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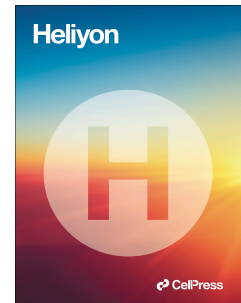
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Analyzing Consumer Behaviour Towards Food and Nutrition Labeling: A Comprehensive Review

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Abstract

Studying consumer behaviour towards food and nutrition labelling (F&NL) is increasingly becoming important across the world. Bibliometric analysis is a way to identify influential research, track trends, and understand methodologies in any field. In this paper, we used bibliometric analysis and a review of theories too to critically evaluate theories and concepts used in studying consumer behaviour towards F&NL. Using the Scopus database, we obtained 1017 articles, which were further filtered to perform various analyses like Co-occurrence and co-authorship network analysis. We found limited East and Southeast Asia-based research. Personal beliefs, attitudes, and past experiences were identified as influencers of consumer behaviour regarding food labelling. Trending topics were food waste, purchase intention, and sustainability labels.

Keywords: ADO framework; front &back of pack label; bibliometric analysis; attitude; beliefs; Content analysis.

1. Introduction

1.1. Food and nutrition labelling (F&NL) research and its importance

Food labels (1) provide information on food packaging that helps consumers make informed choices about the food they eat. It is a legal requirement in many countries and typically includes a list of ingredients and nutritional information (2,3) such as the calorie content (4,5), fat (6,7), protein (5,8), and carbohydrate levels (9), and any specific health claims (10,11) related to the food. The purpose of F&NL is to ensure that consumers have access to accurate and helpful information about the food they buy, which can help them make healthier choices (12) and manage their diets more effectively. In addition to promoting consumer health and well-being, F&NL supports the food industry by providing transparency and building customer trust (13). While reformulating food products, including fortification with essential nutrients such as omega acids and proper food labelling (14), food manufacturers can enhance the nutritional value of their products. Thus, they provide consumers with accurate information about the composition and health benefits of what they consume.

Few review papers (7,9) have been published on F&NL research in the past 20 years. Earlier studies on F&NL have yet to cover the entire range of this subject matter. Additionally, there needs to be more research exploring the underlying conceptual and intellectual framework of this emerging field. To address these gaps, we utilized quantitative (15) and qualitative methods (16) to comprehensively review existing literature and establish a guide for future research. This is the first systematic literature review and bibliometric analysis that provides a holistic overview of F&NL. Our study covers the latest advancements and is intended to assist practitioners, policymakers, educators, and researchers.

1.2. Consumer behaviour towards food and nutrition labelling

Consumer behaviour (17) towards F&NL has recently gained significant attention. The food industry is constantly evolving, as are consumers' demands and preferences (18). With an increasing emphasis on health and wellness, consumers are now more aware of the nutritional value of their food (19). As a result, F&NL have become important tools for consumers to make knowledgeable decisions about their food selections (20). F&NL provides information about the ingredients, nutritional value, and allergens in a product, among other things. However, not all consumers are receptive to such labelling. Various factors such as age (21), gender (22), education (9), income (23), and cultural background (24) can influence how consumers interpret and use F&NL. Therefore, it is essential to understand consumer behaviour related to F&NL.

1.3. Possible contributions to theory and practice

The present review aims to uncover various aspects of consumer behaviour concerning food and nutrition labelling research. It will delve into consumers' attitudes, perceptions, and decision-making processes when interpreting and utilizing food labels. The bibliometric review will explore how different types of nutrition information, such as nutrient content, health claims, and front-of-pack labels, influence consumers' food choices. Additionally, it will analyze the impact of labelling formats, design elements, and label clarity on consumer understanding and engagement. The review will also investigate any changes in consumer behaviour over time in response to evolving food labelling regulations and marketing strategies. Ultimately, the review seeks to provide valuable insights into consumer responses to food and nutrition labelling, helping to inform policymakers, businesses, and researchers about effective strategies for promoting healthier food choices and enhancing consumer well-being.

1.4. Bibliometric analysis in F&NL research

Bibliometric analysis (25,26) is valuable for studying research trends, patterns, and relationships in the F&NL field. It involves analyzing bibliographic data to identify key research areas, famous authors, and influential publications. In recent years, bibliometric analysis has gained popularity as a tool for mapping the research landscape in various disciplines (27–29). This study aims to conduct a bibliometric analysis of research related to consumer behaviour toward F&NL. Analyzing and mapping the patterns of published literature, including articles, journals, and citations, this study aims to gain insights into the trends, growth, and impact of research in this domain. Through this comprehensive analysis, researchers and practitioners can identify key themes, prominent authors, influential publications, and gaps in the existing literature, enabling them to make informed decisions, drive future research directions, and develop strategies that better understand and cater to consumers' preferences and behaviours in the context of F&NL products and services.

This research incorporated a qualitative bibliometric analysis (30), which represents a recent advancement in the field. While traditional bibliometric analysis focuses primarily on quantitative measures, such as citation counts and publication trends, our study delved deeper into the qualitative aspects of the bibliographic data. This allowed us to gain a more nuanced understanding of the content, context, and impact of the publications within our research domain. By embracing these latest developments in bibliometrics, our study contributes to the ongoing evolution of the field. The utilization of the ADO framework and qualitative

bibliometric analysis enriches our research methodology and enhances the comprehensiveness of our findings. The study aims to answer the following research questions to determine the scope of the research on this topic:

RQ1. What are the publication trends, influential authors, journals, affiliated countries, institutions, and articles in consumer behaviour towards food and nutrition labelling? What are the prominent keywords used in this context?

RQ2. What are the significant research studies and themes that have had an impact on this field?

RQ3. How has the intellectual framework of research in F&NL developed over time, and what are the current trends in research within this field?

This article is structured as follows: In section 2, we provide a detailed account of the review methodology used in this study. Section 3 presents a performance analysis of F&NL research productivity and its impact (RQ1), exploring publication trends and citation patterns to gauge the scholarly influence of the field. Moving on to section 4, we delve into the major themes that have shaped the F&NL field (RQ2), identified through a thematic analysis of scholarly works. We shift focus to reveal the emerging topics in F&NL (RQ3), shedding light on recent trends and areas of growing interest within the domain. Section 5 presents content analysis along with conceptual framework, outlining key theoretical constructs and concepts (ADO framework). Section 6 provides major theories used in F&NL research. Finally, section 7 represents the discussions and conclusions of the research paper. This section includes several subsections, such as research and policy implications. Additionally, the section suggests limitations of the current study. It provides suggestions for future research avenues that could further contribute to understanding consumer behaviour towards food and nutrition labelling.

2. Materials and methods

2.1. Data search and identification

The most significant bibliography sources are Scopus and Google Scholar (37,38). When conducting this review, we relied on the Scopus database. Scopus(39,40) is more comprehensive than other databases regarding publication quantity and journal coverage in social sciences. We used the search phrases "food label," "nutritional label," "food and nutrition label," "front of pack label," "back of pack label," "traffic light label," "nutrition facts panel label," and "warning label" to find the information we needed. We used the search terms only in English (41) academic journals that fell under the social sciences area and obtained 3450 articles.

