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THE INFLUENCE OF PLASTIC INDOOR MATERIALS ON HEALTH: A SCIENTOMETRIC ANALYSIS USING WEB OF SCIENCE AND VOSVIEWER

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Abstract: *This research seeks to examine the impact of plastic materials used in indoor environments on human health from a scientometric standpoint. Drawing on literature indexed in the Web of Science database, the study maps prevailing research trends, identify leading contributors, and highlights the main thematic directions in this domain by employing VOSviewer software. The outcomes of the analysis not only advance understanding of the health-related consequences of indoor plastics but also provide meaningful insights to inform future scholarly work and policy development.*
Key words: *EDU4PlastiCircular project, plastic, indoor, health, scientometrics*

1. INTRODUCTION

Nowadays, people live most of their time indoors, so one of the factors that influence human health is the indoor air quality. The increasing use of plastic materials leads to the generation of microplastics, found in the ambient air in the form of inhalable particles. Thus, exposure to this type of environmental contaminants becomes more problematic from a health point of view, and attracts more and more attention to researchers coming from multiple study domains [1, 2].

Scientometric research refers to the systematic analysis and evaluation of scientific output, focusing on both the quantity of publications and the influence of research articles. The present paper integrates a scientometric analysis to present a comprehensive survey of the literature with a systematic literature review to delve deeply into the research. Systematic literature reviews are conducted to reveal the current understanding within a specific field and pinpoint areas for potential future research endeavors [3, 4].

The Web of Science database was chosen for the scientometric analysis owing to its broad coverage of scholarly publications and its reputation as a leading bibliographic resource encompassing many high-impact journals. Its rigorous selection process ensures the quality and reliability of the indexed data, making it a trustworthy foundation for scientometric investigations. In addition, the platform provides advanced functions for filtering, sorting, and visualizing information, which substantially improve the effectiveness of the analytical process [5].

VOSviewer, a freely available and intuitive software package, was employed to construct and explore scientific networks. The program is particularly well suited for generating visual maps and graphical representations of co-citation, co-occurrence of terms, and author collaboration patterns. Beyond visualization, VOSviewer integrates advanced analytical features, including cluster detection, identification of communities within networks, exploration of central and related terms, and the ability to trace the evolution of research fields over time [6-9].

2. RESEARCH METHODOLOGY

The central research question explored in this study concerns the impact of plastic indoor materials on human health. To address this, the authors carried out a scientometric investigation

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aimed at synthesizing recent advances, prevailing themes, and emerging trends in the field. Relevant publications were retrieved from the Web of Science Core Collection using the search string "plastic AND indoor AND health."

This search yielded 481 articles, of which 65 were review papers specifically addressing the topic. These review papers were downloaded and subsequently analyzed with the VOSviewer software. The analysis was performed in two stages, allowing for the identification of key terms and their associations within a network, thereby offering deeper insights into the thematic structure and interconnections present in the research landscape.

3. RESULTS AND DISCUSSIONS

3.1 Keyword analysis

From the analyzed publications, a total of 451 keywords were extracted. For the purposes of this study, the inclusion criterion required that a keyword appear at least twice, resulting in 93 keywords grouped into distinct clusters. To facilitate the visualization of these clusters and the relationships among terms, Figure 1 presents the scientific literature network map, which illustrates how topics and research papers are interlinked through shared themes. In this map, the nodes correspond to specific keywords or topics, while the connecting lines represent their relationships. A detailed examination of each cluster allowed the identification of five main research directions within the field studied:

1. BLUE cluster comprises the breakdown of the main concepts and their connections:

Microplastics and Pollution: Microplastic Pollution; Plastic Waste; Airborne Microplastics; Synthetic Fibers; Polystyrene Microplastics; Nanoplastics; Degradation; Contamination; Atmospheric Fallout

Environment: Marine Environment; Freshwater; Deposition; Sediments; Atmosphere; Indoor Air;

Health Impact and Exposure: Human Exposure; Indoor Dust; Particles; Oxidative Stress; Inflammation; Metabolism; Urinary Levels of Di(2-ethylhexyl) Phthalate; Sources of (micro) plastics: Personal Care Products; House Dust; Table Salts;

Chemicals and Compounds: Polybrominated Diphenyl Ethers; Phthalates; Bisphenol-A; Di(2-ethylhexyl) Phthalate;

2. YELLOW cluster explores the vulnerable population affected: Indoor dust; Wastewater; Association; Children; Air pollution;

3. RED cluster approaches comparative effects of indoor plastic (center right in Fig. 1): Polybrominated diphenyl ethers; Indoor air; Phthalates; House dust; Exposure; Oxidative stress;

4. GREEN cluster contains the concepts related to Microplastics sources and their presence in environment at large scale: Synthetic fibers; Marine environment; Particles; Atmospheric contribution; Ecological risk;

5. PURPLE cluster deals with concepts more related to macro or mezzo - environmental scale, rather than to microenvironment (as indoor environment is): Transport; Freshwater; Human exposure.

