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Precision Nutrition Across Species: A Bibliometric Analysis of PubMed-Indexed Research

Zubair Azhar Nomi[1*], Maira Ashfaq[2], Muhammad Qamar Abdullah[3], Alishba Mazhar[4], Eiman sheikh[5], Laiba Iftikhar[6], Hanium Mrrya[7]

[1,3]Faculty of Veterinary and Animal Sciences, Muhammad Nawaz Shareef University of Agriculture, Pakistan
[2,6,7]Department of Human Nutrition and Dietetics, Nishtar Medical University, Multan, Pakistan
[4,5]Department of Human Nutrition and Dietetics, Muhammad Nawaz Shareef University of Agriculture, Pakistan

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***Corresponding author:** Zubair Azhar Nomi
Faculty of Veterinary and Animal Sciences, Muhammad Nawaz Shareef University of Agriculture, Pakistan

Abstract

Precision nutrition is a potentially disruptive paradigm of nutritional science that seeks to precisely customize food advice depending on the biological, genetic, environmental, and lifestyle factors of individuals. The intensive research growth in human and animal nutrition, nutrigenomics, metabolomics and data-driven methods has produced a convoluted and multidisciplinary literature that is difficult to synthesize in terms of conventional narrative methods. The current paper presents a combined bibliometric and scientmetric review of the world-wide research on precision nutrition published in PubMed index between 2005 and 2025 which incorporates the performance analysis, science mapping and multivariate conceptual approaches. One hundred and thirty-two publications were analyzed in 81 sources with the help of Bibliometrix R package and VOSviewer. Temporal analysis indicated that the output of research has increased significantly since 2015 as a result of increasing use of omics technologies, microbiome research, and computational analytics. The source analysis revealed that there is a high concentration of journal that has a few core nutrition journals that cover a huge percentage of the publications, which is in line with the law of Bradford. The geographic evaluation showed that the high-income nations, especially the United States and Western Europe, had been dominant, with a moderate yet growing cooperation at the international level. The keywords co-occurrence networks, density mapping, and overlay visualization revealed diet-health interaction, nutrigenomics, and human nutritional status as the key themes of research, whereas artificial intelligence and microbiome-based personalization and precision feeding in animals became emerging directions. Several correspondence analyses also showed the specific conceptual axes between molecular and omics-oriented research on the one hand and, on the other hand, applied and preventive nutrition areas. All the results point to parallel, but still not fully integrated processes of human and animal precision nutrition studies. The paper has provided a strategic overview of intellectual, thematic, and future directions of the field of precision nutrition, which offers a solid evidence base to guide interdisciplinary research, translational implementation, and policy formulation.

Keywords: Precision nutrition; Nutrigenomics; Bibliometric analysis; Personalized nutrition; Animal nutrition; Omics technologies.

1. INTRODUCTION

A paradigm shift in nutrition science is occurring whereby the customary dietary prescriptions to the people are undergoing a transformation to precision nutrition which aims at prescribing dietary suggestions founded on personal biological, genetic, environmental, and lifestyle factors (Ridgway *et al.,* 2019). This shift has been precipitated by the increasing appreciation of high inter-individual differences in food responses that cannot be effectively described using the conventional one-size-fits-all nutritional prescriptions (Morand *et al.,* 2020). The current developments in the fields of genomics, metabolomics, microbiome studies, and computational analytics have all provided a more mechanistic perspective on diet-host-biology interaction, thus paving the way to tailored and predictive diets (Rajakovich & Balskus, 2019). Precision nutrition is closely connected with the advent of nutrigenomics and nutrigenetics which study the impact of genetic variation on dietary effects and disease susceptibility, and the effect of nutrients on gene expression and metabolic pathways

(Rahman & Muhammad, 2023). Massive cohort researches and controlled dietary investigations have shown that the individuals have significantly varying metabolic, inflammatory, and glycemic reactions to the same foods, which highlights the shortage of generalized dietary counseling (Rein *et al.,* 2022). Consequently, more and more attention has been paid to the idea of precision nutrition as a promising model of disease prevention, metabolic health optimization, and long-term wellness (Guasch-Ferré *et al.,* 2025). Alongside the changes in the field of human nutrition, animal nutrition and precision feeding have undergone similar changes in methodology (Pomar & Remus, 2023). Precision livestock nutrition is the combination of sensor technologies, genomic selection, metabolic modeling, and data-driven systems of feeding to maximize the health, productivity, and sustainability of animals (Sonea *et al.,* 2023). Although these are the common conceptual frameworks, studies in animal and human precision nutrition have developed in parallel, as opposed to integrated fashion. The opportunity to bridge these areas also has a significant potential of cross-species transfer of knowledge, new methods, and one Health-based approaches to nutrition (Le Moli, 2023). The fast growth of research in the field of precision nutrition is also characterized by the growth of conceptual complexity and interdisciplinary diversification (Singh, 2024). Research has been extended into clinical nutrition, molecular biology, systems medicine, veterinary sciences, data science, and artificial intelligence (Ezanno *et al.,* 2021). Although this diversity is the sign of the field being lively, it also creates difficulties in the process of synthesis of existing knowledge, determining the prevailing research themes, and seeing the emerging directions (Gopal *et al.,* 2025). Although useful, traditional narrative reviews have their weaknesses in the sense that they cannot help to chart the intellectual framework and development of such a booming and multi-dimensional research field in a systematic way (Wright, 2020). Bibliometric and scientometric analyses offer an effective methodological framework that can be used to tackle such issues. The bibliometric methods allow objective evaluation of the growth of research, concentration of knowledge, and organization of ideas by quantitatively analyzing patterns of publications, networks of collaboration, and thematic patterns (Hassan & Duarte, 2024). Past bibliometric investigations have examined nutrigenomics or personalized nutrition independently; nevertheless, a synthesis which combines human and animal precision nutrition, analyzes notions convergence over time and evaluates thematic development over time is still unattained (Hinojosa-Nogueira *et al.,* 2024). This is why the aim of the current study was to provide a systematized mapping of the world research on the topic of precision nutrition on the basis of integrated bibliometric and scientometric analysis. In particular, this paper intended to: (i) describe the temporal development and geographic trend of the research on precision nutrition; (ii) determine the main journals and knowledge dissemination trends with the help of Bradford law; (iii) interpret the intellectual structure and the thematic hierarchy of the research field by using keywords co-occurrence, factorial analysis, and thematic mapping (iv), and (v) discuss the degree of conceptual convergence between human and animal nutrition research. Offering a high-level synthesis of the structure and maturity of the field and future directions, the study will provide a strategic base to future research, policy formulation, and translational research to precision nutrition.

