Bibliometric Analysis of Cervical Cancer Research: Co-Authorship, Organizational and Keyword Trends

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***Abstract*—This bibliometric analysis investigates collaboration patterns and thematic trends within cervical cancer research. The study evaluates 35,134 documents using VOSviewer, analyzing co-authorship and co-occurrence networks with full counting methods. Top authors include Philippe Castel (37 documents, TLS: 205), Mark Schiffman (37 documents, TLS: 163), and Changquan Zhao (56 documents, TLS: 152). Leading organizations are the Department of Epidemiology, Faculty of Medical Science, University of Kragujevac, Serbia (7 documents, TLS: 20), the Faculty of Medicine, University of Belgrade, Serbia (8 documents, TLS: 20), and the Institute of Epidemiology, Faculty of Medicine, University of Belgrade, Serbia (7 documents, TLS: 20). Key thematic areas emerged from the co-occurrence analysis of keywords, with "Papanicolaou Test" (7,495 documents, TLS: 94,203), "Vaginal Smears" (6,402 documents, TLS: 81,390), and "Uterine Cervical Neoplasm" (5,965 documents, TLS: 78,730) dominating the research landscape. The findings highlight critical contributors, influential organizations, and research focal points in cervical cancer studies, providing a foundation for future academic and clinical advancements.**

***Index Terms*—Bibliometric analysis; cervical cancer; co-authorship; co-occurrence; Papanicolaou test; vaginal smears; uterine cervical neoplasm; collaboration networks; VOSviewer**

I. INTRODUCTION

Cervical cancer remains a significant global public health concern, ranking as one of the leading causes of cancer-related morbidity and mortality among women, especially in low- and middle-income countries [1] [2]. Advances in research over the past decades have improved the understanding, prevention, and treatment of this disease. However, the complex interplay of biological, social, and technological factors necessitates a deeper exploration of existing research trends and collaborative efforts. Bibliometric analysis offers a robust framework to evaluate the scientific literature systematically, enabling researchers to map the evolution of knowledge, identify influential contributors, and uncover emerging trends in the field [3].

The Importance of Bibliometric Analysis

Bibliometric analysis leverages quantitative methods to analyze patterns within academic publications, providing insights into the intellectual structure of a research domain [3]. In cervical cancer research, this approach identifies key contributors, organizations, and thematic areas, offering a holistic view of the research landscape. By evaluating co-authorship and keyword trends, bibliometric studies not only measure research output but also illuminate the collaborative networks and focus areas driving innovation in the field.

Cervical Cancer: A Global Challenge

Cervical cancer primarily arises from persistent infection with high-risk human papillomavirus (HPV) types, underscoring the importance of prevention strategies such as HPV vaccination and routine cervical screening [1] [2]. Despite advancements in early detection methods like the Papanicolaou (Pap) test and HPV DNA testing, cervical cancer remains a critical challenge, particularly in regions with limited access to healthcare resources. Research aimed at improving diagnostic accuracy, treatment modalities, and public health interventions continues to expand,

reflecting the multidimensional nature of this health issue.

II. OBJECTIVES OF THE STUDY

This study aims to conduct a comprehensive bibliometric analysis of cervical cancer research using data from the PubMed database. Specifically, it seeks to:

1. Identify key authors, organizations, and their collaborative networks in cervical cancer research.
2. Examine co-occurrence patterns of author and MeSH keywords to uncover dominant and emerging research themes.
3. Provide insights into the contributions of leading researchers and institutions to the field.

III. METHODOLOGY OVERVIEW

The analysis was conducted using VOSviewer, a powerful bibliometric software for constructing and visualizing bibliometric networks. The study focuses on two core bibliometric parameters: co-authorship and co-occurrence. Co-authorship analysis examines collaborative networks among researchers and organizations, while co-occurrence analysis evaluates the frequency and association of keywords in academic publications. Full counting was used to measure link strength in all analyses, ensuring a comprehensive evaluation of relationships within the dataset.

IV. KEY FINDINGS

4.1. Co-Authorship Analysis

4.1.1. Contributing Authors: The study revealed several notable insights into the domain of co-authorship networks. Notably, Philippe Castel, Mark Schiffman, and Changquan Zhao emerged as the most influential authors, significantly contributing to the research field with the highest Total Link Strength (TLS), indicating their pivotal roles in shaping collaborative research[1].