2.2. Data extraction and cleaning

Elsevier's Scopus database includes a wide range of journals, which include science, technology, social studies, humanities, and more. The articles with key phrases on Tobacco, Cigarette, and Alcohol papers are removed, as these words are unrelated to food products. We removed documents on medicine, Biochemistry, Genetics, and molecular biology, chemical science (1394) because they used words like "pharmacology" or "molecular" that were not relevant to consumer studies. The researcher looked at each title, abstract, and keyword and removed the papers which did not fulfil the criteria (chemical, pure science, tobacco, drug).
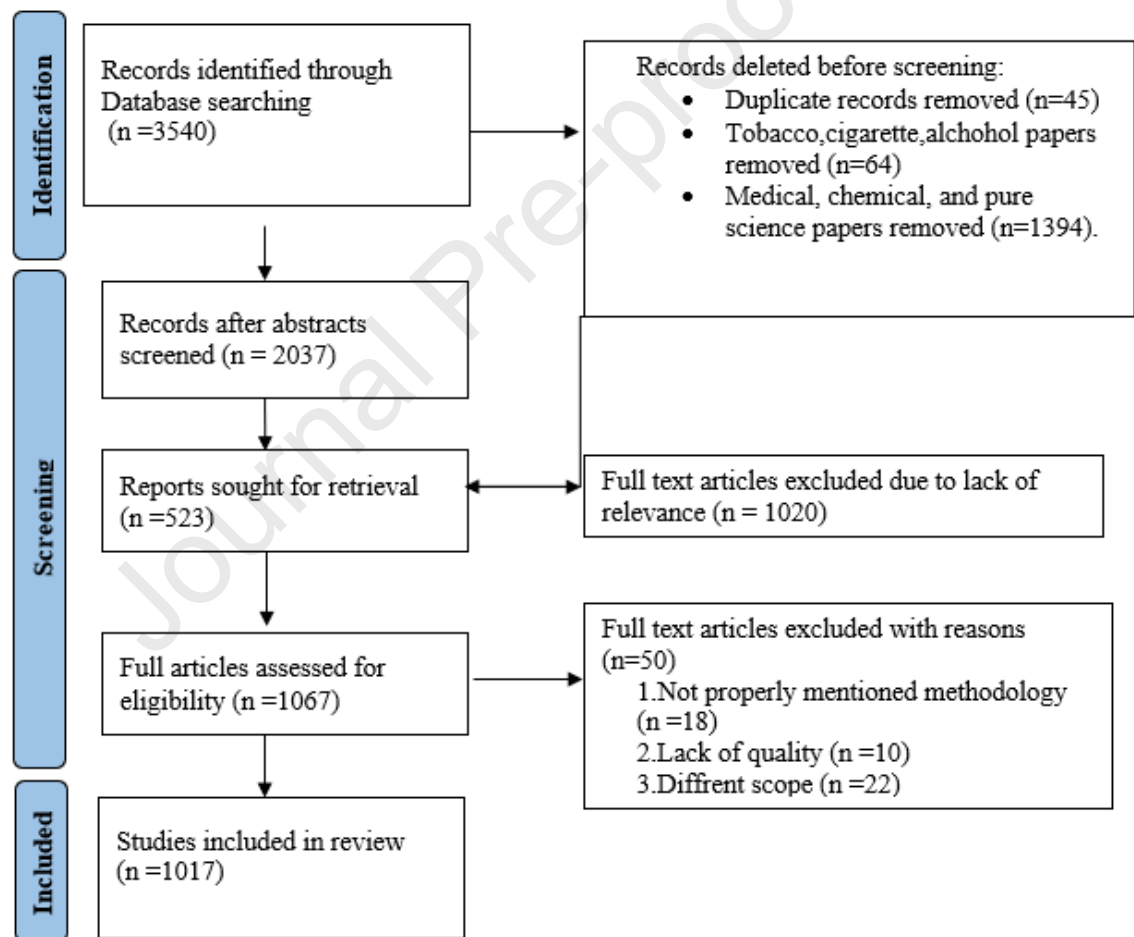
Identification of studies via databases.

Figure 1. The flow of data search, extraction, and cleaning

3. Performance analysis

3.1. Year-wise publication and citations trends

Table 1 shows that 1,017 review articles were obtained from the Scopus database, all focused on food and nutrition labelling (F & NL) research. Figure 1 displays the publication trend of

these 1,017 articles over the years. The data depicted in Figure 1 indicates a consistent and notable increase in the number of papers published on F&NL, and the year 2021 recorded the highest number of publications. An interesting observation is that out of the 1,017 articles, 380 were published in the last five years, specifically between 2016 and 2020. This highlights the growing interest and significance of the subject in recent times. Figure 2 illustrates the trends in F&NL research publications and citations from 1996 to 2021 (RQ1). Throughout this time, the journal's publication rate has risen steadily, albeit with some fluctuations and cycles. Notably, there were periods of increased publication from 1991 to 1998, a decline from 1999 to 2004, and a subsequent increase from 2014 to 2022. Based on the publication's performance over the first five months of 2023, it is anticipated that this year will continue its upward trend. The observed cycles and surges in the publication trend can be attributed to the proactive nature of F&NL researchers. Despite the declines, each succeeding low point in publication rate has been greater than the preceding one. This pattern validates the overall growth of F&NL publications.

Table 1. Year-wise academic writings

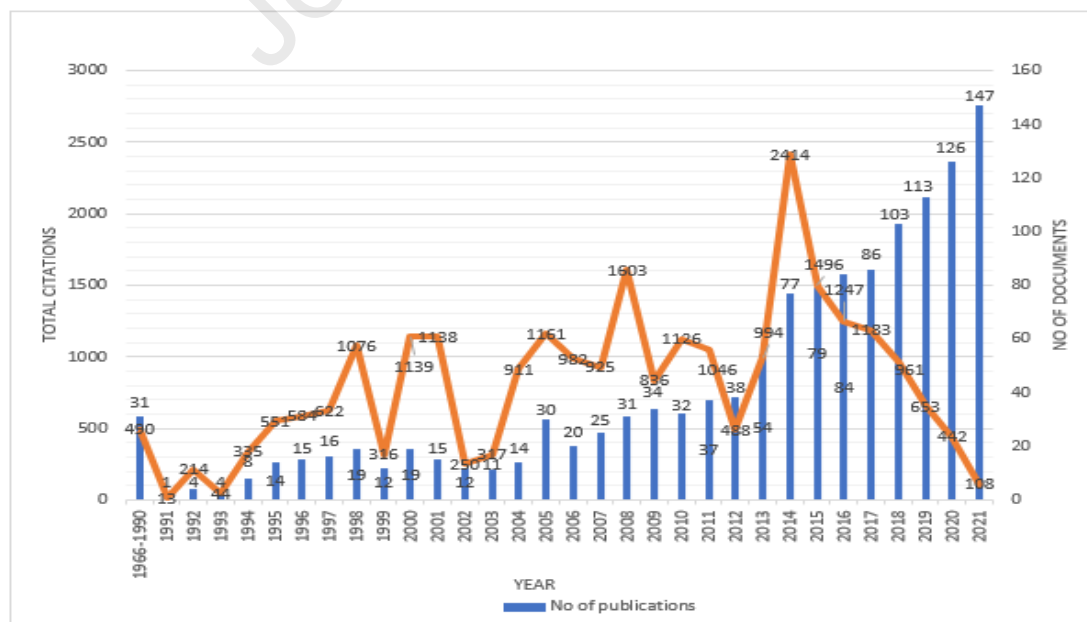| Used in Title	Source	1972 - 2000	2001- 2005	2006- 2010	2011- 2015	2016- 2020	2021 to June 2023	Total academic writings
Usage of "food label", " food and nutrition label", or "front/back of pack label "and "consumer" terms in academic writings.	Scopus data base	28	70	104	224	380	211	1017

Figure 2. Comparative analysis of publications and citations from 1966 to 2021.

Articles published have increased year by year due to F&NL awareness. Looking at the number of citations received for those papers published in specific years, for example, papers published in 2014 received the highest number of citations. However, the recently published papers might receive fewer citations because of the short period. To represent the research trend visually, we categorized the author's keywords into eight periods. 2013-2015 (food safety plays a significant role), 2015-2017 (5 keywords), 2017-2019 (5 Keywords), 2019-2021 (3 keywords).
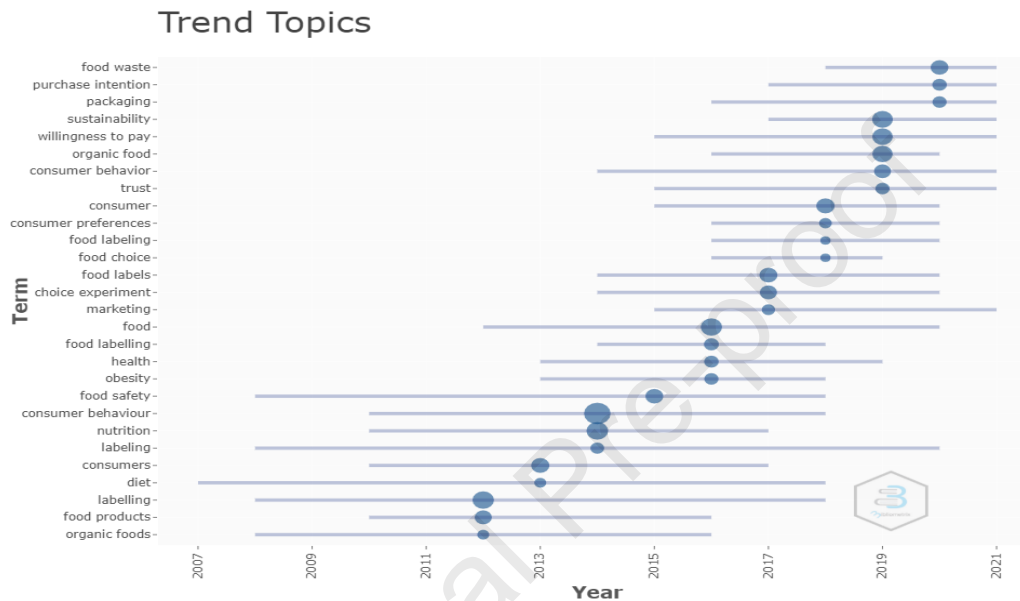

Figure 3. Top trending topics covered from 2007 to 2022

Figure 3 shows that the current (2022) trending topics are food waste, purchase intention, packaging, and sustainability.

