publishing countries and author distribution. (A) Global distribution of authors in MPM research; (B) top ten countries publishing MPM-related publications globally. MPM, malignant pleural mesothelioma.

contributing to MPM research, with the intensity of color corresponding to the number of authors per country. *Figure 2B* presents a bar graph showing the number of MPM-related publications from the top ten contributing countries. Together, these figures provide key insights into the sociopolitical and epidemiological factors shaping global mesothelioma research. The United States' dual dominance in both author density (2,841 contributors) and publication output (6,971 articles) highlights its central role as a hub for MPM research. This dominance is likely supported by substantial cancer research funding, the presence of leading research institutions, and a large MPM patient population. Additionally, clinical progress in MPM, such as the development of pembrolizumab-based regimens (NCT02784171) (20), has been driven by this extensive research activity.

While the number of authors is relatively lower in other regions, notable contributions are observed from Western Europe and East Asia (including Japan and China). This can likely be attributed to improving healthcare systems, widespread clinical trial networks, and important cross-institutional collaborations. Furthermore, given

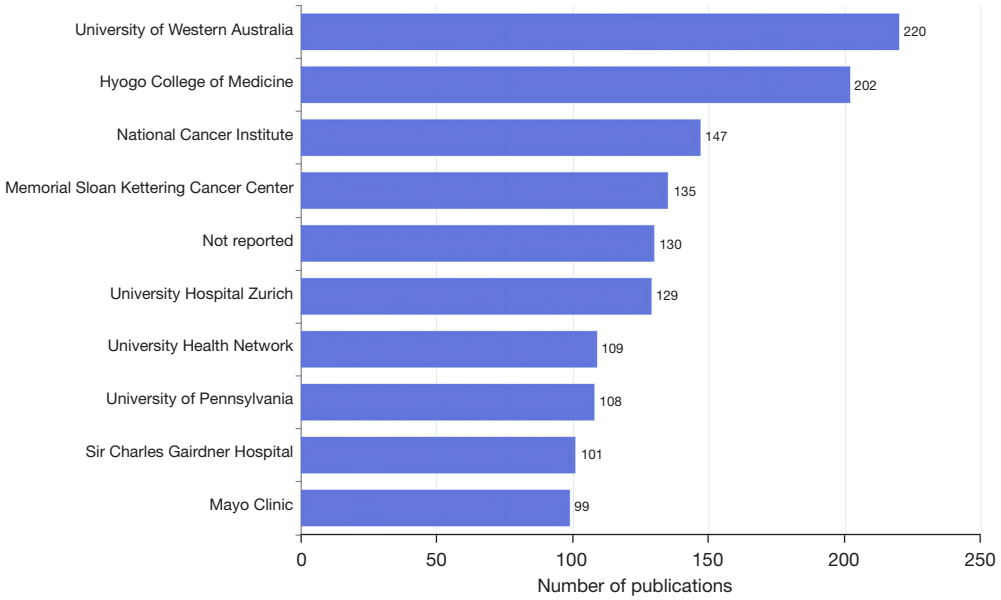

Figure 3 Global institutions contributing to MPM-related publications. MPM, malignant pleural mesothelioma.

that asbestos has been recognized as a major cause of MPM (21), the global distribution of authors largely reflects regions with a historical burden of asbestos use. In contrast, countries in Africa, South America, and the Middle East exhibit marked underrepresentation, which may be attributed to limited research funding, fewer research collaborations, and a lack of clinical research in MPM. Overall, the findings underscore the importance of international collaboration in mesothelioma research and highlight the increasing asbestos-related health risks in emerging economies.

Distribution of institutions and analysis of output

The institutional distribution map highlights the prominence and activity of various institutions in the field of MPM research. As shown in *Figure 3*, the University of Western Australia ranks first with 220 publications, underscoring its leading position in this domain. Additionally, four of the top ten institutions are based in the United States, further reflecting the country's leadership in MPM research.