2. MATERIALS AND METHODS

2.1 Study design and analytical framework

The research design adopted in this study was the bibliometric and scientometric research design and aimed to present an intellectual map, a thematic development and a pattern of global research on precision nutrition in human and animal nutrition areas. To establish transparency, reproducibility and methodological rigor, the analytical framework was a combination of performance analysis, science mapping, and multivariate conceptual analysis based on the established bibliometric guidelines.

2.2 Data source and searching strategy in the literature

As the main source of data, the PubMed database was chosen as it provides credible information on biomedicine, nutrition, genetic, and clinical studies. An extensive search strategy was created based on Medical Subject Headings (MeSH) and free-text words that are related to precision nutrition, nutrigenomics, metabolomics, dietary personalization, and animal nutrition. The search was done in 2025 and limited to publications that were indexed in the year 2005 to 2025. Peer reviewed documents were taken into consideration only. The entire bibliographic data were exported in XML format in terms of titles, abstracts, author keywords, Keywords Plus, author affiliations and publication metadata.

2.3 Eligibility and study selection.

Articles were considered to enter the research provided that they dealt with precision nutrition, nutrigenomics, personalized nutrition, or the diet-gene interaction, and considered human or animal nutrition as well. Studies that have been indexed in PubMed and fall within the time frame were only factored into consideration. Documents of no relevance to nutrition and those with incomplete bibliographic information were excluded as well as those that had carried out research solely on non-nutritional genetics. Following the screening and the application of the eligibility criteria, a final dataset of 132 publications of 81 different sources was included in the analysis.

2.4 Preprocessing and standardization of data

Bibliographic information was added to the Bibliometrix R program (R version 4.5.1). Before analysing, harmonisation of keywords was done to

minimise redundancy and concept consistency. Singular and plural forms, variations of spelling and similar words were standardized. The names of the countries and institutions were standardized in order to have precise analysis of geographies and collaboration.

2.5 Bibliometric performance analysis

To describe the dataset, descriptive bibliometric indicators were computed that include; annual scientific production, productivity of sources, productivity of authors and collaboration index, and country-specific research output and patterns of collaboration. Besides, journal dispersion was also measured by Bradford law that divides journals into core, related and peripheral zones based on their publication productivity.

2.6 Science Mapping and Network Analysis

2.6.1 Co-occurrence analysis of keywords

VOSviewer was used to build keyword co-occurrence networks to determine key conceptual clusters in the research on precision nutrition. Author keywords were used as well as Keywords Plus in order to be able to capture thematic breadth. Network, density and overlay visualizations were produced to determine conceptual structure, intensity of research and temporal development of themes.

2.6.2 Thematic mapping

The thematic evolution was evaluated with the help of the thematic map algorithm of Bibliometrix that places a cluster of keywords based on a centrality (relevance) and density (development). Themes were categorized into motor, basic, niche and emerging/declining ones, which allowed identifying both mature and developing research areas.

2.7 Factorial analysis

In order to explore in more detail the conceptual organization of the field, multiple correspondence analysis (MCA) was utilized with respect to the data of keywords. MCA transforms high dimensional categorical data to a low dimensional factorial space where conceptual proximities and oppositions can be visualized. The two dimensions that depicted the greatest amount of variance were interpreted to determine the most dominant conceptual axes in the precision nutrition research.

2.8 Visualization and reporting

Bibliometrix and VOSviewer were used to create all the visualizations. The interpretation of figures was performed based on the inclusion of qualitative indicators of figures alongside quantitative indicators to guarantee coherent synthesis. The work followed optimal principles of bibliometric reports and was focused on the interpretative rather than descriptive description.

2.9 Methodological soundness and reproducibility

The standards governing the methodological workflow were bibliometric standards, which made the work reproducible and transparent. Various complementary analytic methods were used to reduce the bias of tools and strengthen the results.