Food waste, purchase intention, packaging, and sustainability are critical and trending topics in F&NL research. Regarding food waste, Wong et al.(47) suggest that labelling can significantly reduce food waste by providing consumers with information about food shelf life, storage requirements, and proper handling. This information can help consumers make informed decisions about purchasing and consuming food, reducing the likelihood of food waste in terms of purchase intention (47–51). Alsini et al. (52) suggest that food labelling can impact consumers' purchase decisions, particularly regarding health and sustainability-related claims. Consumers are increasingly seeking healthier and more sustainable food options, and food labelling can provide them with the necessary information to make informed decisions. Packaging is also a crucial topic in F&NL research.

3.2. Top journals

We analyzed journals that published the top 100 most-cited publications on F&NLs. The findings indicated that articles are dispersed over a diverse range of journals. Each among the top 100 most-cited publications was published in at least 36 journals. On the other hand, only 16 of those journals have published two or more papers(see Table 2). All but one is a top-ranked journal (Q1-ScimagoJR). This research demonstrates highly referenced publications in high-impact journals. In our analysis, we utilized the source normalized impact per publication (SNIP) as a metric to determine the average number of citations per paper in a specific journal as a percentage of the journal's citation potential in each field, as proposed by (53). Our findings indicate that all the top 16 journals in this study have a SNIP larger than one, with the lowest being 0.813.

Table 2. Top journals - 100 most cited publications

Source	TP	TC	CPP	Cite score	SNIP	Scopus quartile
British Food Journal	422	6933	16	3.50	0.857	Q1
Food Policy	136	5865	43	7.70	2.401	Q1
Journal of Cleaner Production	137	4508	33	13.10	2.475	Q1
Journal of Consumer Affairs	34	1401	41	2.70	1.202	Q1
International Journal of Consumer Studies	110	2605	24	4.20	1.356	Q1
Journal of Public Policy and Marketing	85	4080	48	4.90	1.162	Q1
Journal of Marketing Research	13	934	72	9.60	3.039	Q1
Applied Economic Perspectives and Policy	6	271	45	4.8	1.904	Q1
Journal of Consumer Policy	36	1462	41	2.50	1.364	Q2
Health Promotion International	6	471	79	3.50	1.201	Q1
Journal of Food Products Marketing	43	348	8	3.50	0.813	Q2
Agribusiness	14	204	15	2.90	1.066	Q1
European Journal of Marketing	28	644	23	4.70	1.72	Q1
Journal of Consumer Marketing	7	133	19	2.80	1.07	Q1
Journal of Business Ethics	7	285	41	9.00	2.534	Q1
Journal of International Food and Agribusiness Marketing	22	205	9	2.70	0.984	Q2

Notes: TP=Total publications: TC=Total citations; CPP=Citations per publication; SNIP=Source normalized impact per

paper; SJR=Scimago Journal Ranking; Figures for 2022 provided by SCOPUS.

3.3. Top contributing authors

Table 3 highlights various prolific authors and their respective affiliations, along with citation statistics. Nayga Jr. R.M., with 33 articles, is affiliated with Texas A&M University in the USA and has received 1496 citations. Hercberg S., associated with Sorbonne Paris Nord University, Inserm, Inrae, Cnam, and other institutions in France, has authored 31 articles with 750 citations. Julia C., with 30 articles, is linked to the Department of Public Health at Hôpitaux Universitaires Paris Seine-Saint-Denis in France, garnering 661 citations. Ares G., having 26 articles, is affiliated with institutions in Uruguay and has received 580 citations. Hammond D., contributing 25 articles, is associated with the School of Public Health and Health Systems at the University of Waterloo in Canada, accumulating 842 citations. Roberto C.A., with 24 articles, is connected to The Rudd Center for Food Policy and Obesity at Yale University in the USA, garnering 930 citations. Pettigrew S., having authored 23 articles, is affiliated with The George Institute for Global Health in Australia and has received 509 citations. Verbeke W., with 21 articles, is associated with Ghent University in Belgium and has received 1688 citations. Taillie L.S., contributing 19 articles, is linked to the Department of Nutrition at the University of North Carolina at Chapel Hill in the USA, with 374 citations. Finally, Kelly B. has 17 articles, is affiliated with the School of Health and Society at the University of Wollongong in Australia, and has received 866 citations.

Table 3. Top authors with affiliation detail

S.no	Authors	# of articles	Institution	Affiliation Type	Country	Citations
1	Nayga jr. r.m.	33	Texas A&M University	Education	USA	1496
2	Hercberg s.	31	Sorbonne Paris Nord University, Epidemiology and Statistics Research Centre -University of Paris (CRESS), Bobigny.	Research Institute	France	750
3	Julia c.	30	Department of Public Health, Hôpitaux Universitaires Paris Seine-Saint-Denis (AP-HP),	Government	France	661

4	Ares g.	26	1A Centro de Investigacion ´ Basica ´ en Psicología, Facultad de Psicología, Universidad de la República, Tristan ´ Narvaja, CP 11200 Montevideo. Sensometrics & Consumer Science, Instituto Polo Tecnol' logic de Pando, Facultad de Química, Universidad de la República, By Pass de Rutas 8 y 101 s/n, CP 91000, Pando, Canelones.	Education	Uruguay	580
5	Hammond d.	25	School of Public Health and Health Systems, Faculty of Applied Health Sciences, University of Waterloo, Waterloo, ON N2L 3G1.	Education	Canada	842
6	Roberto c.a.	24	The Rudd Center for Food Policy and Obesity, Yale University,	Education	USA	930
7	Pettigrew s.	23	The George Institute for Global Health, Newtown NSW, Sydney.	Medical Institute	Australia	509
8	Verbeke w.	21	Ghent University, Ghent.	Education	Belgium	1688
9	Taillie l.s.	19	Department of Nutrition, University of North Carolina at Chapel Hill, 135 Dauer Dr, Chapel Hill	Education	USA	374
10	Kelly b.	17	School of Health and Society, University of Wollongong, Wollongong, New South Wales.	Education	Australia	866

3.4. Top Universities

Table 4 presents the highest number of citations received for F&NL (Food and Nutrition Labelling) research from several top universities worldwide. The University of North Carolina at Chapel Hill's Population Centre in the United States has received the maximum number of citations on F&NL research. Following closely are Purdue University's Department of

Agricultural Economics in the USA, Harvard T.H. Chan School of Public Health's Department of Nutrition in the USA, and the National Institute for Health Innovation at the University of Auckland in New Zealand. The top seven universities have garnered over 19% of the total citations in the field. Among these seven universities, three are from the USA, one from New Zealand, one from Slovenia, and one each from Australia and Canada.