Analysis of journal distribution

The study analyzed 6,487 articles published across 1,116 journals. *Table 1* lists the top 10 journals by publication volume, along with their most recent Journal Citation Reports (JCR) quartile rankings and impact factors for 2024. The three journals with the highest number of articles were the *Journal of Thoracic Oncology* (125 articles), *Lung Cancer* (125 articles), and *Cancers* (123 articles). Among the top ten journals, seven were ranked in JCR Q1, with the highest impact factor reaching 21 and an average impact factor of 5.41, highlighting the significant influence of these journals within the academic community. Additionally, three of the top ten journals are published by Swiss publishers, with two each from the United States and China.

Author distribution and cooperation network analysis

A total of 28,365 authors have contributed to research on MPM, with 10.67% of them participating in multi-center collaborations. *Figure 4A* illustrates the number of publications of the top authors in MPM-related research. It is evident from the chart that Anna K. Nowak (Australia) and Takashi Nakano (Japan) are at the forefront of the field, having published 56 and 55 papers, respectively, significantly outpacing other researchers. This trend highlights the long-term commitment and ongoing contributions of these two authors to MPM research. Their extensive publication record underscores their pivotal role in advancing the understanding of MPM, with a likely focus on areas such as immunotherapy, early diagnosis, and survival outcomes

The author collaboration network graph illustrates the collaborative relationships and academic network among researchers in the field. Different colored nodes represent distinct author groups, with the size of each node indicating the research output or influence of the

Table 1 The top ten journals by publication volume on MPM

Rank	Periodicals	JCR	Published papers	Impact factor
1	*Journal of Thoracic Oncology*	Q1	125	21
2	*Lung Cancer*	Q1	125	4.5
3	*Cancers*	Q1	123	4.5
4	*Frontiers in Oncology*	Q2	92	3.5
5	*Journal of Thoracic Disease*	Q3	78	2.1
6	*International Journal of Molecular Sciences*	Q1	76	4.9
7	*Annals of Surgical Oncology*	Q1	74	3.4
8	*Translational Lung Cancer Research*	Q1	66	4.0
9	*Annals of Thoracic Surgery*	Q1	54	4.6
10	*Anticancer Research*	Q4	52	1.6

JCR, Journal Citation Reports; MPM, malignant pleural mesothelioma.

respective author. The lines between the nodes signify collaborative relationships, with closer nodes indicating tighter cooperation among the authors. In *Figure 4B*, the 49 most prolific authors are divided into nine clusters, with two clusters being notably smaller, aside from the more prominent eight. The central purple nodes represent key figures in the field, demonstrating extensive collaboration and communication. Harvey Pass plays a pivotal role in the research on MPM, with a broad collaboration network. Authors Takashi Nakano and Seiki Hasegawa form a relatively independent collaborative group (green), showcasing their close cooperation with one another as well as with other researchers. Author Alessandro Marinaccio is located on the right, primarily collaborating with a small group of researchers, forming an independent cluster (orange), reflecting his focused and independent research direction.

Figure 4C illustrates the global network of author collaborations, with the United States and Europe, particularly Western Europe, serving as the primary hubs for international collaboration. Regions with a higher density of lines, indicating more numerous and concentrated connections, signify greater collaboration among these areas. There is substantial cooperation between these regions, evidenced by dense lines and extensive connections, reflecting a strong transatlantic partnership. Additionally, Australia and parts of Asia, such as Japan and China, exhibit significant collaborative links with European and American institutions. Given the rarity of MPM, multi-center and multi-institutional collaboration is deemed essential for advancing research in this field.

Hotspots and trends of publications

Literature citation analysis

Table 2 lists the top ten most cited publications, each with over 200 citations. The most cited article, published in 2017 in *JCO Precision Oncology* and titled 'Landscape of Microsatellite Instability Across 39 Cancer Types', garnered 682 citations. This study utilized cancer genomics to explore the distribution of microsatellite instability (MSI) in MPM, highlighting that patients with MSI-positive tumors could benefit from novel immunotherapies in clinical trials (22). The second most cited article, published in The *Journal of Clinical Investigation* in 2016, examined the relationship between chimeric antigen receptor (CAR)-T cells and tumor immune checkpoints, with 499 citations, underscoring the potential application of CAR-T therapy in MPM (23). The third article, a comprehensive genomic analysis of MPM published in *Nature Genetics*, was cited 412 times and identified four subtypes of the disease, along with a detailed discussion of the associated mutated genes (24). These studies laid the foundation for subsequent immunotherapy and targeted therapy research related to MPM.

