HEALTH POLICY TOWARDS OBESITY HAS AN IMPACT ON NON-COMMUNICABLE DISEASES (NCDS) OVER THE LAST 10 YEARS: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

The prevalence of obesity has significantly increased, affecting millions of people worldwide. Obesity is a growing public health concern worldwide. According to the statistical data, millions of individuals were classified as obese. Policy plays a crucial role as a macro-level factor in shaping behavioral changes. This study aimed to analyze global trends in health policy research on obesity and its impact on Non-Communicable Diseases (NCDs) from a bibliometric perspective using Scopus-indexed documents. Data analysis methods and visualization techniques were applied to publications from 2014 to 2023 using the keywords (overweight OR obesity OR obes* OR over$weight) AND (health AND (policy OR regulation OR procedure OR system) AND ncd*). RStudio and VOSviewer were utilized for bibliometric publication statistical analysis, resulting in 132 publications from the Scopus metadata. We used bibliometric analysis to examine the published literature and visualize development trends regarding the effects of health policies on obesity. These findings indicate that health policies related to obesity focus on the mechanisms that affect NCDs. The identified policies included taxes on unhealthy foods and food subsidies. Health policies play a crucial role in preventing obesity and reducing its impact on NCDs. Collaboration between the government and various sectors of society is necessary to implement effective policies for the prevention of obesity. Future policies are expected to be adopted by each country regarding unhealthy food tax policies, food subsidy policies, Early Care and Education (ECE) policies, and Health in All Policies (HiAP). This study provides additional information regarding health policies related to obesity research trends.

Keywords *bibliometric analysis, health policy, ncds, obesity, prevention*

INTRODUCTION

The World Health Organization (WHO) has stated that obesity is a major public health problem and has become a global epidemic. Obesity is a complex, multifactorial disease defined as the accumulation of abnormal or excessive fat that poses a health risk. In general, the standard prevalence of obesity in adults aged >18 years is that a BMI >25 kg/m^2 is considered overweight and >30 kg/m^2 is considered obese. The increasing obesity trend has occurred from 1990 to 2022, with 2.5 billion adults over 18 years overweight and 890 million people overweight. The prevalence of obesity has also increased by 6% globally in children and adolescents aged 5 -19 years, from 2% in 1990 to 8% in 2022 (World Health Organization, 2023).

Over the last four decades, the prevalence of obesity has significantly increased. By 2030, it is estimated that the majority of the world's adult population will be overweight and obese. This problem contributes to the global burden of chronic diseases, with serious psychological and social implications that affect all ages and economic groups (Omer, 2020). Globally, there has been an increase in obesity since 2000, 2010, and 2022, with prevalence rates of 8.74%, 11.5%, and 15.8%, respectively (Micha, 2022). Obesity is closely related to the incidence of non-communicable diseases (NCDs), which are chronic and not usually transmitted between individuals, such as heart disease, type 2 diabetes, chronic respiratory diseases, and several types of cancer. Obesity, which is associated with significant excess

fat in the body, is one of the main factors in the development of noncommunicable diseases (Peng et al., 2024).

Obesity is driving a double nutritional burden in most countries. Access to nutritious food is needed to overcome the burden of being underweight or overweight through nutritional transition (Phelps et al., 2024). Obesity is a major challenge for increasing the risk of non-communicable diseases such as type 2 diabetes mellitus, cardiovascular disease (stroke and mainly heart disease), osteoarthritis, and several types of cancer. These impacts contribute to quality and expectancy of life. Obesity is often associated with unemployment, social disadvantages, and reduced economic productivity, which have an impact on the economic burden (Ri et al., 2018).

Health policies include various choices, outcomes, and actions taken by the government and health service organizations to regulate, direct, or influence the health system in a country or region (Bombak, 2014). Thus, health policies play an important role in addressing obesity. Appropriate health policies can help encourage behavioral change, encourage an environment that supports healthy lifestyles, and increase access to obesity-related health services related to obesity (Bauvin et al., 2024). The relationship between health policy systems and obesity is very close, and strategies to prevent and control obesity are a public health problem. The health policy system acts as a framework and guideline that directs the actions of the community, government, and health institutions to deal with obesity through various structured and integrated interventions (Balasundaram & Daley, 2025). Lifestyle changes to prevent complications and their development require identification of risk factors. The importance of public policy strategies and dietary guidelines for addressing obesity needs to be underscored. Bibliometric and visual analyses provide insights into research trends, influential publications, and collaborative networks, helping shape future directions to address these issues (Balasundaram & Daley, 2025).