Table 4. Top Research Institutions Based on F&NL Research

S.no	Name	No of documents	No of citations	Average citation
1	University of North Carolina at Chapel Hill, Population Centre, USA.	10	321	32.10
2	Purdue University, Department of Agricultural Economics, USA.	6	191	31.83
3	Harvard t.h. Chan School of Public Health, Department of Nutrition, USA.	10	197	19.70
4	National Institute for Health Innovation, University of Auckland, New Zealand.	6	182	30.33
5	Nutrition Institute, Slovenia.	8	109	13.63
6	Curtin University, School of Psychology, Australia.	7	335	47.86
7	University of Waterloo, School of Public health and Health systems, Canada.	8	144	18.00

3.5 Top countries with international collaboration and relationship

Figure 5 Countries that had a minimum of two publications were analyzed. US-based researchers have published almost as much as the remaining countries (30.52%), double that of its competitor, the United Kingdom. Furthermore, the top three countries (the United States, the United Kingdom, and Italy) jointly generated 50.08% of the publications. The findings reflect Asia's minimal contributions to labelling research. India, Norway, and Greece contributed less than 3%, whereas Australia, Germany, Spain, France, and Canada each contributed 4.30% to the total publications. This, it appears, demonstrates the necessity for non-Western viewpoints on F&NLs.
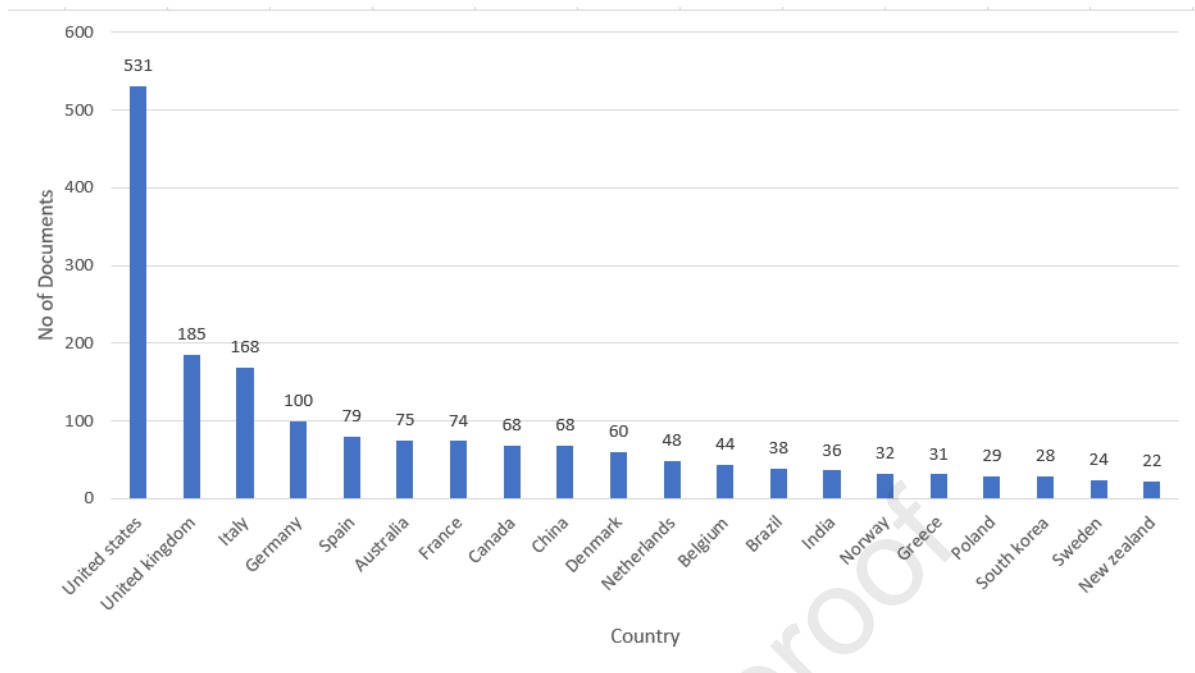
Figure 4. Publications by country (100 most cited publications)

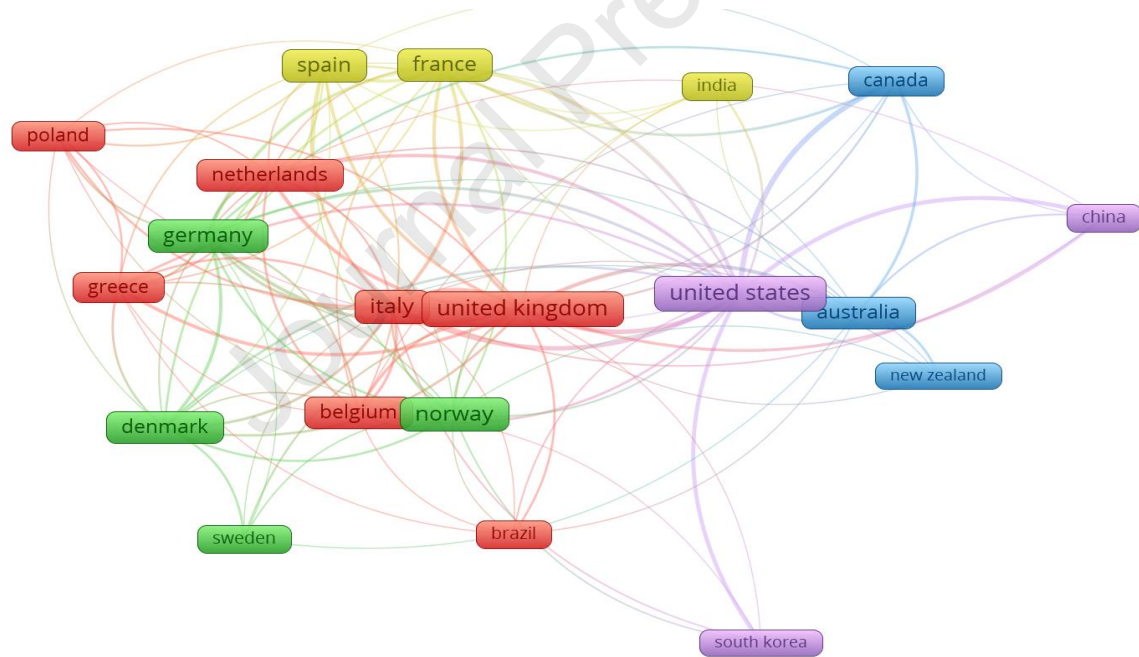

Figure 5. Collaboration network – countries

Note: Minimum number of articles by country was set at one, and phrases with ambiguous identifiers of countries were omitted from the research.

Over 100 articles have received citations exceeding 1,000 times, as depicted in Figure 4. To enhance clarity, only countries that have contributed a minimum of five articles are displayed in the graph.

4. Science mapping

Science mapping explores the relationships between different research constituents (54). Lim et al.(54) examine these constituents' intellectual interactions and structural connections. Various techniques are employed for science mapping (28), including citation analysis, co-citation analysis, bibliographic coupling, co-word analysis, and co-authorship analysis. Combined with network analysis, these techniques are crucial in presenting the research field's bibliometric structure and intellectual structure (Baker, Pandey, Kumar, & Haldar, 2020; Tunger & Eulerich, 2018).

4.1. Co-citation analysis based on authors

A co-citation analysis was conducted using the 1017 review articles under examination to gain deeper insights into the data. The analysis revealed six distinct clusters of authors frequently cited together, as depicted in Figure 6. Notably, the findings from both Figure 6 and Table 5 validate each other, identifying a common group of major contributors to the field of F&NL research.
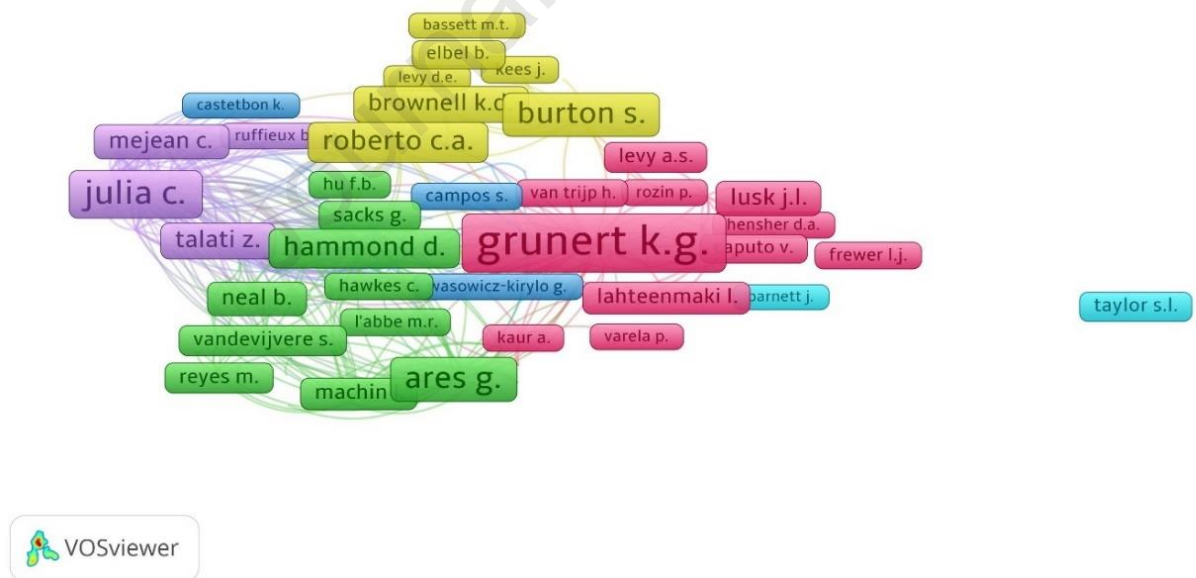
Figure 6. Co-citation analysis based on authors