Analysis of hot spots and trending topics

This treemap visualizes the distribution of key terms in the research literature on MPM. Each colored block represents a specific research domain or keyword, with the size of the block indicating the frequency of the term's appearance

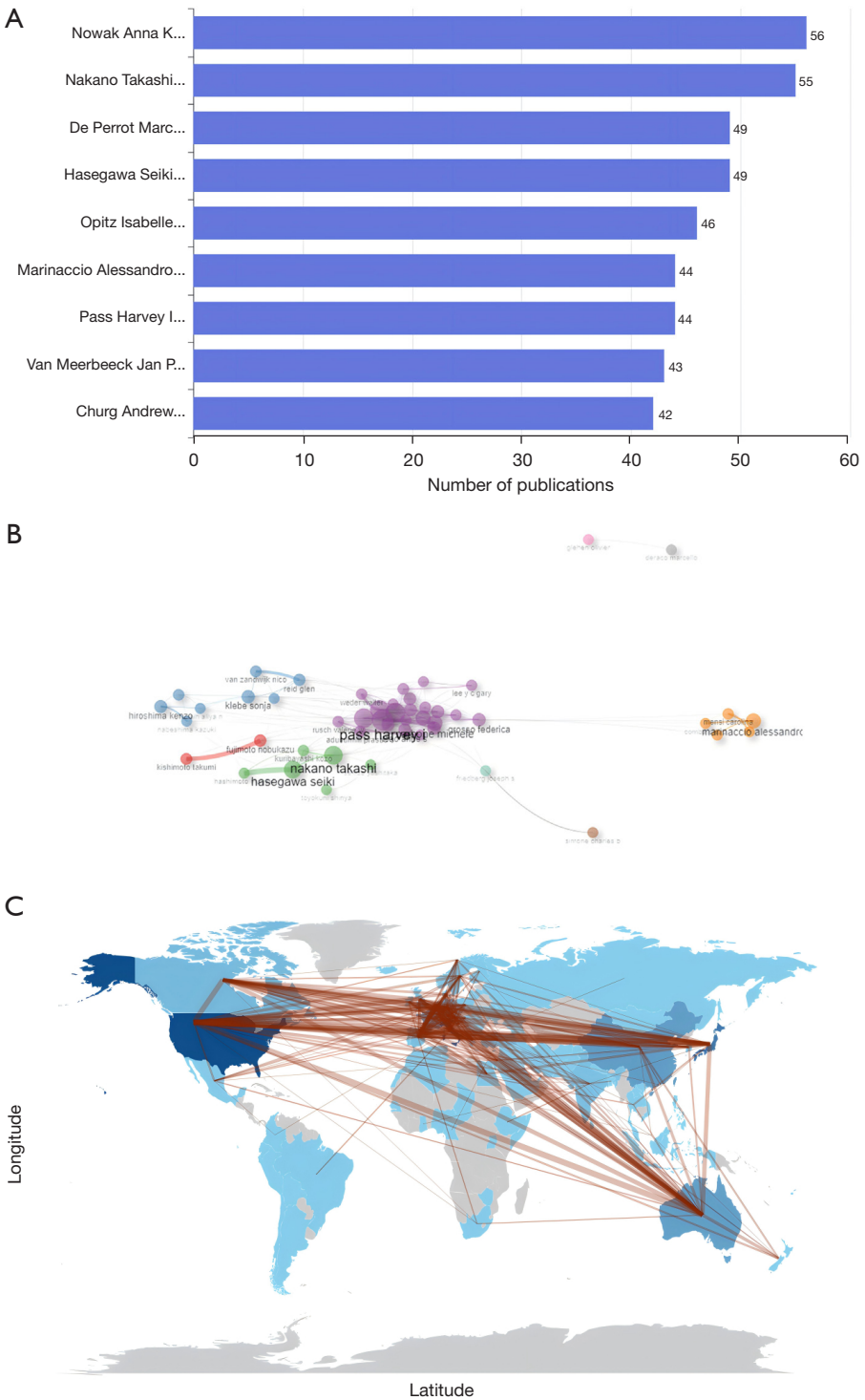

Figure 4 Key contributors and collaborative networks in MPM research. (A) Top 9 authors with most publications on MPM; (B) author cooperation network diagram; (C) global collaboration network of authors in MPM research. MPM, malignant pleural mesothelioma.