3. RESULTS

3.1 Growth trajectory of precision nutrition research

The analysis included 132 documents indexed in PubMed that were published within the period 2005 to 2025 and their key data is provided in table 1. This can be seen in Figure 1, which depicts that the output of research was irregular until around 2014, then it started to grow steadily and sharply after 2018. The observed significant increase in the publications in the past five years suggests the rapid maturation of precision nutrition as a specific interdisciplinary research area, that cuts across the fields of human and animal nutrition, genomics, and clinical sciences.

Table 1: Bibliometric characteristics of precision nutrition literature indexed in PubMed (2005–2025)

Category	Indicator	Value
Dataset overview	Timespan	2005–2025
	Total documents	132
	Sources (journals, books, etc.)	81
	Annual growth rate (%)	13.9
	Average document age (years)	5.53
	Average citations per document	0
	Total references	0
Document content	Author keywords (DE)	494
	Keywords Plus (ID)	494
Authorship	Total authors	599
	Authors of single-authored documents	20
Collaboration patterns	Single-authored documents	22
	Co-authors per document	4.79
	International co-authorship (%)	19.7
Document types	Journal articles	35
	Journal articles; review	51

Category	Indicator	Value
	Journal articles; systematic review	3
	Journal articles; scoping review	1
	Journal articles; meta-analysis & systematic review	1
	Clinical trial (veterinary); journal article	1
	Comparative study; journal article	1
	Observational study; journal article	1
	Multicenter randomized controlled trial	1
	Historical article; journal article	1
	Historical article; journal article; review	3
	Editorial	1
	Interview	1
	Lecture	2
Funding-related publication types	Research support, NIH (extramural)	1
	Research support, NIH (extramural); review	2
	Research support, NIH (extramural); systematic review	1
	Research support, non-US government	6
	Research support, non-US government; review	10
	Research support, non-US government; systematic review	3
	Research support, non-US government; scoping review	1
	Research support, US government (non-PHS); review	1
	Research support, NIH (extramural); non-US government; US government (non-PHS)	1

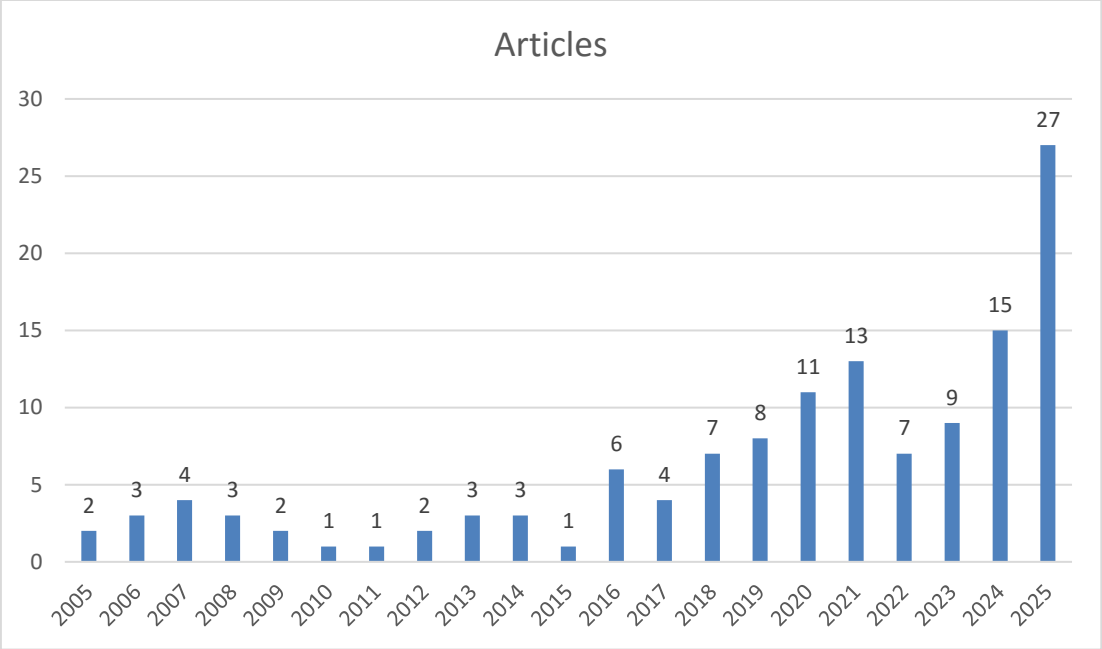

Figure 1: Annual scientific production of precision nutrition research (2005–2025)

3.2 Core journals and Bradford's law distribution

The source analysis revealed 81 journals that were contributing to the field, however, publications were highly skewed (Figure 2). The disproportionate contribution to articles was given by a small number of journals, headed by Nutrients and Advances in Nutrition. Another analysis of the law by Bradford differentiated journals into three productivity areas (Figure 3). Zone 1 consisted of a small number of central journals that contributed a large percentage of the publications, and Zones 2 and 3 contained steadily increasing numbers of journals with lower productivity. This trend establishes the high concentration of journals and the pivotal role of nutrition-oriented, multidisciplinary journals in the development of the field.