Bibliometric analysis is a quantitative technique that assesses the influence and relationships between publications in a particular field of study using mathematical and statistical methods (Ellegaard O, 2015). The benefit of bibliometric analysis is that it provides a broad and effective overview in identifying research, authors, journals, research organizations, and countries. It is efficient to analyze a large amount of academic literature. Bibliometric analysis of health and obesity policies can be carried out using various bibliometric tools and databases (Kawuki et al., 2021) The search strategy for which involves keeping the database for items containing "obesity" and "policy" as subject terms, such as in the title, abstract, or keywords. This will help to identify articles, conference proceedings, and other publications that focus on obesity-related health policies (Ellegaard & Wallin, 2015).

The analysis then involves extracting relevant data, such as the number of publications, institution, country of origin, journal, citation metrics, and co-occurrence networks. This data can be visualized using various tools, such as co-author networks, thematic maps, and journal citation networks, The results may provide insight into the growth and distribution of research on health policy and obesity, as well as patterns of collaboration and research centers in this area (Kiss et al., 2020).

Therefore, this study aims to analyze trends in health policy research on the incidence of obesity, which has an impact on non-communicable diseases at the global level, through a bibliometric perspective using documents indexed in the Scopus database. This study provides useful insights and information for the government, policymakers, health workers, media, academics, corporate researchers, and the entire community regarding health policies to control the incidence of obesity.

METHODS

a. Study Design

This research was aimed at understanding the trends, assessing collaboration networks, evaluating policy effectiveness, and identifying the major components of research related to obesity and NCDs in the last 10 years. .Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were first used in this research to analyze and systematically review the articles.

b. Data Sources

This study uses the Scopus database, which was accessed on April 20, 2024. This study does not require ethical clearance because it uses a public database, and so does not entail interaction or intervention with animal or human participants.

c. Data Analysis

This study used the following search terms: (TITLE-ABS-KEY ((overweight OR obesity OR obes* OR over$weight)) AND TITLE-ABS-KEY (health AND (policy OR regulation OR procedure OR system)) AND TITLE-ABS-KEY (ncd*)) AND PUBYEAR > 2013 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA, "MEDI") OR LIMIT-TO (SUBJAREA, "NURS") OR LIMIT-TO (SUBJAREA, "BIOC") OR LIMIT-TO (SUBJAREA, "AGRI") OR LIMIT-TO (SUBJAREA, "MULT") OR LIMIT-TO (SUBJAREA, "HEAL") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "PHAR") OR LIMIT-TO (SUBJAREA, "ENVI")) AND (LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "re") OR LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")).

The results obtained were 132 documents, the author determined documents that had been published in the last 10 years between 2014 - 2023 (n=109), then only included documents with a subject area in the form of Medicine; Genetics and Molecular Biology; Biochemistry, Agricultural and Biological Sciences; Nursing; Multidisciplinary; Social Sciences; Environmental Sciences; Health Professions; and Pharmacology, Toxicology and Pharmaceutics (n=108). It was then filtered again based on the document type article, review, and conference paper (n=106). The overall identification results were limited to research published in English, resulting in 102 articles that were subjected to bibliometric analysis.