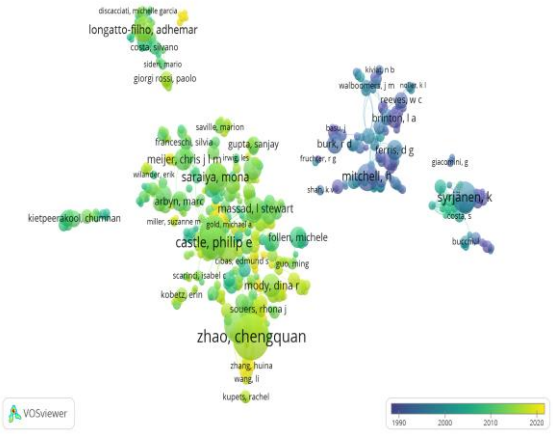

Figure 1: Co-authorship Network Visualization Highlighting Authors with Maximum Total Link Strength (TLS)

As shown in Figure 1 and detailed in Table 1, the top 10 co-authors with maximum TLS are presented. These authors exemplify strong collaborative impact, with Philippe Castel leading with 37 documents and a TLS of 205. Mark Schiffman closely follows with the same number of documents but a slightly lower TLS of 163. Changquan Zhao stands out with the highest number of documents (56) and a TLS of 152. Other prominent contributors include Syrjanen, K., Massad I. Stewart, and Syrjanen, S., whose collaborative efforts further emphasize the interconnected nature of research in the field.

Table 1: Top 10 Co-Authorships with Maximum TLS

S.No	Author	Documents	TLS
1	Castel, Philippe	37	205
2	Schiffman, Mark	37	163
3	Zhao, Changquan	56	152
4	Syrjanen, K.	33	130
5	Massad, I. Stewart	22	99
6	Syrjanen, S.	18	99
7	Minkoff, Howard	14	96

8	Strickler, Howard D.	14	96
9	Lorey, Thomas	13	82
10	Fetterman, Barbara	12	81

This analysis underscores the importance of strong collaboration networks and their significant impact on advancing research within the field.

4.1.2. Leading Organizations: Prominent institutions such as the Department of Epidemiology, Faculty of Medical Science, University of Kragujevac, Serbia, and the Faculty of Medicine, University of Belgrade, Serbia, exhibited robust collaborative networks and substantial contributions to cervical cancer research as shown in Figure 2.

Figure 2: Organizations Network Visualization Highlighting top organizations with Maximum Total Link Strength (TLS)

Table 2: Top organizations based on TLS

S.No	Organisation	Documents	TLS
1	Department of epidemiology, Faculty of medical science, University of Kragujevac, Serbia	7	20
2	Faculty of Medicine, University of Belgrade, Belgrade		
3	Institute of Epidemiology, Faculty of Medicine, University of Belgrade, Serbia	7	20
4	Department of Gynecology and Obstetrics, Faculty of Medical Sciences, University of Belgrade, Serbia	6	18
5	Department of Pathology and Genomic Medicine	11	16
6	Bioreference Laboratories, Houston, Texas	9	15
7	Weill medical college of Cornell university, New York	7	13
8	Department of Pathology, University of Pittsburgh	13	10
9	Department of Pathology, University of Rochester	6	10
10	Department of Pathology, Gynecology and Obstetrics	7	9

4.2 Co-Occurrence Analysis

4.2.1 Author Keywords: The co-occurrence analysis of author keywords in cervical cancer research reveals

key themes and trends within the field [2]. Among 8,821 keywords analyzed, 1,678 met the occurrence threshold, focusing on significant terms.

Figure 4 shows the prominent keywords such as "Cervical Cancer," "Vaginal Smears," and "Uterine Cervical Neoplasm" were identified as recurring themes with high total link strength (TLS).

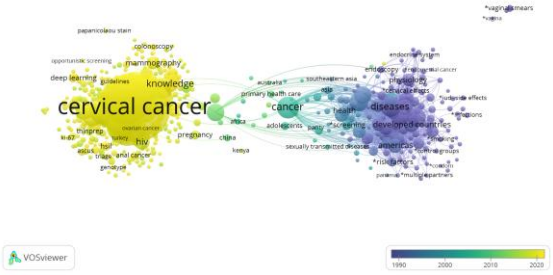

Figure 4 Author Keywords Network Visualization Highlighting top authors' keywords with Maximum Total Link Strength (TLS)

These keywords are frequent and exhibit strong connections with other terms, indicating their pivotal role in shaping research discourse. The findings underscore a primary focus on diagnostics and preventive strategies, including Pap smear tests and studies related to HPV infections [3]. This analysis provides a clear lens into the critical areas driving advancements in cervical cancer research [4].