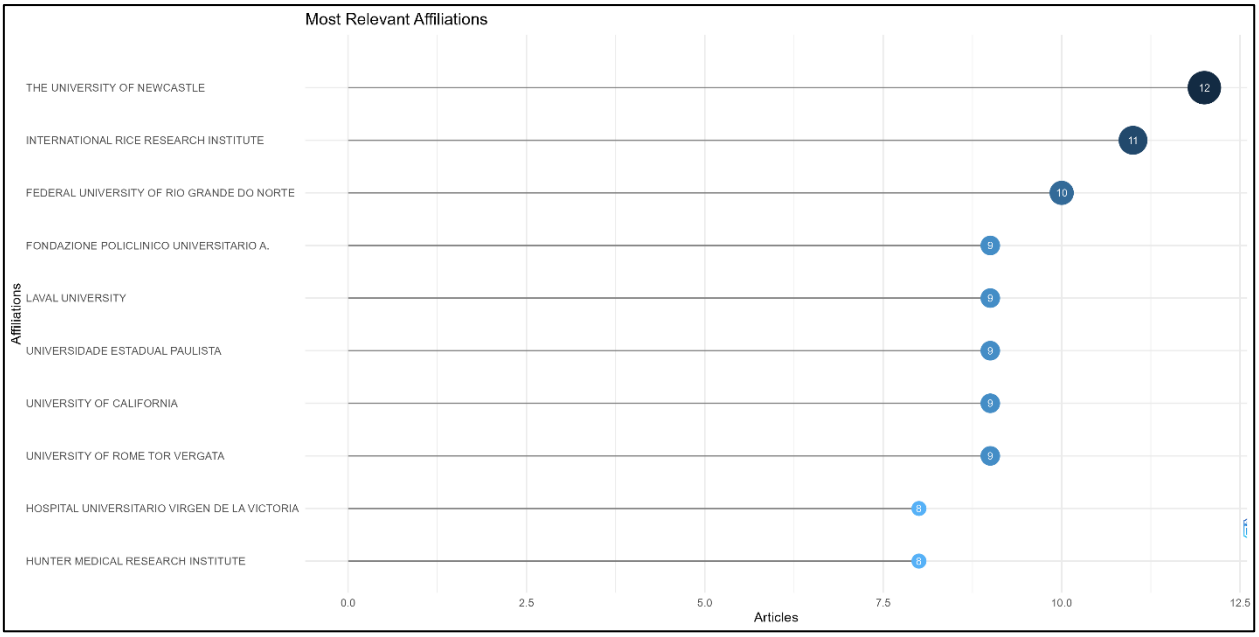

Figure 2: Distribution of precision nutrition publications across journals.

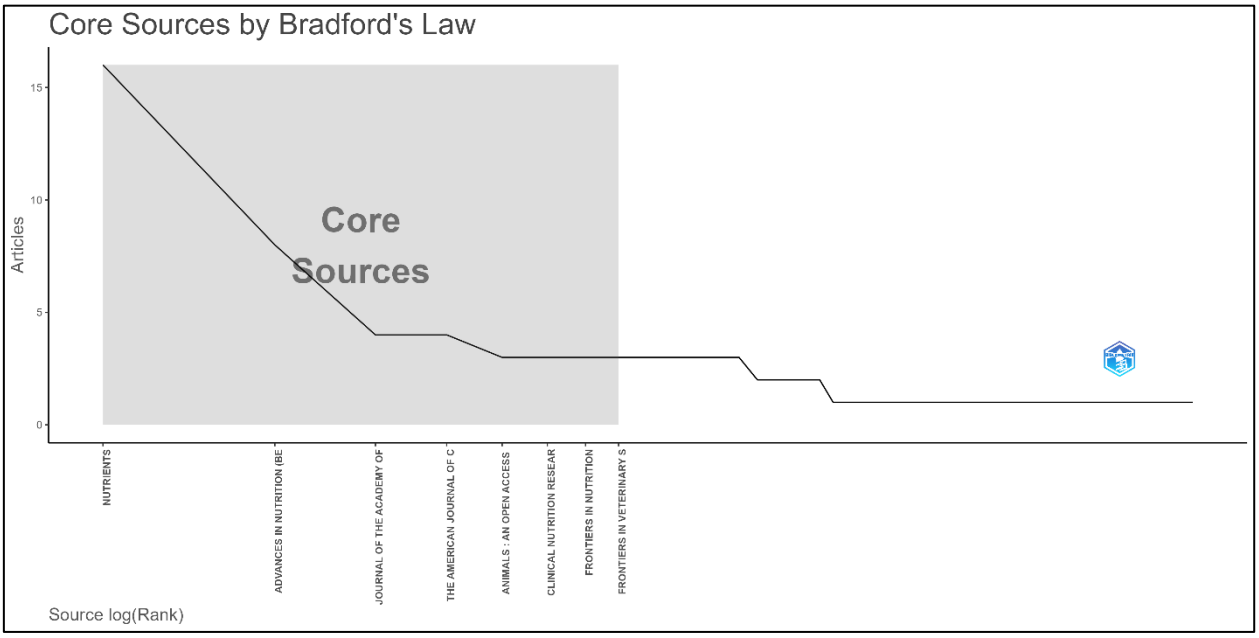

Figure 3: Bradford's law distribution of source journals

3.3 Geographic distribution and international collaboration

Comparison of similar authors showed that there was an uneven distribution of research output (Figure 4) geographically. The US came out as the leading donor, and then there came Australia, Canada and various countries in Europe. There were single-country publications but there was a significant fraction of the multiple-country publication too which demonstrates a growing international cooperation especially among the high-income nations. The resource-intensive aspects of omics-based and precision nutrition studies are due to this trend.