Table 2 Analysis of publications citation

Rank	Document title	Date issued	Periodicals	Impact factor	Citations
1	Landscape of Microsatellite Instability Across 39 Cancer Types	2018/6/1	*JCO Precision Oncology*	5.3	682
2	Human CAR T cells with cell-intrinsic PD-1 checkpoint blockade resist tumor-mediated inhibition	2016/7/26	*Journal of Clinical Investigation*	13.3	499
3	Comprehensive genomic analysis of malignant pleural mesothelioma identifies recurrent mutations, gene fusions and splicing alterations	2016/3/2	*Nature Genetics*	31.7	412
4	Lung cancer: Biology and treatment options	2015/8/23	–	–	394
5	Assessing Tumor-Infiltrating Lymphocytes in Solid Tumors: A Practical Review for Pathologists and Proposal for a Standardized Method from the International Immuno-Oncology Biomarkers Working Group: Part 2: TILs in Melanoma, Gastrointestinal Tract Carcinomas, Non-Small Cell Lung Carcinoma and Mesothelioma, Endometrial and Ovarian Carcinomas, Squamous Cell Carcinoma of the Head and Neck, Genitourinary Carcinomas, and Primary Brain Tumors	2017/8/5	*Advances in Anatomic Pathology*	5.1	305
6	COVID-19 in patients with thoracic malignancies (TERAVOLT): first results of an international, registry-based, cohort study	2020/6/17	*Lancet Oncology*	41.6	280
7	Association of tumour mutational burden with outcomes in patients with advanced solid tumours treated with pembrolizumab: prospective biomarker analysis of the multicohort, open-label, phase 2 KEYNOTE-158 study	2020/9/13	*Lancet Oncology*	41.6	267
8	Bevacizumab for newly diagnosed pleural mesothelioma in the Mesothelioma Avastin Cisplatin Pemetrexed Study (MAPS): a randomised, controlled, open-label, phase 3 trial	2016/1/1	*Lancet*	98.4	262
9	Mesothelin-Targeted CARs: Driving T Cells to Solid Tumors	2015/10/28	*Cancer Discovery*	29.7	239
10	Asbestos, carbon nanotubes and the pleural mesothelium: a review of the hypothesis regarding the role of long fibre retention in the parietal pleura, inflammation and mesothelioma	2010/3/24	*Particle and Fibre Toxicology*	7.2	233

in publications. As shown in *Figure 5A*, it is clear that topics like MPM and asbestos are highly prevalent in the literature, reflecting their significance in ongoing research.

Recent studies have shown that asbestos exposure is a significant cause of MPM (11,25-27). Key terms such as "immunotherapy", "PD-1", and "immunohistochemistry" highlight the promising future of immunotherapy in the treatment of MPM. On the other hand, terms such as "chemotherapy" and "surgery" indicate that traditional treatments remain a crucial part of MPM management. Additionally, keywords like "biomarkers", "miRNA", and "BAP1" underscore the increasing role of molecular diagnostics and targeted therapies in MPM management.

Previous studies have identified "mesothelin", a cell surface protein that is expressed at low levels in normal tissues but significantly upregulated in malignant pleural tumors, as a diagnostic and prognostic marker, as well as a potential therapeutic target (28-30). Moreover, specific treatment strategies such as "cytoreductive surgery" and "hyperthermic intrathoracic chemotherapy" are also represented, indicating their role in MPM treatment.

Figure 5A presents the current hotspots in MPM research, emphasizing immunotherapy, molecular biomarkers, and traditional treatment approaches. The distribution of these keywords reflects the cutting-edge directions of MPM research, particularly in the ongoing advancements in precision medicine and interdisciplinary collaboration.