d. Data Visualization

All data were exported from Scopus in bib format for further processing using the Blibiometrix application (R Studio version 4.3.3). This software includes the distribution and frequency of keywords, author institutions, document types, productive areas, journals, research fields, journal impact factors, and total citations (TC). The 2019 InCites Journal Citation Reports Ranking was used
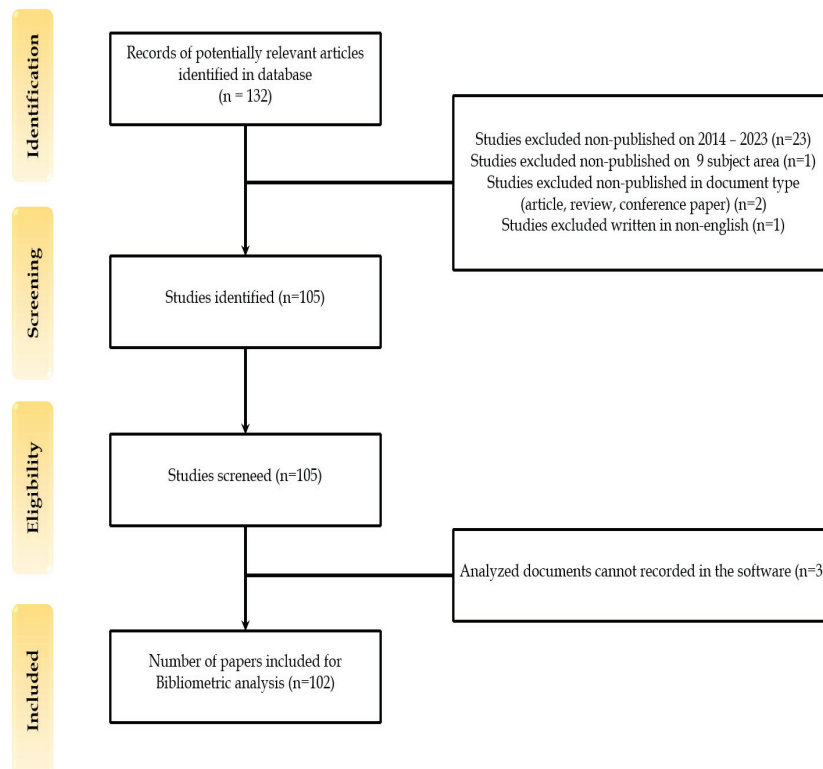

Figure 1.   Flow Chart of PRISMA in Literature Search and Bibliometric Analysis

to determine the impact factor of a journal Citation Reports (JCR) Ranking 2019 is used. In addition, for visualization, mapping and mining data were exported in ris format for data processing using VOSviewer v.1.6.11. The number of studies was calculated based on the year of publication, researcher, journal, country of publication, research area, and research organization. We analyzed the data visualization as follows: the size of the circular dots on the visualized map indicates the number of frequencies or publications, relationships between nodes indicate connectedness, and the distance between nodes indicates the degree of connection.

MS Excel 365 and Windows Text Document (Notepad) software were used in this study. Research trends are obtained based on the number of keywords, average year of publication, number of publications, and citations so that the importance of the research can be determined.

RESULTS AND DISCUSSION

a. Descriptive Analysis

The results of research analysis with the themes raised provide the data presented in Figure 2, that the last 10 years show a decreasing trend in publications related to the themes. However, the number of publications peaked in 2017 followed by a slight decline in 2018. In the last 10 years, the document has been cited on average 3 – 10 times, with a peak in 2020. However, this is not in line with the obesity trend. Obesity has increased globally and is called globesity. Developing and developing countries face a problem, namely, obesity. According to the World Obesity Atlas 2023 data, the percentage of the population experiencing overweight and obesity is 38% and is expected to increase to 51% by 2035. A health policy is an effort to regulate regulations related to obesity prevention. Health policies for obesity prevention should focus on regulating food marketing, promoting healthy eating patterns and physical activity, strengthening health systems, and creating supportive environments. These policies are designed to address obesity as a complex, multifactorial chronic disease influenced by environmental, social, and behavioral factors (CDC, 2024; Temple, 2023; WHO, 2023, 2025).

Table 1 presents the number of publications in the top ten research areas. Based on subject area, medicine (79.41%) was the leading field in this research theme. This was followed by biochemistry, genetics, molecular biology, and nursing, which had the same records (13.73%). Engineering had the lowest percentage (1.96%). Obesity is a pathophysiological mechanism; therefore, it is not far from the scope of discussion in the fields of biochemistry, genetics, and molecular energy that have the highest percentage (Sikaris, 2004; Tirthani et al., 2024; Zamanian-Azodi et al., 2013).

Based on Table 2, the results of analyzing papers by journal showed that BMJ Open (5.88%), Plos One (4.90%), BMC Public Health (2.94%), Obesity Reviews (2.94%), and Reproductive Biology and Endocrinology (2.94%) had the highest number of published papers. In this analysis, 80 journals published research themes. Based on the ranking of journal publications on the topic, on average, the top 10 journals had the same journal production. In addition to the number of publications, Table 2 presents the 2019 Journal Citation Reports (JCR) to identify the impact factors.