S.no	Author name	No.of documents	No. of citations	Avg. citation per Item
Table 5. Top 10 authors based on the number of co-citations				
1	Grunert K.G	7	1254	179.14
2	Julia C.	3	886	295.33

3	Hercberg S.	3	856	285.33
4	Verbeke W	5	832	166.40
5	Ares G.	4	800	200.00
6	Nayga R.M	3	787	262.33
7	Burton S.	4	750	187.50
8	Wills J.M	3	667	222.33
9	Roberto C.A	1	647	647.00
10	Hammond D.	4	615	153.75

4.2. Co-Citation analysis based on journals

Figures 7 and Table 6 show the distribution of co-citations. The themes were categorized into six clusters based on their thematic relevance. Cluster 1 focuses on food and agriculture, Cluster 2 on nutrition, Cluster 3 on health behaviour, Cluster 4 on business and food composition, and Cluster 5 on environmental aspects. The data revealed that the journal "Appetite" and "Research Policy" received the highest number of co-citations, as indicated in Table 6. Following carefully were the "Journal of Cleaner Production," "Food Policy," and "British Food Journal. "The most prominent cluster in terms of cited sources was Cluster 1&3, which covered various food and nutrition research topics. These findings were further supported by the keyword analysis in Figure 6, suggesting a consistent trend in the field.

Table 6. *Top 10 journals based on high citations*

| S.no	Journal name	No.of documents	Total citations
1	Appetite	160	6853
2	Food policy	62	3827
3	Nutrients	207	3112
4	Public health nutrition	109	2896
5	Food quality and preference	66	2545
6	Journal of the American dietetic association	53	1547
7	British food journal	71	1457
8	Journal of nutrition education and behaviour	37	1171
9	International journal of behavioural nutrition and physical activity	31	1135
10	American journal of preventive medicine	22	1109
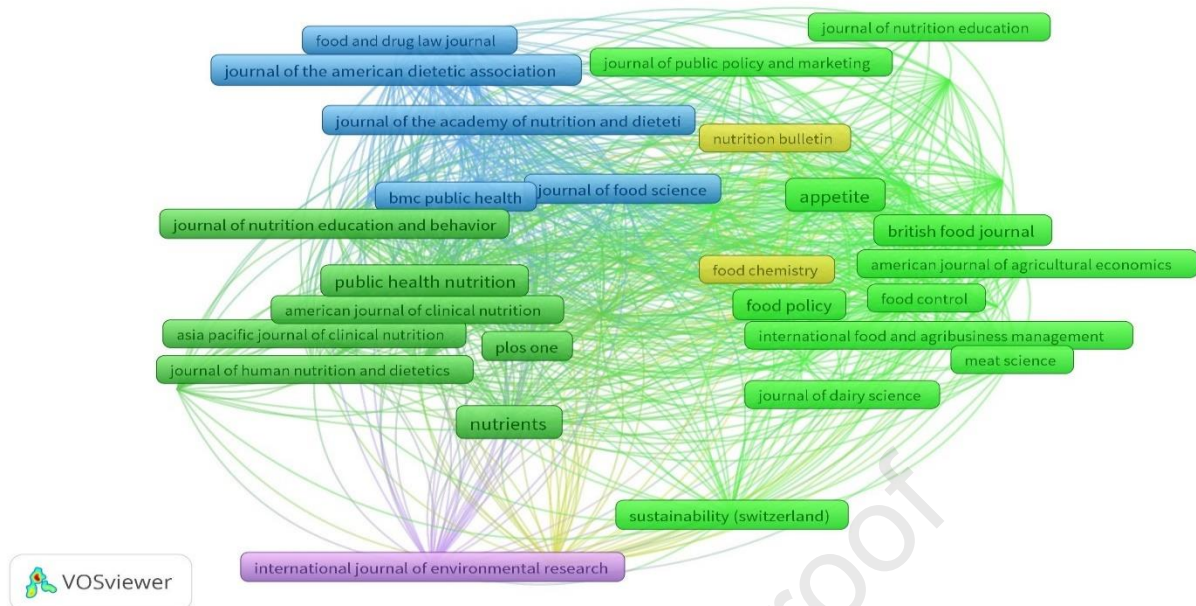
Figure 7. Most cited journals

Note: Minimum limit of 100 citations per article was utilized to understand the network structure better. Only 46 of the 50 networks are included in the database.

4.3. Keyword analysis

Visualizing bibliometric networks has garnered significant attention in bibliometric studies (55). The researcher used VOS viewer to analyse the co-occurrence of author keywords, and the results are displayed in Figure 8.
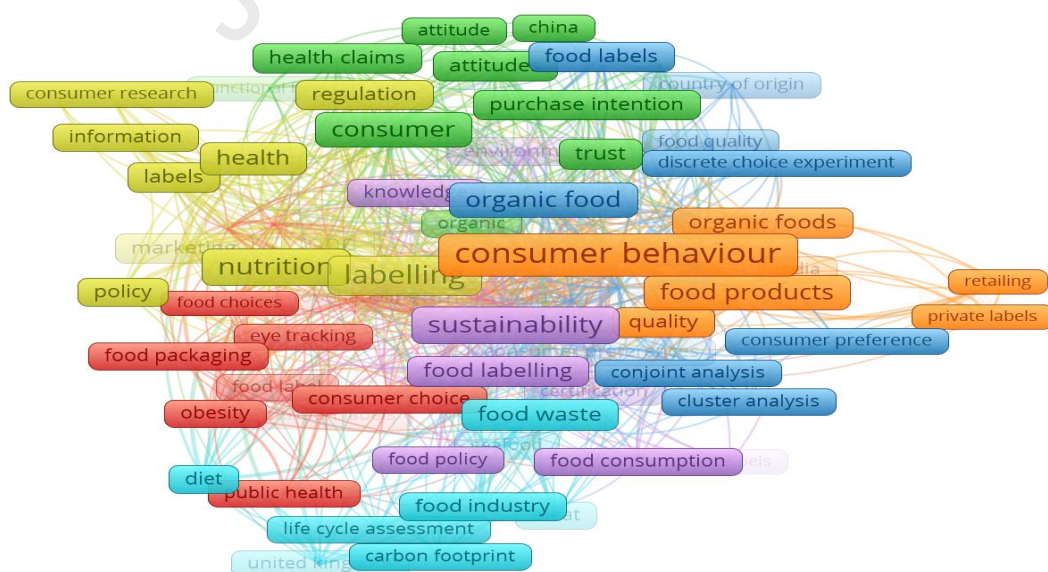

Figure 8. The most frequently used terms are linked in a co-occurrence network.

Note: A minimum frequency of ten times for the keyword analysis was taken.

As a result, this criterion was satisfied by 81 of the 3801 terms tested. Replacing the same terms spelt differently with words from a thesaurus file was necessary. This study did not include the keyword article since it was deemed unnecessary. As shown in Figure 8, the first and subsequent clusters appear near each other within the visualization network and are relatively distant from different sets. This suggests a strong correlation between the keywords within this cluster and the rest, indicating a focus on consumer behaviour related to food and nutrition labelling (F&NL) in this research study. The keyword analysis revealed six clusters of words, each represented by a unique colour, as illustrated in Figure 8. These clusters indicate groups of words that frequently occur together.

Major clusters are

- Cluster1-Attitude, purchase intention, trust and regulations.
- Cluster 2- Retailing, organic foods, Consumer behaviour,
- Cluster 3-Sustainability, food policy, food consumption.
- Cluster 4-Nutrition labelling and consumer research.
- Cluster 5-Public health, consumer choice, health, eye tracking.
- Cluster 6- Food waste, carbon food print and life cycle assessment.

The results of the keyword analysis reveal six distinct clusters of related articles. The first cluster predominantly revolves around the theory of planned behaviour constructs. In contrast, the second cluster focuses on retailing and organic food. The third cluster is centred on sustainable food consumption, while the fourth cluster delves into various aspects of consumer research. Moving on, the fifth cluster is primarily concerned with public health and eye tracking matters. Lastly, the sixth cluster pertains to the critical subjects of food waste and lifecycle assessment. These clusters help categorize and highlight the main themes explored within the articles.