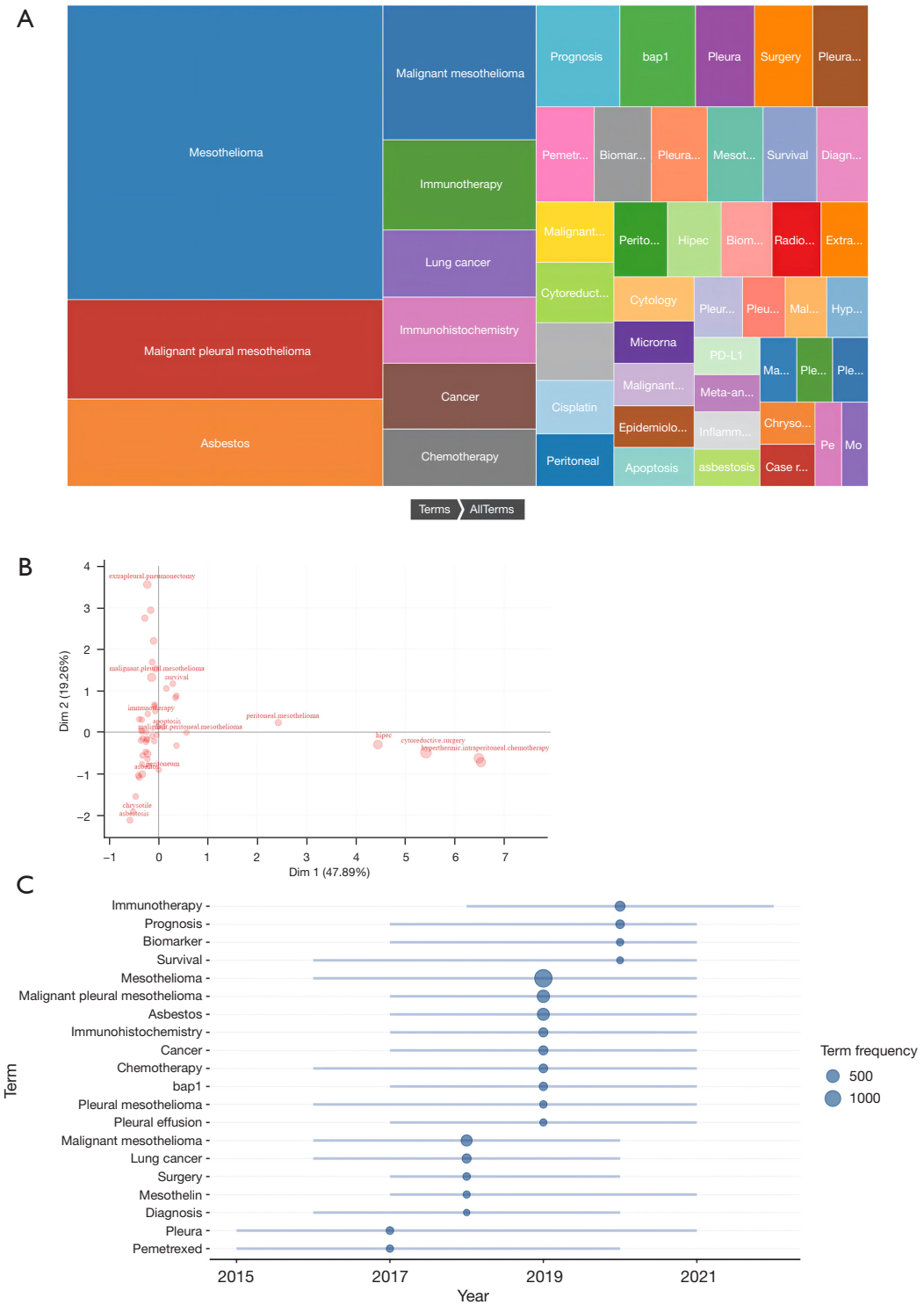

Figure 5 Keyword analysis and research trends in MPM studies. (A) Keyword distribution in MPM research; (B) keywords and research trends in MPM research: a dimensional analysis; (C) keywords frequency trend: core terms in MPM research (2015–2021). MPM, malignant pleural mesothelioma.