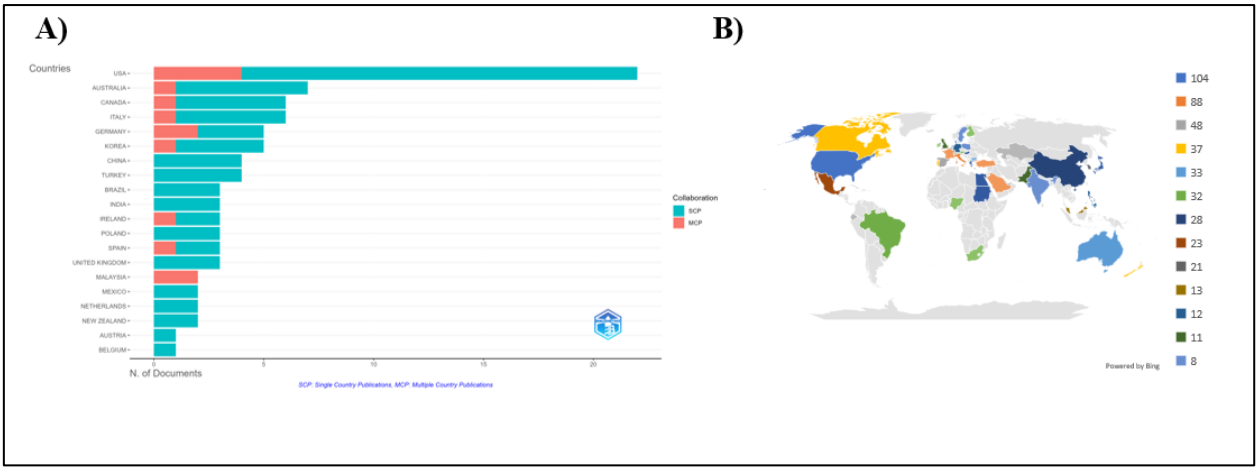

Figure 4: Geographic distribution of corresponding authors and collaboration patterns

3.4 Conceptual structure based on keyword co-occurrence

The use of key word co-occurrence network analysis revealed a number of conceptual clusters (Figure 5a). The key nodes were humans, diet, and nutrigenomics, which implies the fundamental combination of dietary interventions with molecular and genetic models. The metabolomics, gastrointestinal microbiome, precision nutrition, and animal nutrition are surrounded clusters highlighting the translational connection between human and animal nutrition studies.

Figure 5b density visualisation showed that the research intensity was the greater in the area of nutrigenomics and diet-related terms, and the issues of artificial intelligence and more sophisticated computational methods were less concentrated, indicating the areas of emergence or undeveloped issues.

The average publication year (Figure 5c) showed that the focus of the research changed over time, where the articles published earlier focused on the description of the population and their nutritional condition and the articles published later were more concentrated on the omics technologies, the microbiome research, and the personalized diet approach.