Fifteen countries have published two or more papers were 15 countries. The country is the main author of this study. The United Kingdom published the most articles (13.73%), followed by the USA (10.78%), India (8.82%), Australia (7.84%), and South Africa (6.86%). Thirty countries were involved in the results of this analysis is 30 (Table 3).

Table 1. Distribution by Research Area

Ranking	Subject area	Records (n)	% (of 102)
1	Medicine	81	79.41
2	Biochemistry, Genetics and Molecular Biology	14	13.73
2	Nursing	14	13.73
4	Agricultural and Biological Sciences	8	7.84
5	Multidisciplinary	7	6.86
5	Social Sciences	7	6.86
7	Health Professions	6	5.88
8	Environmental Science	5	4.90
8	Pharmacology, Toxicology and Pharmaceutics	5	4.90
10	Engineering	2	1.96

Table 2. Distribution by Journal

Ranking	Journal Title	Records (n)	% (of 102)	Impact factor*
1	BMJ Open	6	5.88	2.49
2	Plos One	5	4.90	2.74
3	BMC Public Health	3	2.94	2.52
3	Obesity Reviews	3	2.94	7.31
3	Reproductive Biology and Endocrinology	3	2.94	3.23
6	Current Pharmaceutical Design	2	1.96	2.2
6	Nutrients	2	1.96	4.54
6	Physical Therapy	2	1.96	3.14
9	African Health Sciences	1	0.98	0.69
9	American Journal of Cardiology	1	0.98	2.57

*Journal Citation Reports (JCR) 2019 was used as a basic reference

Table 3. Distribution by Country

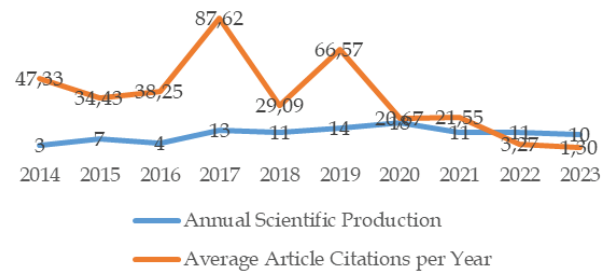| Ranking	Country	Records (n)	% (of 102)
1	United kingdom	14	13.73
2	USA	11	10.78
3	India	9	8.82
4	Australia	8	7.84
5	South africa	7	6.86
6	China	6	5.88
6	Italy	6	5.88
8	Brazil	3	2.94
9	Canada	2	1.96
9	Chile	2	1.96
9	Ethiopia	2	1.96
9	Hong Kong	2	1.96
9	Japan	2	1.96
9	Nigeria	2	1.96
9	Spain	2	1.96

Figure 2. The Annual Publication and Citation Growth Trend of Health Policy Toward Obesity and NCDs-Based Research

b. Most Influential Journals

Figure 3 and Table 4 present the growth of sources for the ten most productive journals on health policy with obesity issues from 2014 to 2023. In the last 10 years, the highest number for the most productive journal was BMJ Open, followed by Plos One.

The first cluster, ranked based on the Hirsch index (H-index), is presented in Figure 3 and measures citation influence and publication productivity. Although other authors have widely used a variety of disciplines to assess source impact factors, this index primarily draws attention to an author's performance in a particular field. Therefore, journal performance factors can be used to identify the importance of journals.

Figure 4a present the trend most productive journals for Obesity articles. BMJ Open has the highest number of publications (6) according to bibliometric analysis for 2014-2023, followed by Plos One and International Journal of Environmental Research and Public Health.