Figure 5B employs multidimensional scaling (MDS) to visualize core keywords in MPM research, clustering them into four distinct quadrants that reveal critical research directions and their interconnections. MDS, a dimensionality reduction technique, projects high-dimensional data into a two-dimensional space to facilitate intuitive interpretation of relationships between keywords (31). The horizontal axis (Dim 1) and vertical axis (Dim 2) represent the two primary dimensions of variation. Each red bubble corresponds to a keyword, with bubble size potentially reflecting its frequency in the literature. The spatial proximity between keywords indicates their thematic association—closer bubbles suggest co-occurrence in similar research contexts, while distant ones reflect divergent research focuses.

(I) First quadrant (upper right): this cluster centers on surgical interventions and patient prognosis, featuring keywords such as "extrapleural pneumonectomy" and "survival", highlighting the clinical significance of surgical approaches and survival rate evaluations.
(II) Second quadrant (upper left): dominated by immunotherapy and apoptosis, this quadrant reflects advancements in tumor microenvironment research and molecular mechanisms, particularly the exploration of novel therapies like immune checkpoint inhibitors (ICIs).
(III) Third quadrant (lower left): focused on environmental etiologies, keywords such as "asbestos" and "white asbestos" underscore the foundational role of asbestos exposure in MPM pathogenesis, providing critical insights for disease prevention.
(IV) Fourth quadrant (lower right): encompassing localized therapeutic strategies like "cytoreductive surgery" and "HIPEC" (hyperthermic intrathoracic chemotherapy), this cluster emphasizes the clinical value of combining surgery with hyperthermic chemotherapy in advanced-stage cases.

Collectively, the MDS plot delineates the multidimensional nature of MPM research—spanning etiology, conventional therapies, and precision medicine. The spatial distribution and bubble sizes visually map research hotspots and their interrelationships, offering strategic guidance for interdisciplinary collaboration and future directions, such as optimizing immunotherapies and mitigating environmental risk factors.

Figure 5C displays the frequency trend of core terms related to MPM research from 2015 to 2021. The horizontal axis represents time (from 2015 to 2021), while the vertical axis lists the keywords associated with MPM research. The horizontal bars next to each keyword represent the term frequency across different years, with the length of the bar indicating the period of active research. The circle at the end of each bar indicates the frequency of the keyword in that specific year; larger circles represent higher frequency keywords. The circles in blue show the term frequency in the literature, with larger circles indicating higher frequency terms. This figure provides a clear representation of the shifting focus in MPM research, with increasing attention towards immunotherapy, biomarkers, and molecular targets over the years. The trends depicted also suggest that traditional treatments, such as chemotherapy and surgery, remain crucial, but the emphasis is now expanding towards precision medicine and early detection through biomarkers. This analysis highlights the dynamic nature of MPM research and the growing interdisciplinary approach needed to advance both therapeutic and preventive strategies.

Discussion

To the best of our knowledge, this is the first bibliometric analysis of MPM. Our study reveals that the global distribution of publications on MPM closely aligns with the regional patterns of asbestos use, reflecting real-world situations (32). Although Italy currently leads in the number of MPM-related publications, the research prominence of the United States is increasing, with four of the top ten contributing institutions based there. Japan, Australia, China, and Switzerland also play significant roles in MPM research. Analysis of authorship shows that Takashi Nakano (Japan), Anna K. Nowak (Australia), and Harvey Pass (United States) hold key academic positions, facilitating global collaboration and academic networks. It is evident that international multi-center cooperation has significantly advanced MPM research. Given the rarity of MPM, we advocate for the necessity of joint multi-center clinical trials. Additionally, we recognize that the exclusion of a substantial number of Chinese publications from PubMed due to language barriers may contribute to the under representation of China's contributions in MPM research.

Current therapeutic research in MPM emphasizes immunotherapy as a key investigational direction. ICIs, initially implemented as second-line therapeutic agents (33), have demonstrated measurable clinical efficacy. The landmark CheckMate743 trial established the superiority