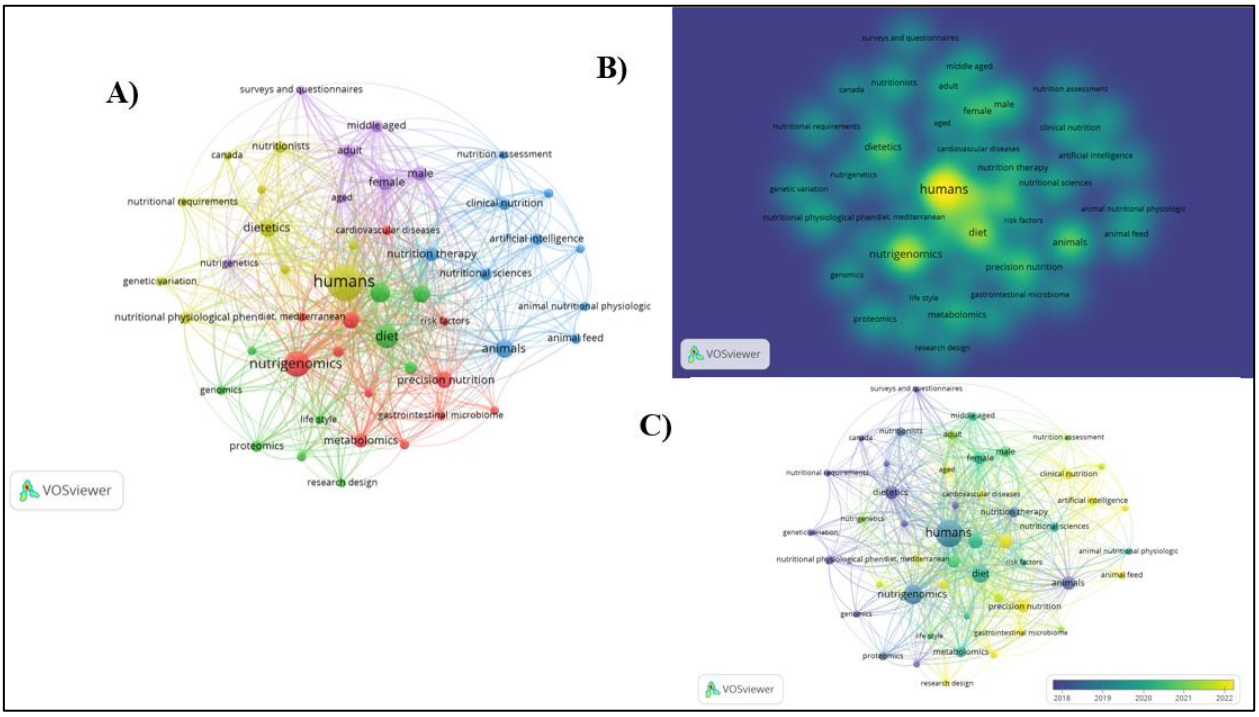

Figure 5: Conceptual structure and thematic evolution of precision nutrition research

(A) Keyword co-occurrence network visualization illustrating the major conceptual clusters within precision nutrition research, with node size reflecting keyword frequency and link thickness

representing co-occurrence strength. **(B)** Density visualization highlighting areas of high thematic concentration, indicating dominant research foci such as nutrigenomics, diet, and human nutrition, alongside less explored peripheral topics. **(C)** Overlay visualization depicting the temporal evolution of research themes, where color gradients represent the average publication year, revealing a shift from population-level dietary assessment toward omics-driven and personalized nutrition approaches.

3.5 Factorial analysis and conceptual positioning

Even the multiple correspondence analysis (MCA) helped to better understand the conceptual structure of the field (Figure 6). The initial two dimensions explained 55.83% of the total inertia. The main theme of D1 was a biological-translational continuum, with one side having molecular and omics-driven nutrition studies and the other side having applied and institutional topics of dietetics and nutritional needs. Dimension 2 represented a clinical-preventive dimension, the opposition of the disease risk and metabolic dysfunction with the lifestyle-oriented and preventive nutrition notions.

The factorial form was similar to the key clusters that were found during VOSviewer analyses, which contributed to the strength of the identified conceptual domains.

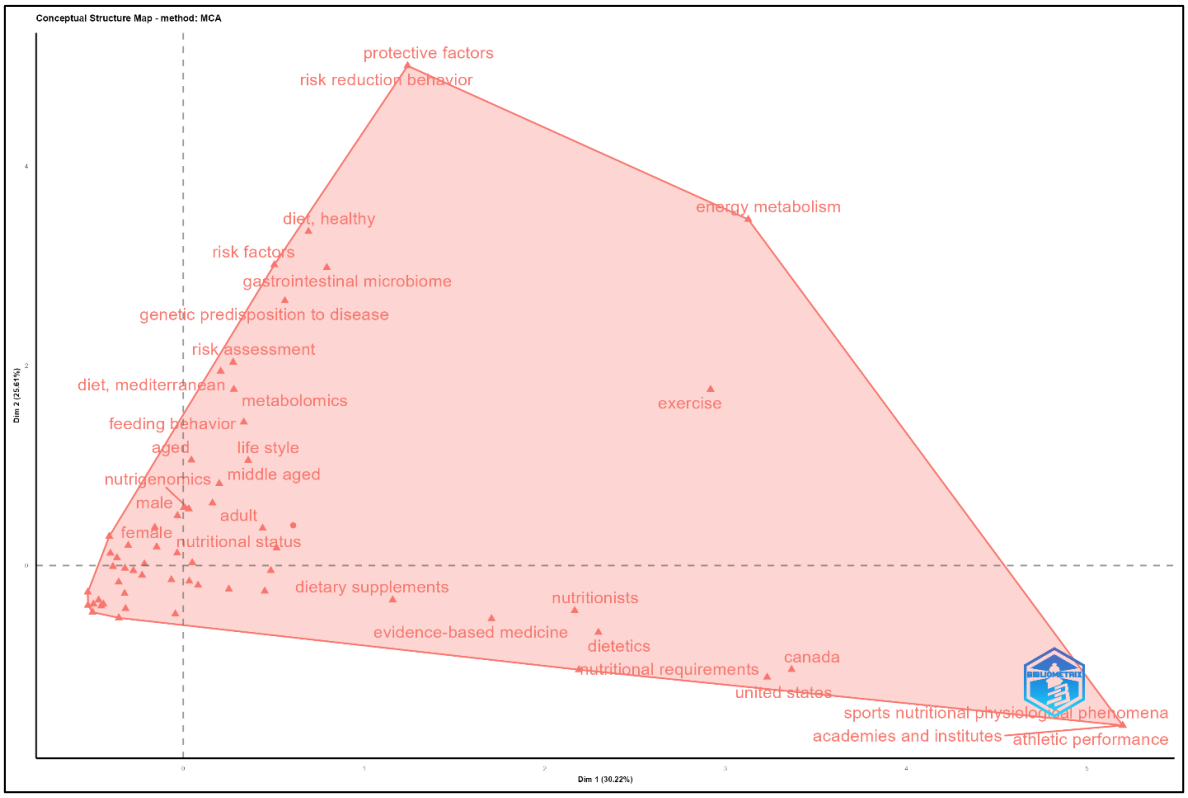

Figure 6: Conceptual structure map based on multiple correspondence analysis (MCA)

3.6 Thematic evolution and research maturity

The thematic map (Figure 7) highlighted diet, nutritional status, and humans as motor themes whose centrality as well as density is high. The basic themes quadrant had omics-related topics and genetic variation so it is foundational but still developing the conceptualization. Themes that emerged were artificial intelligence, biomarkers, and cross-sectional analysis methods and could be expanded in the future to incorporate data-driven and predictive models of nutrition.