The findings from the keyword analysis have provided valuable insights into the main themes and topics discussed within the articles. The identified clusters offer a comprehensive view of the diverse areas of research and interest in the field. In this discussion section, we will explore and interpret the implications of these clusters in the context of existing literature and potential future research directions.

4.3.1. Cluster 1. Theory of planned behavior constructs

The presence of a distinct cluster centred around the theory of planned behavior constructs indicates a significant focus on understanding human behavior and decision-making processes. The theory of planned behavior has been widely employed in various disciplines, including psychology, marketing, and public health, to explore the determinants of individual behavior. Scholars may have used this theoretical framework to investigate how attitudes, subjective norms, and perceived behavioural control influence intentions and actions related to specific domains, such as sustainable food consumption or food waste reduction.

4.3.2. Cluster 2. Retailing and organic Food

The second cluster's concentration on retailing and organic food highlights the growing interest in sustainable and organic food products within the retail industry. Consumers' increasing awareness of environmental and health concerns has driven the demand for organic products. Researchers within this cluster may have explored consumer preferences, purchasing behaviors, and the marketing strategies that influence the adoption and promotion of organic food items in retail settings.

4.3.3. Cluster 3. Sustainable food consumption

The third cluster's primary focus on sustainable food consumption aligns with the global push for more eco-friendly and ethical food choices. As sustainability concerns rise, consumers are increasingly interested in the environmental impact of their food choices. Researchers within this cluster may have investigated the factors that drive sustainable food consumption, such as eco-labeling, packaging, and supply chain practices, aiming to promote more environmentally friendly food habits.

4.3.4. Cluster 4. Consumer research

The fourth cluster's concentration on consumer research suggests a broader scope of studies examining various consumer-related topics. This cluster could encompass research on consumer behavior, preferences, attitudes, and decision-making processes across different domains beyond the ones explicitly covered in the other clusters. Studies in this cluster may contribute to a comprehensive understanding of consumers' needs and behaviors, influencing food-related policies and marketing strategies.

4.3.5. Cluster 5. Public health and eye tracking

The fifth cluster's focus on public health and eye tracking indicates an interest in studying the relationship between visual attention and health-related behaviors. Eye tracking research can provide valuable insights into how individuals process health-related information and make

decisions about their food choices. Understanding these processes can inform the design of effective public health campaigns and interventions to promote healthier eating habits.

4.3.6. Cluster 6: Food waste and lifecycle assessment

The final cluster's emphasis on food waste and lifecycle assessment underscores the growing concern over food waste's environmental impact and sustainability. Research within this cluster may have explored methods to reduce food waste, assess the environmental footprint of food production and consumption, and propose strategies for more sustainable food systems.

4.4. Three plot mapping (journal, author, keyword)

The width of the diagram (see figure 9) represents journals, authors, and author keyword frequency. At a time, we can analyze three areas that primarily used authors' keywords, which author used them the most, and which journal had a high impact. The diagram depicts that the Journal of Food Public Policy and Marketing has the highest frequency of publications, which is why it appears as the largest node in the diagram. The British Food Journal and Food Policy Journals have a relatively high frequency of publications and are depicted as second higher nodes. The term "consumer behaviour" is commonly used by researchers such as Verbeke and Nyga Jr, among others. Three-plot mapping is helpful for quickly identifying the journals that publish more papers on food and nutrition research.
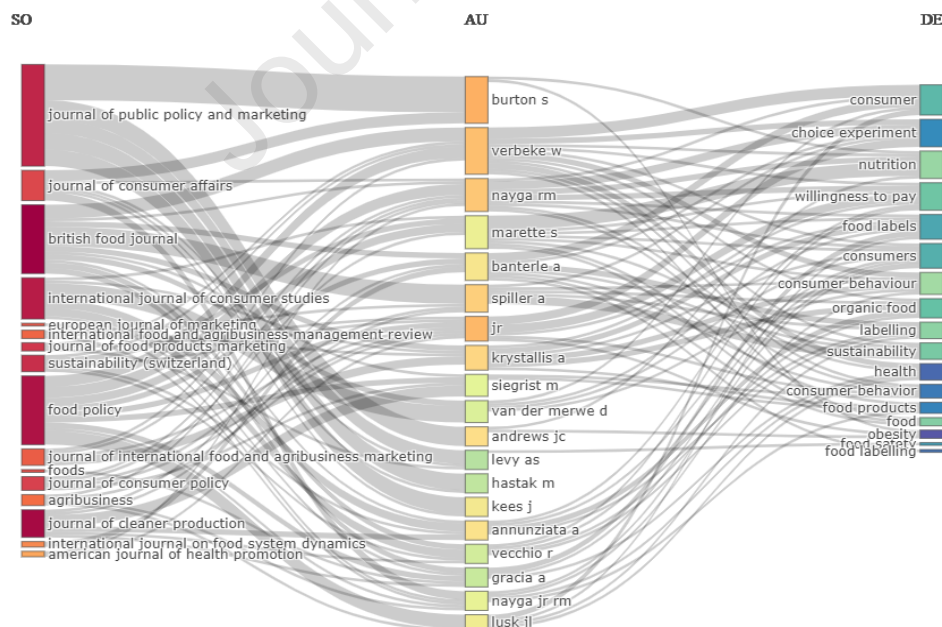

Figure 9. Three field plots relationship among journal, author, and keywords mapping

4.5. Analysis of clusters and multiple correspondences for high-frequency keywords:

The researchers employed Multiple Correspondence Analysis (MCA) to analyse the keywords. Figure 10 illustrates the structural model of the keywords as presented. The positioning of keywords concerning the center signifies the level of attention they have received, with those closer to the center attracting significant interest.

Figure 10. Conceptual structure map with multiple correspondence analysis of keywords on F&NL research.

Cluster 1, indicated in red and consisting of nine keywords, encompasses papers around organic food, consumer behaviour, quality, consumers, and diet. The primary theme within this cluster is consumer preferences. Cluster 2, depicted in blue, comprises 31 keywords primarily associated with publications related to willingness to pay, discrete choice experiment, conjoint analysis, nutrition label/labelling, attitude, packaging, food labelling, marketing, food choice, and country of origin. The major theme observed in this cluster is decision-making regarding food and nutrition labelling (F&NL).

5 Content analysis

The conceptual framework depicted in Figure 11 summarizes an in-depth content analysis (56). The analysis provides a comprehensive overview of the themes and topics covered in the research. The illustrated model provides a conceptual framework of the factors that lead to F&NL and its impact on consumer behaviour and decision-making. In the context of these antecedents, demographic variables such as age (58), gender (59), income (60), and socio-economic factors (61) have a significant influence on individuals' use of F&NL. The conceptual