of dual immunotherapy (nivolumab plus ipilimumab) over standard chemotherapy in treatment-naïve MPM patients, showing durable survival benefits (34,35). Subsequent investigations validated the therapeutic potential of pembrolizumab and nivolumab both as monotherapy and in combination with ipilimumab for second-line regimens (36-38). Notably, the nivolumab-ipilimumab combination has attained regulatory approval for first-line MPM treatment in both the United States and China (39). While traditional modalities, including platinum-based chemotherapy and pleurectomy, remain foundational to treatment algorithms, emerging strategies integrate ICIs with conventional therapies. Promising clinical evidence supports combination approaches utilizing ICIs and chemotherapy for advanced disease management (31,40). The multicenter phase II DREAM study demonstrated enhanced therapeutic metrics with first-line durvalumab [programmed cell death ligand 1 (PD-L1) inhibitor] plus platinum chemotherapy, achieving improved 6-month progression-free survival (PFS) and objective response rate (ORR) while maintaining a manageable safety profile (41). An ongoing phase III confirmatory trial may further validate these findings, potentially reshaping first-line treatment paradigms and optimizing frontline management strategies (42).

The role of surgical intervention in MPM management remains contentious in contemporary oncology practice (43,44). Emerging evidence suggests potential survival benefits from radical resection in stage I–II sarcomatoid subtype patients, albeit with significantly elevated perioperative morbidity (12.8–34%) and mortality rates (4.3–11.7%) compared to non-sarcomatoid histologies (45,46). This risk-benefit paradox underscores the necessity for meticulous patient selection, particularly across histological variants and disease stages (I–III).

Current surgical paradigms predominantly involve two approaches: extrapleural pneumonectomy (EPP) and pleurectomy/decortication (P/D). EPP entails *en bloc* resection of lung, parietal/visceral pleura, ipsilateral diaphragm, and pericardium, carrying substantial operative risks (mortality 5–15%). Conversely, P/D preserves pulmonary parenchyma through visceral pleurectomy and tumor debulking, though potentially compromising macroscopic completeness (R1 resection rate: 38–67%) (47). Retrospective analyses demonstrate superior median overall survival with P/D versus EPP (23.8 *vs.* 16.8 months, P=0.01) (48), findings corroborated by the MARS trial which precipitated a paradigm shift towards organ-sparing strategies (49-51). Notably, the complex anatomical involvement characteristic of MPM renders R0 resection achievable in only 15–25% of cases, with R1 resection constituting the primary surgical objective in most instances (52). Emerging evidence supports adjuvant hyperthermic intrathoracic chemoperfusion (HITOC) with P/D, demonstrating 24-month survival rates of 53.4% in phase II trials (53,54). The evolving therapeutic landscape is further shaped by molecular profiling advances. BAP1 mutations (present in 21–63% of MPMs) and novel biomarker discovery are informing targeted therapeutic development. This scientific progression, coupled with immunotherapy breakthroughs (anti-PD-1/CTLA-4 agents) (55), positions precision oncology and immunological interventions as focal points for future MPM research initiatives.

The rise of immunotherapy has been accompanied by a surge in high-impact literature, reflecting the growing interest among researchers and clinicians. This trend is likely fueled by the recent success of immunotherapy in treating other cancers. However, our bibliometric analysis also reveals significant gaps in MPM immunotherapy research, particularly the lack of systematic studies on its long-term efficacy and safety.

Due to the limitations of our statistical analysis methods, niche studies in emerging fields may not have been captured, and keyword selection could impact the comprehensiveness of the results. Meanwhile, the inclusion of only English-language literature may result in the exclusion of papers in other languages from the analysis, thereby introducing a certain bias. Additionally, the inherent limitations of the PubMed database may introduce slight deviations in our findings (56-58). Future research should incorporate diverse methodologies to explore the dynamic changes in MPM research, providing more comprehensive scientific insights in this field.

Conclusions

Research on traditional chemotherapy and asbestos exposure in m MPM has reached a relatively mature stage. However, the focus of research in this field has shifted from conventional etiological studies to exploring novel treatment strategies. In particular, there is a growing emphasis on precision medicine and personalized therapy as potential avenues for improving patient outcomes. Looking ahead, future research is likely to concentrate more on understanding the molecular mechanisms underlying MPM and developing individualized treatment approaches tailored to the specific needs of patients.

Acknowledgments

None.

Footnote

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1778/prf

Funding: None.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1778/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: Chen S, Zhao C, Liu R, Jiao W. A bibliometric analysis of malignant pleural mesothelioma from 2010 to 2023. J Thorac Dis 2025;17(4):2014-2027. doi: 10.21037/jtd-24-1778