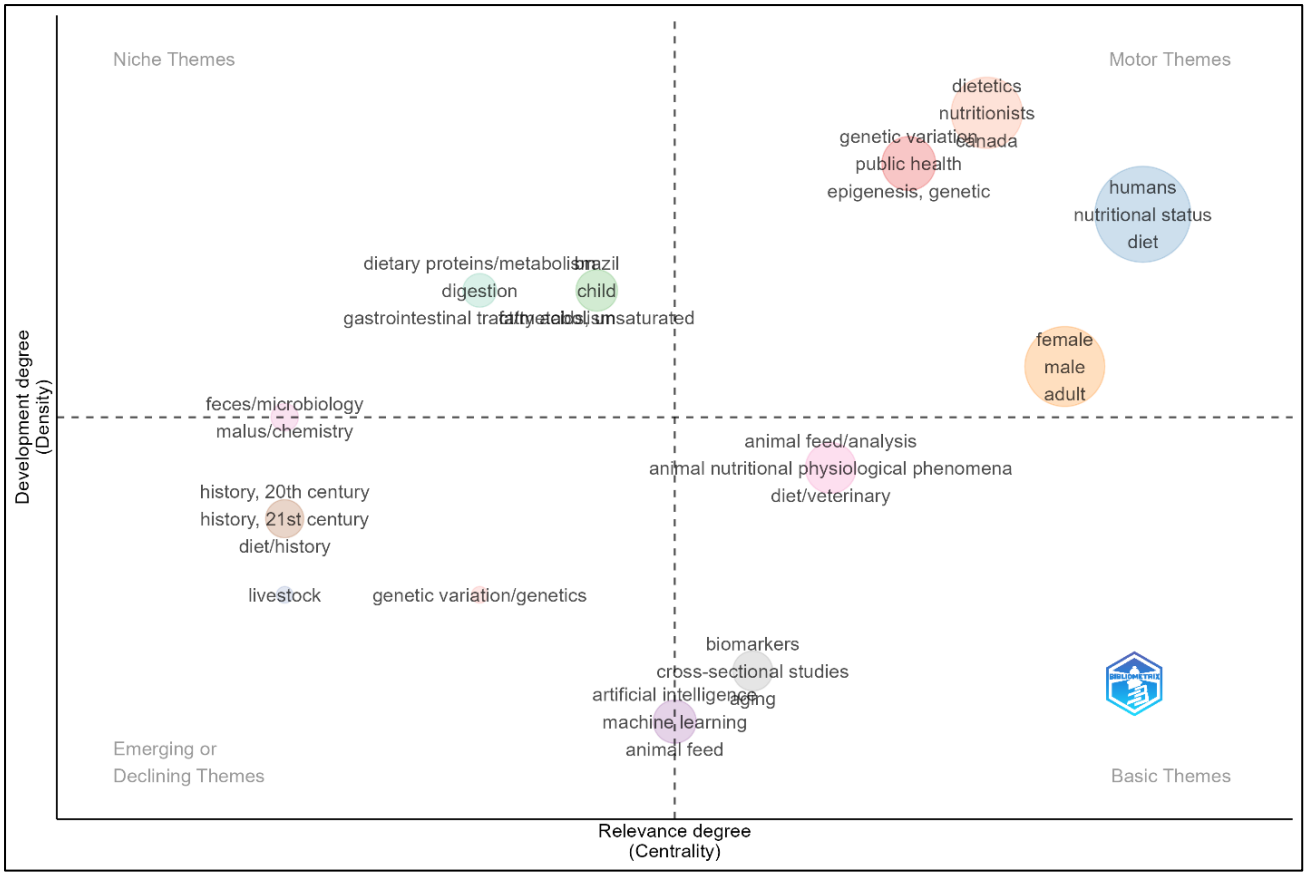

Figure 7: Thematic map of precision nutrition research

4. DISCUSSION

The current bibliometric and scientometric analysis is a synthesis of all the research on the world in precision nutrition in both human and animal nutrition spheres. The current study will be able to go beyond the enumerative description to the structural form, thematic maturity and path of development of this rapidly evolving field using the combination of performance indicators, science mapping as well as factorial analysis. A combination of these data points to the fact that precision nutrition ceases to be a niche area of research which is defined by the conceptual focus and becomes a data-driven, interdisciplinary paradigm of relying on the omics technologies, systems biology, and individualized dietary interventions. The sudden rise in publication rates of scientific publications in 2015 and beyond is an indication of an even greater change towards an individualistic and mechanistic nutritional science. This has been supported by creating high-throughput sequencing, metabolomics, microbiome profiling, and computational analytics, which have enabled it to describe inter-individual differences in dietary responses (Gibney *et al.,* 2005; Zeisel, 2020; Ordovas & Berciano, 2020). The information on the parallelity of growth patterns were additionally documented in the earlier bibliometric analyses of nutrigenomics and customized nutrition, yet the entire majority of the former studies were restricted to the context of human health. The fact of integrating the animal nutrition sources into the specified analysis refers to the setting of the similar evolution of the accuracy-based feeding strategies in the livestock systems with a special emphasis on the cross-species nutritional studies that have a translational potential (Forum & National Academies of Sciences, Engineering, and Medicine, 2018). The concentration of the publications in a small number of core journals as demonstrated in Bradford law analysis highlights the extent of the precision nutrition research being concentrated in the high visibility 27 rganized 27 d journals. Methodological innovations and conceptualizations in the field have largely been published in such journals as Nutrients, Advances in Nutrition and the American Journal of Clinical Nutrition. This is comparable to other fields associated with the research of metabolomics and microbiomes where limited numbers of interdisciplinary journals exist as intellectual bottlenecks (Chen *et al.,* 2016; Leydesdorff *et al.,* 2018). In the meantime, the peripheral journals are a symptom of the interdisciplinary preciseness nutrition as a discipline which cuts across clinical medicine, veterinary science, genomics, and food systems research. The geographic distribution of the relevant authors showed that the countries with high incomes were predominant particularly the United States and the Western European nations. This disparity is consistent with the historical researches on the genomics-and -omics-based areas of research, implying the structural imbalance of access to advanced analytical systems,

funding, and information (Jonsson & Stefansdottir, 2019). The low- and middle-income nations do not play a substantial role in the environment of the global cooperation, which is why the dissemination of cross-border cooperation based on the international collaboration networks appears to be a issue of concern with the reference to the global applicability of the precision nutrition frameworks. This leaves the risk of personalized nutrition models not being adequate in terms of genetic, dietary and environmental differences in the global population which may compromise them without improved geographic coverage (Ordovas & Taib, 2008). Factorial analysis and co-occurring key words established an incredibly 28rganized conceptual space with diet-health interactions, nutrigenomics, and human nutritional status prevailing. These themes are arranged in the middle as per the main role associated with molecular nutrition in the formulation of preciseness-based