3.2 Research directions

In the second phase of the analysis, closer attention was given to the research directions emerging within the investigated field. The 65 articles were allocated across six clusters, according to the themes represented in each cluster. A review of the articles associated with these clusters was then undertaken, with the goal of consolidating and refining the identified research directions. During this process, 16 papers were found to be unrelated to the established directions and were therefore excluded. As a result, 44 articles were retained for further analysis and synthesis of information within the identified research areas. Figure 2 illustrates the network graph of associations between terms linked to environmental pollutants, with particular emphasis on indoor plastic and microplastic pollution over the period 2014–2024. The analysis revealed the following key research themes:

1. Environment:

- *Marine Environment* comprising terms like "marine-environment," "fresh-water," and "marine pollution" suggest studies concerning the impact of plastics on aquatic ecosystems.

- *Atmospheric Deposition* which mentions “atmosphere,” “atmospheric fallout,” and “particulate matter” points to the deposition and spread of pollutants via atmospheric pathways.

2. Health effects:

- *Exposure:* “Exposure,” “indoor air,” and “urinary levels” indicate research on human exposure pathways.
- *Toxicity and Stress*: “toxicity,” “oxidative stress,” “inflammation,” and “metabolism” suggest studies on the health implications of these pollutants.
- *Specific Chemicals:* Frequent mention of “polybrominated diphenyl ethers,” “phthalates”, “bisphenol-a,” and “di(2-ethylhexyl) phthalate” indicates research on specific harmful chemicals associated with plastics.

3. Sources and spread:

- *Waste and Pollutants*: Frequent mentions of “microplastics,” “plastic,” “synthetic fibers,” “wastewater,” as main concepts in plastic pollution investigations;
- *Plastic Pollution*: Terms like “plastics,” “plasticizers,” “polystyrene microplastics,” and “house-dust” suggest a focus on plastic pollution sources and pathways;
- *Personal Care Products:* Mention of “personal care products” indicates a potential source of microplastic pollution in the environment.

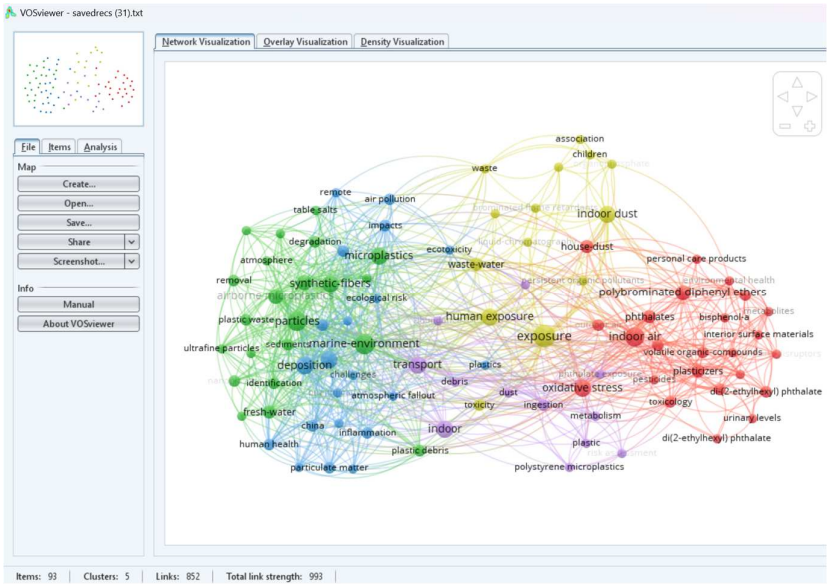

Fig. 1. Visualization of clusters, screen capture from VOSviewer software.