framework also represents the logical relationships between three constructs of F&NL.(62) have found that the attitude & knowledge about nutrition labels and consumer behaviour are interconnected, and this relationship exists not only within the research field of F&NL(63).
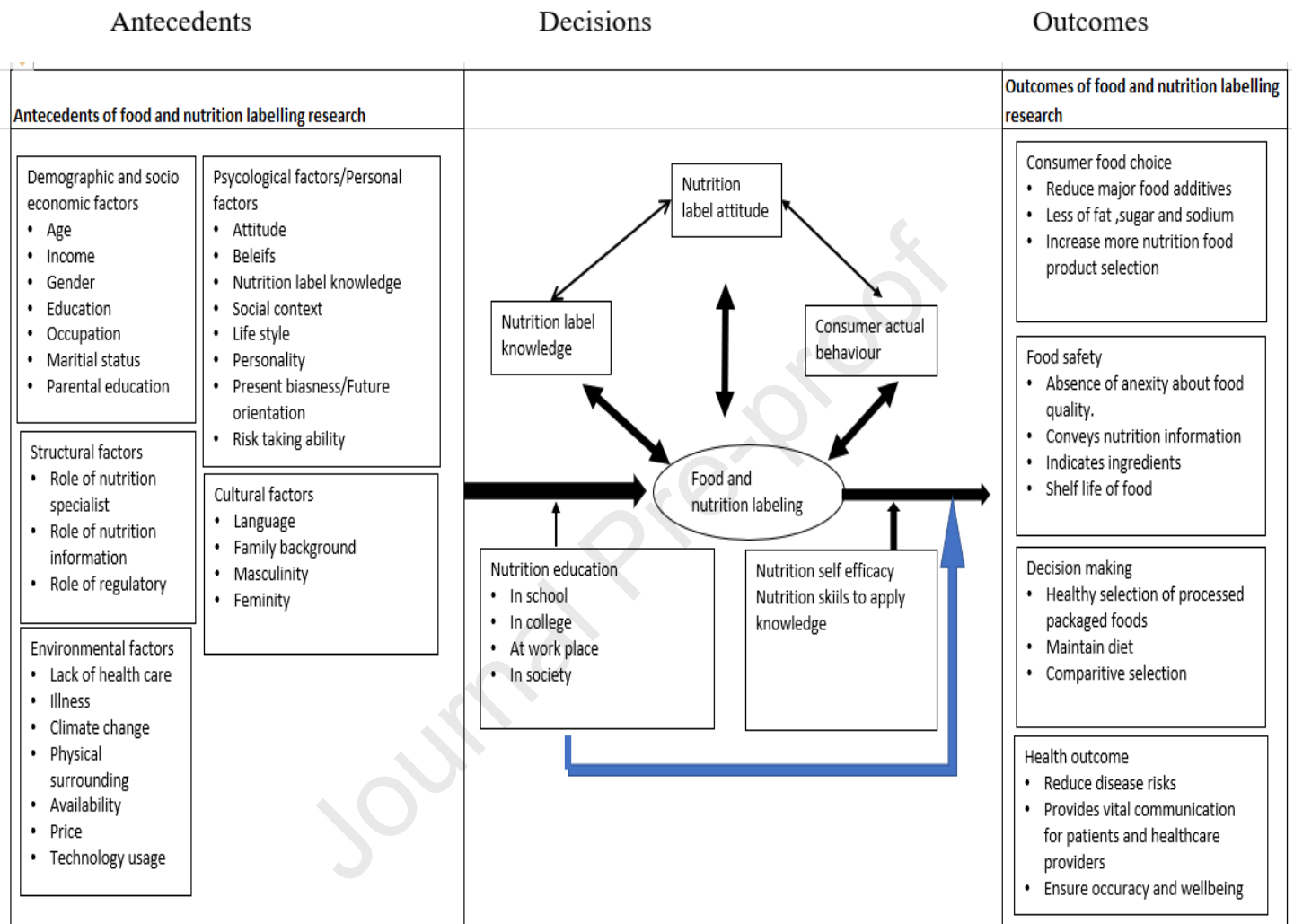

Figure 11. Conceptual (ADO) framework of consumer behaviour towards food and nutrition labels

Aryee et al.(85) found that individuals with good knowledge of nutrition labels are more likely to comprehend better fundamental and advanced concepts related to nutrition labelling. Edenbrandt and Nordström (66) have suggested that consumer behaviour is another factor that influences F&NL, and individuals who exhibit desirable consumer behaviour are more likely to participate in the food market actively. Based on the Theory of Planned Behaviour (TPB) (67), the attitude towards nutrition labels mediates between nutrition knowledge and consumer behaviour. This finding has been supported by the research conducted by (68). Social cognitive theory (69) explains that nutrition self-efficacy refers to an individual's belief in their capacity

to regulate their nutrition-related behaviour. The idea that nutrition self-efficacy is essential for translating the use of F&NL into consumer decision-making (70) behaviour has been supported by prior research (71). The ability to confidently understand nutrition labels and apply the acquired knowledge are the driving forces facilitating converting nutrition label knowledge into actual behaviour. In other words, these factors can be likened to the wagons that carry the knowledge to its destination of translating into behaviour. Tian et al. (20) argued that nutrition education is a prerequisite for fully absorbing the findings of food and nutrition label (F&NL) research and for individuals to effectively utilize nutrition label knowledge in their healthy choice behaviour (72). Therefore, only a nutritionally educated individual can fully capitalize on the potential benefits that nutrition label knowledge offer (72).

6. Theories used in F&NL research

Researchers have developed several theories to understand why consumers make certain choices to provide frameworks for their decision-making processes (73). These theories include the "Theory of Planned Behaviour(TPB)" (74–76), "Social cognitive theory" (SCT) (77–80), Health belief model(HBM)(60,81–83), "Information motivation behavioural skills model (IMB)" (84), Diffusion of innovation theory (DIT) and Social Learning Theory (SLT) (85–87) are the most used theories in the context of F&NL research. These theories provide insights into how attitudes, beliefs, social norms, and personal experiences influence consumer behaviour. Using these theories, researchers can identify the factors that drive consumer behaviour and develop more effective marketing strategies and interventions targeting these factors. Ultimately, understanding consumer behaviour can help businesses and organizations make better decisions and improve their products and services to meet better the needs and preferences of their customers (88).

7. Discussions & Conclusions

This research employed a bibliometric methodology to analyse the scientific literature on food and nutrition labelling (F&NL) from a consumer behaviour perspective. Publication trends indicate a growing interest in food waste, purchase intention, packaging, and sustainability. International collaboration in F&NL research showed significant contributions from the United States, the United Kingdom, and Italy, while certain countries had minimal involvement (Zimbabwe, Slovakia). To address minimal involvement countries like Zimbabwe, Slovakia, Iraq, and Latvia in research collaboration on food and nutrition labelling, it's crucial to identify shared interests and benefits, set clear objectives aligned with each country's priorities, foster open communication with relevant stakeholders, and offer capacity-building initiatives to enhance research capabilities. Emphasize mutual benefit, seek external funding, establish a

collaborative network, and ensure legal and ethical considerations are met. Recognize and give visibility to contributions from all nations, maintain a long-term commitment to sustain the partnership, and work towards creating valuable outcomes for all involved parties. The analysis of top journals, namely Appetite, Nutrients, and the British Food Journal, revealed a wide distribution of highly cited publications with 6853, 3112, and 1457 citations, respectively. These high citation counts were attributed to 160, 207, and 71 documents published in these journals. This finding emphasizes the importance of aiming for high-impact journals to maximize the visibility and influence of research publications.

The study revealed a significant increase in publications over twenty years, from 70 in 2001 to 380 in 2022. This expansion signifies a surge in research activity, leading to greater knowledge dissemination, scientific impact, and collaboration among researchers and institutions. The rise in publications attracts global recognition and additional funding and fosters a competitive academic landscape. However, it also raises concerns about maintaining research quality and ensuring the credibility of findings in the face of increased volume. The findings indicate a dynamic and active research environment within the field, with both positive outcomes and challenges to address.

The analysis of keywords revealed "food labelling" as the most significant keyword, comprising 9% of the total keywords analyzed, indicating a strong focus and interest in this topic. Other important keywords following "food labelling" include " "sustainability," "consumer behaviour," "willingness to pay," "nutrition label," and "purchase intention." These interconnected themes suggest a multidimensional exploration of food labelling impact on consumer choices, sustainability, and nutrition awareness. The emphasis on consumer behaviour and willingness to pay underscores the importance of understanding consumers' preferences and decision-making processes in designing effective labelling strategies. The presence of "sustainability" implies a growing interest in the environmental and ethical aspects of food labelling. Overall, this research outcome reflects the relevance of food labelling in policymaking, industry practices, and promoting informed consumer choices and sustainability efforts.

Among the less utilized keywords are "food adulteration," "trans fat," "ethical consumption," "infant nutrition," and "mislabeling." However, these keywords present valuable opportunities for further research through empirical investigation. Conducting studies on these topics can yield important results that benefit academics and policymakers. By exploring issues related to food adulteration, trans fat, ethical consumption, infant nutrition, and mislabeling, researchers

can contribute to a deeper understanding of these areas and offer insights that can inform policy decisions and practices.

The analysis of the six clusters offers a comprehensive overview of various themes and research interests within the field of interest. Identifying these clusters, researchers and policymakers gain better understanding of the prevailing topics and gaps in current research. The insights obtained from this study can serve as a foundation for future investigations, enabling scholars to address pressing issues related to sustainable food consumption, waste reduction, consumer behavior, and public health. Moreover, the findings may have practical implications for policymakers, retailers, and marketers seeking to promote sustainable and health-conscious food choices among consumers. Further research in these areas will contribute to the broader goal of building a more sustainable and healthier food system for the future.

Identifying prominent authors in the field of F&NL research, including Grunert, Julia, Nayaga, Herberg, and Ares, has significant implications. Their prominence suggests recognized expertise and influential contributions to the field, shaping research directions and highlighting key areas of interest. Collaborating with these established researchers can enhance the quality and impact of F&NL studies and foster knowledge exchange (after personally reaching out to all five authors, the researcher received a response from Grunert regarding food labelling research). Their frequently cited work can serve as foundational research, guiding future studies and influencing policy decisions and industry practices related to food labelling. Additionally, their presence may indicate existing research collaboration networks, promoting interdisciplinary research and international cooperation. Analyzing their work can offer insights into emerging research trends, aiding researchers and policymakers in prioritizing areas of study for advancing Food and Nutrition Labelling research.