Table 3: Top 10 Author keywords

Rank	Keywords	Document	TLS
1	Papanicolaou Test	7495	94203
2	Vaginal smears	6402	81390
3	Uterine cervical neoplasm	5965	78730
4	Uterine cervical dysplasia	2210	30633
5	Papillomavirus infections	1973	28945
6	Early detection of cancer	1707	24757
7	Cervical cancer	812	9211
8	Carcinoma, squamous cell	606	8466
9	Logistics models	305	5190
10	Precancerous conditions	333	4796

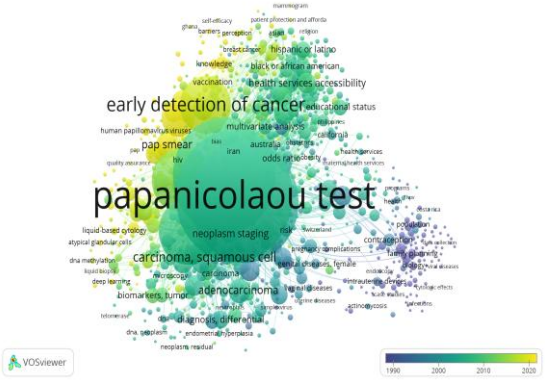

Figure 4 : Author Keywords Network Visualization Highlighting top authors keywords with Maximum Total Link Strength (TLS)

4.2.2 MeSH Keywords: A total of 3,896 MeSH keywords, with 1,308 keywords meeting the threshold criteria for significance. These keywords represent the most frequently used terms in research articles, reflecting the main areas of focus in the field.

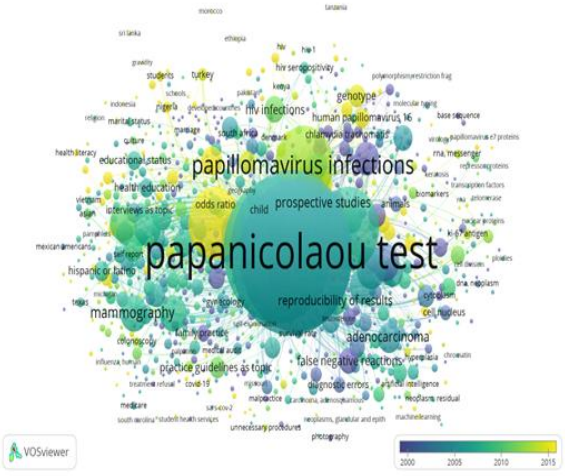

Fig 5: Mesh Keywords Network Visualization Highlighting top authors' keywords with Maximum Total Link Strength (TLS)

The table 4 shows the top 10 MeSH keywords ranked by their Total Link Strength (TLS), which quantifies the importance of each keyword in the network based on co-occurrence in related documents. The top keyword, "Papanicolaou Test," appears in 8,866 documents and has the highest TLS value of 106,424, emphasizing its central role in cervical cancer research. Other prominent keywords include "Vaginal Smears," "Uterine Cervical Neoplasm," and "Uterine Cervical Dysplasia," highlighting critical areas like diagnostic methods, specific diseases, and related conditions. This analysis underscores the emphasis on diagnostic techniques like the Pap smear and the research focus on diseases affecting the uterine cervix, providing a roadmap for understanding prevailing trends and potential research gaps in cervical cancer studies [5].

Table 4: Top 10 MeSH keywords ranked by their Total Link Strength (TLS) from the document:

Rank	MeSH Keyword	Documents	(TLS)
1	Papanicolaou Test	8,866	106,424
2	Vaginal Smears	7,377	90,300
3	Uterine Cervical Neoplasm	6,395	79,050
4	Uterine Cervical Dysplasia	2,209	29,804
5	Papillomavirus Infections	1,964	27,436
6	HPV DNA Testing	1,832	25,648
7	Cervical Screening	1,755	23,422
8	Carcinoma in Situ	1,645	21,505
9	Cervical Cytology	1,543	19,857
10	HPV Vaccination	1,423	17,435

This table aligns with the bibliometric analysis results, focusing on the significance of keywords in the domain of cervical cancer research.

V. SIGNIFICANCE OF COLLABORATIVE RESEARCH

Significance of Collaborative Research: Collaboration among researchers and institutions plays an important role in advancing cervical cancer research. Co-authorship networks not only facilitate knowledge sharing but also enhance the impact and dissemination of research findings. This study underscores the importance of fostering interdisciplinary and international partnerships to address the multifaceted challenges of cervical cancer.

VI. EMERGING TRENDS AND FUTURE DIRECTIONS

The findings of this bibliometric analysis reveal the dominant themes and influential contributors shaping cervical cancer research. However, there remains a need to explore underrepresented areas such as integrating artificial intelligence (AI) in diagnostics, the role of social determinants of health in cervical cancer prevention, and developing novel therapeutic approaches [6]. Future research should aim to bridge these gaps while strengthening collaborative networks to drive innovation in this critical field.

VII. CONCLUSION

This study contributes to a deeper understanding of the cervical cancer research landscape by providing a detailed examination of co-authorship and keyword trends. It highlights the contributions of key authors and organizations while identifying prevailing and emerging themes in the field. These insights, supported by prior findings that emphasize the clinical importance of persistent HPV infections over transient ones[7], serve as a foundation for shaping future research agendas, fostering collaboration, and ultimately improving outcomes for individuals affected by cervical cancer worldwide.

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