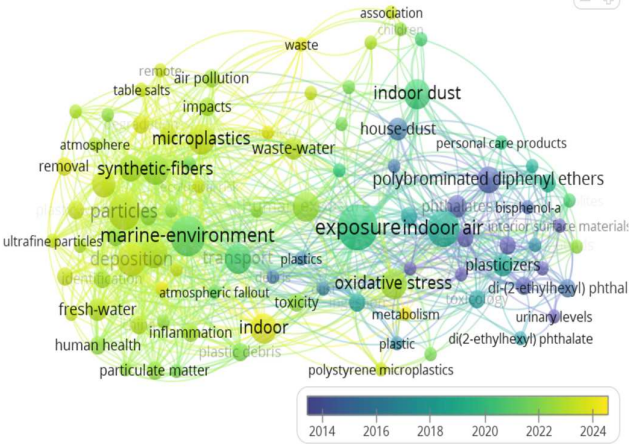

Fig. 2. Network graph showing research directions.

4. Research and trends: The research in the area investigated was published between 2014 to 2024, suggesting a timeline of research and trends in the field of environmental pollution, particularly related to plastics and microplastics.

5. Technological solutions: "Removal synthetic-fibers" suggests research on methods to remove synthetic fibers and microplastics from the environment.

6. Associations and relationships: The term "association" appears at the beginning, suggesting a study or analysis of associations between different pollutants and their impacts, pointing out the complexity of the problem.

3.3 Co-authorship

The image in Figure 3 is a diagram mapping various authors and the years associated with published paper, illustrating a network of connections. Based on network analysis and co-citations, the VOSviewer software pointed out the most relevant researchers and research groups in the field investigated:

1. Gasperi (2018) - Central node [10] connected to:

- Akanyange (2022), [11];
- Akanyange (2021), [12];
- Ly (2022), [13];
- Facciola (2021),[14];
- Le (2023), [15];
- Can-Guven (2021), [16];
- Sridharan (2021), [17];
- Luo (2022), [18];
- Munyaneza (2022), [19];
- Zuri (2023), [20];

2. Thompson (2009), [21] - Showing strong presence with large blue node, is connected to:

- Sheraz (2023), [22];
- Ageel (2022), [23];

3. Ageel (2022) - Connected to:

- Damaj (2024), [24];
- Kek (2024), [25];
- Bhatia (2024), [26].

This visualizes collaborative work or citation patterns among researchers/authors over different years.

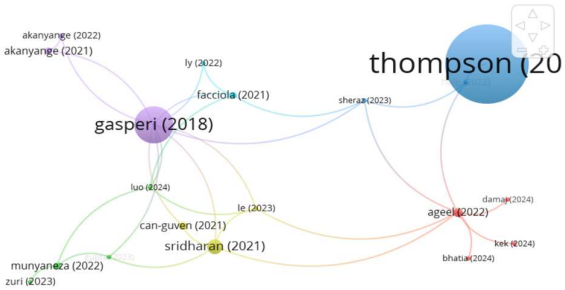

Fig. 3. Authors' diagram mapping

3. CONCLUSIONS

The relationship between plastic indoor materials and human health is a complex subject, involving a multidisciplinary approach.

The scientometric analysis revealed a growing interest in the research, coming from different traditional study domains and indicates the importance of further research in this area.

Key themes identified included sources of plastics indoors, chemicals responsible for environmental contamination and consequently human health problems.

Collaboration among researchers from various disciplines, including environmental sciences, public health, and materials science, is essential for a comprehensive understanding of this complex issue.

Policymakers and manufacturers should consider the potential health implications of using plastic materials indoors and prioritize the development of safer alternatives.

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Influența materialelor plastice utilizate in interioare asupra sănătății: O analiză scientometrică folosind Web of Science și Vosviewer

Obiectivul acestei cercetări este de a explora influența materialelor plastice de interior asupra sănătății umane din punct de vedere scientometric. Printr-o examinare a literaturii actuale în acest domeniu, publicată în baza de date Web of Science, sunt identificate conceptele semnificative, legăturile dintre acestea, autori notabili și domenii de cercetare centrale în acest domeniu, utilizând software-ul VOSviewer. Rezultatele acestui studiu îmbunătățesc înțelegerea implicațiilor potențiale ale materialelor plastice utilizate în interioare asupra mediului în general și asupra sănătății sănătății umane în particular și oferă perspective valoroase pentru orientarea viitoarelor eforturi de cercetare și formularea politicilor**.**

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