dietary strategies (Fenech *et al.,* 2011). The concepts animal nutrition were arranged in a network of concepts, which partly overlapped with each other, which points to the parallel growth rather than complete integration of the concept. This distinction corresponds to the past literature, which indicates that the research on human and animal nutrition is often independent of one another despite the biological resemblance (van der Poel *et al.,* 2020; Wilkinson *et al.,* 2020). Two overriding conceptual axes were also determined by the factorial analysis and which included a biological-translational gradient and a clinical-preventive gradient. These points can be seen as an extended paradigm shift of nutrition research, where instruments of dietary guidelines addressing the whole population to a more personalized, mechanism-directed intervention to prevent diseases and optimize metabolism are involved (Hood and Price, 2014; Zeevi *et al.,* 2015). Cross-validation of the power of this conceptual explanation is a similarity in the outcomes of the VOSviewer and MCA. The thematic map indicated that dietetics, nutritional status and human health were motor themes hence that they are central and well developed in this field. Artificial intelligence, machine learning, and high-level biomarker discovery, in turn, turned into developing or emerging themes. The latter observation correlates with the current requirements to adopt artificial intelligence in precision nutrition to enhance the predictive power and scalability (Topol, 2019). Similarly, the tendency towards microbiome-enhanced personalization also reflects an increase in the value of host-microbe interactions as the factor conditioning dietary reactions (Koh *et al.,* 2016; Valdes *et al.,* 2018). This suggests that convergence with human precision nutrition takes place as new concepts on the precision feeding, sensor technology, and systems modeling on animal nutrition are introduced (Gebbers and Adamchuk, 2010; Dorea *et al.,* 2020). Such translational associations can be reinforced to achieve sustainability, animal welfare, and food resilience. The findings of this paper discern some of the strategic priorities in the advancement of the research of precision nutrition. Firstly, the research on human and animal nutrition needs to be more integrated, so as to capitalize on similar mechanistic knowledge and approach. Second, one needs to expand the study engagement beyond the high-income regions so that to establish encompassing and internationally generalized precision nutrition models. Third, the computational methods, including artificial intelligence and systems biology, will have to be further developed in order to transform complex multi-omics data into the dietary guidelines that would be practical.

5. CONCLUSION

This bibliometric and scientometric review shows that precision nutrition has become an interdisciplinary research area, which grows rapidly in the context of the development of omics technologies, microbiome science, and data analytics. The past decade has seen a significant increase in research production but also a high degree of consolidation into a few dominant journals which are in the high-income countries and concentration of research activity. A conceptual and thematic analysis demonstrates that the intellectual center of the field is the diet and health interactions and nutrigenomics, and artificial intelligence, systems biology, and precision feeding are emerging and strategically significant trends. It is remarkable that the development patterns of human and animal nutrition studies are characterized by parallelism and weak conceptualization, which presents prospects of One Health-based and translational strategies. This research offers a high-level framework of future research by systematically mapping the structure, maturity, and development of precision nutrition research which can proceed with future research, set up cross-domain integration, and facilitate the engineering of inclusion and globally applicable precision nutrition strategies.

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