The ADO framework utilized in this bibliometric analysis of F&NL research provided valuable insights into decision-making processes and their outcomes. By examining antecedents, decisions, and outcomes, trends and patterns in F&NL research were identified, shedding light on factors influencing food labelling decisions and their subsequent impact. Policymakers can leverage these findings for evidence-based policymaking, designing targeted regulations that promote transparent and informative food labelling practices. Additionally, the framework facilitates stakeholder engagement, allowing collaboration among industry, consumer advocacy groups, and researchers to align interests and achieve positive outcomes. As a tool

for impact assessment, the ADO framework enables policymakers to evaluate existing policies and interventions, making data-driven adjustments for more effective food labelling practices. Overall, the ADO framework is a valuable approach for understanding decision-making in F&NL research and holds significant potential for shaping policy implications that improve food labelling standards and promote healthier dietary behaviours.

Among the commonly utilized theories in F&NL research are the Theory of Planned Behaviour (20), Social Cognitive Theory(69), Health Belief Model (90), and Information Motivation Behavioural Skills Model (91). Integrating these theories in future studies could increase recognition and impact within the academic community. Several studies focused on the effects of food labelling on consumer choices, the readability and comprehensibility of nutrition information, and the influence of demographic factors on label use. Moreover, the results highlight the interdisciplinary nature of research in this area, with contributions from various fields such as marketing, public health, and nutrition. Despite the growing body of research, several gaps still need to be addressed. For instance, future research could explore how different types of food labelling, such as front-of-package labelling, influence consumer behaviour. Moreover, given the widespread use of digital platforms for food purchases, future research could explore how digital food labelling (QR codes, barcodes, or RFID tags, which can be scanned using a smartphone or other device to access information about the food product) could be used to promote healthy food choices. Additionally, there is a need to examine how food labelling could be used to address health disparities among different demographic groups.

Several countries have their own mandatory vs voluntary labelling policy schemes. For example, the United States and European Union follow a mandatory Nutrition Facts Panel labelling policy. Seven major nutrients, i.e., fat content, calorie, protein, carbohydrates, sugars, salt, and saturated fat, must be part of the label (Regulation No.1169/2011; FDA,2016).In 2016, Chilean food labelling law (92) covering advertising too was implemented. Therefore, packaged food sales declined, resulting in a small but significant decline in purchasing high-calorie food, sodium, high fat, and sugars. Chilean warning label (93) law reduced the availability of unhealthy foods in schools and discouraged unhealthy snacks and beverages (94).+ Thus, influencing consumer behaviour through law is possible. Food labelling information is essential to know how label (95) works as a policy. It is intended to change consumer behaviour (17).

7.1. Theoretical, research & policy implications

The keyword analysis clusters hold both theoretical and practical implications. The focus on theory of planned behavior constructs (Cluster 1) deepens our understanding of decision-making processes, while consumer research (Cluster 4) enriches insights into consumer behavior. Practical applications emerge from the emphasis on retailing and organic food (Cluster 2), guiding marketers in meeting the demand for organic products. Additionally, the sustainable food consumption cluster (Cluster 3) offers valuable insights for policymakers to promote eco-friendly food choices and reduce food waste (Cluster 6) throughout the supply chain. Finally, the research on public health and eye tracking (Cluster 5) informs the design of health campaigns to influence behavior positively. Together, these implications bridge theoretical advancements with actionable strategies in various sectors related to food consumption and behavior. Analyzing the top authors, top countries, and top cited papers in Food and Nutrition (F&NL) research related to consumer behavior holds significant implications. It enables the recognition of influential scholars and their contributions, leading to role models for aspiring researchers. Understanding the global research landscape highlights prominent countries in the field, encouraging collaboration and knowledge exchange. Examining highly cited papers reveals key research themes and trends, driving theoretical advancements in consumer behavior, particularly in F&NL contexts. This knowledge informs evidence-based policy-making and food marketing strategies to promote healthier and sustainable food choices. Additionally, it addresses global nutrition challenges, such as obesity and food insecurity, by developing targeted interventions. The analysis fosters collaboration and networking opportunities, facilitating interdisciplinary approaches to tackle complex F&NL issues. Ultimately, these implications contribute to improved public health, sustainable practices, and informed consumer decisions on a global scale.

The study addresses the research gap in consumer behaviour within the F&NL field by utilizing bibliometric and network analysis to map its intellectual structure. By identifying the prominent theories employed in F&NL research, including the Theory of Planned Behaviour, Social Cognitive Theory, and Health Belief Model, the study contributes significantly to understanding consumer behaviour in this domain. Furthermore, the findings create new avenues for future research, encouraging the integration of multiple theories to explore more comprehensive frameworks and innovative approaches. This interdisciplinary perspective can potentially uncover previously unexplored factors influencing consumer behaviour towards

F&NL, leading to more effective strategies for consumer protection, purchase decisions, and adherence to health policy regulations. Ultimately, the study's theoretical implications facilitate progress in the field, advancing academic research and practical applications in consumer behaviour within F&NL.In summary, the findings of this bibliometric analysis have important implications for policymakers, marketers, and researchers interested in promoting healthy food choices among consumers. By understanding the factors influencing consumer behaviour towards F&NL, stakeholders can develop effective strategies to promote healthier food choices and improve public health outcomes.

7.2. Limitations & directions for future research

In this study, we relied on a single database (Scopus) for our literature search. The results may be slightly dissimilar if a different database or a collection of databases is used to obtain meaningful data. Packaging performs a crucial function in sales by encouraging customers to be nutrient aware during product purchases. In the future, researchers can conduct a comparative study to explore and compare different types of labelling to evaluate various factors, such as using color, typography, and imagery in packaging and labelling designs. Through this comparative analysis, researchers may identify the best packaging and nutrition labelling practices that can be applied to various industries to enhance consumer comprehension and promote informed decision-making. The label format (e.g., health star label, multiple traffic light label, Nutri score) has been the center of public health attention. However, regulatory authorities must also consider the legal framework (voluntary /mandatory), the foods covered, food scoring, and labels highlighting and promoting transparency throughout the policymaking process. Future studies can optimize life cycle assessments for labelling certification (raw material extraction, manufacturing & processing, waste disposal), improve labelling visualization for more effective communication, and standardize ecological labels (environmental choice, green seal, etc.) to promote sustainable consumption. Further exploration is needed to understand the impact of emerging technologies, such as blockchain and smart packaging, on F&NL and consumer behaviour. Investigating the effectiveness of these technologies in enhancing transparency, trust, and information accessibility for consumers can provide valuable insights for policymakers and industry stakeholders. Next, there is a need to examine the influence of cultural factors on consumers' interpretation and response to F&NL. Exploring how cultural backgrounds shape individuals' understanding and decision-making processes regarding food labelling can help design more targeted and effective labelling strategies that cater to diverse consumer populations. Moreover,

given the growing concern over sustainable food consumption, future research should delve into the role of F&NL in promoting sustainable food choices and reducing food waste.

Examining how online reviews, social media influencers, and e-commerce platforms interact with labelling information and influence consumer choices can provide valuable insights for adapting and optimizing labelling strategies for the digital era. Addressing these future research directions can contribute to a more comprehensive understanding of the dynamics between F&NL, consumer behaviour, and societal challenges, enabling the development of more impactful and consumer-centric food labelling strategies.

The analysis of keyword clusters in F&NL research pertaining to consumer behavior reveals several key insights. Firstly, the identified clusters underscore the diverse and multidisciplinary nature of F&NL research, illustrating the intricate web of factors influencing food choices— from psychological elements to sustainability and health considerations. Secondly, notable themes such as the constructs of the theory of planned behavior, sustainable food consumption, and food waste reduction come to the fore, highlighting the growing significance of addressing sustainability and health-related behaviors in the context of food consumption. Lastly, the global impact of highly cited research emphasizes the universal relevance of F&NL research on consumer behavior, underscoring the need for studies that account for cultural nuances and regional variations in food consumption trends. The analysis of clusters and research themes suggests several future research directions. These include fostering interdisciplinary approaches that incorporate psychology, marketing, public health, and sustainability studies to comprehensively grasp food and nutrition-related consumer behavior across social, cultural, and environmental dimensions. Longitudinal studies can illuminate evolving attitudes and behaviors over time, while investigating cultural and regional disparities can inform targeted interventions.

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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