Figure 4b-d present the top 10 reference publications with the research topic obesity are displayed. Based on bibliometric data, BMJ Open has the largest h-index (4) and g-index (6), BMC public health has the largest m-index (0.5), and the one with the largest total citations is The Lancet. These three journals make it the most influential publication globally.
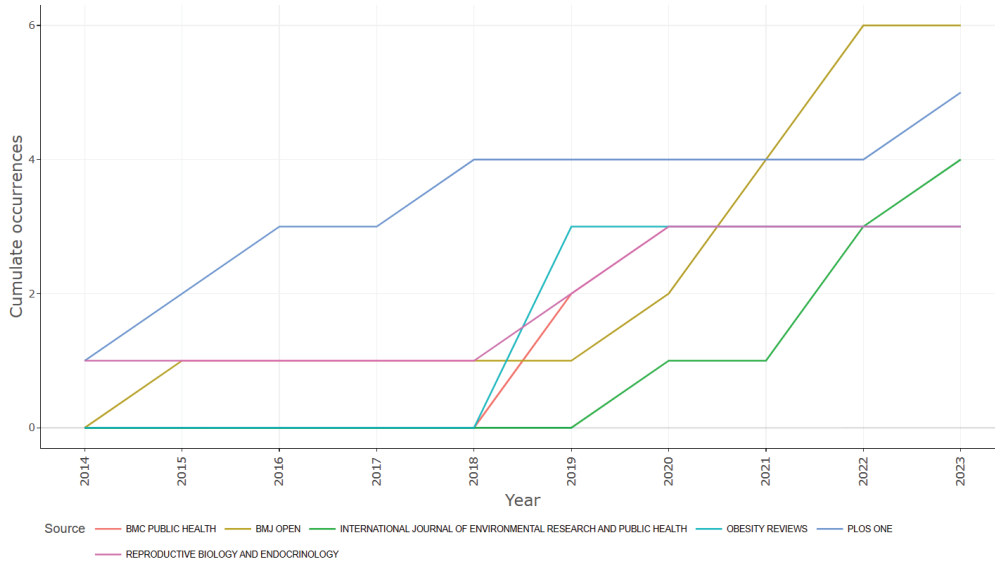
Figure 3. Nuclear Zone 1 Showing The Source Growth of The 10 Most Productive Journals on Health Policy with Obesity Issues from 2014 – 2023

Table 4. First Cluster (Nuclear Zone)

| Element	h_index	g_index	m_index	TC	NP	PY_start
BMJ Open	4	6	0.4	58	6	2015
Plos One	4	5	0.364	195	5	2014
BMC Public Health	3	3	0.5	64	3	2019
Obesity Reviews	3	3	0.5	206	3	2019
Reproductive Biology and Endocrinology	3	3	0.273	140	3	2014
Current Pharmaceutical Design	2	2	0.222	12	2	2016
Nutrients	2	2	0.4	63	2	2020
Physical Therapy	2	2	0.333	60	2	2019
African Health Sciences	1	1	0.25	5	1	2021
American Journal of Cardiology	1	1	0.125	2	1	2017

Note: TC, total citations (TC), number of publications (NP), Publication Year (PY)

(a)

(b)

(c)

(d)

(e)
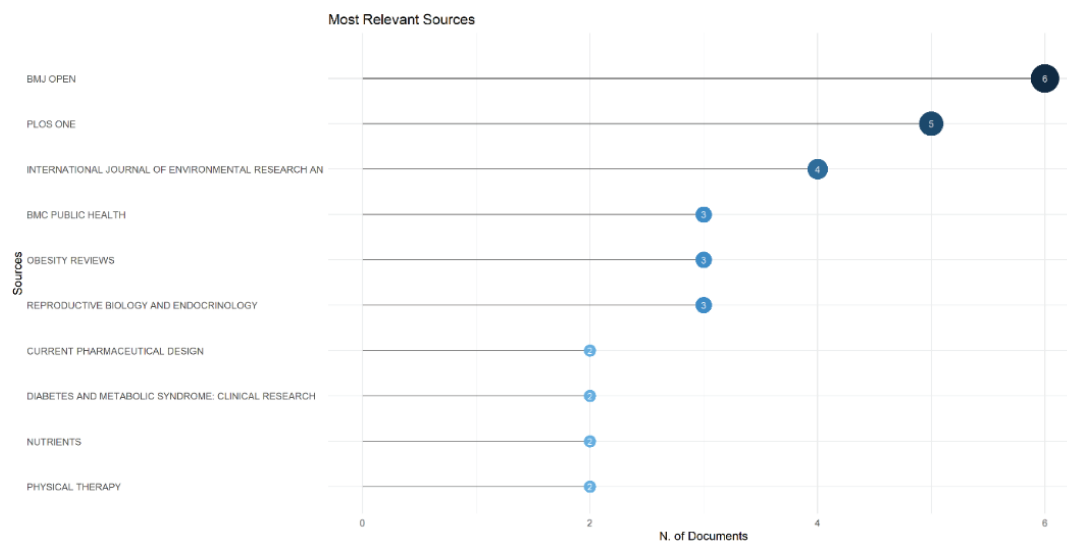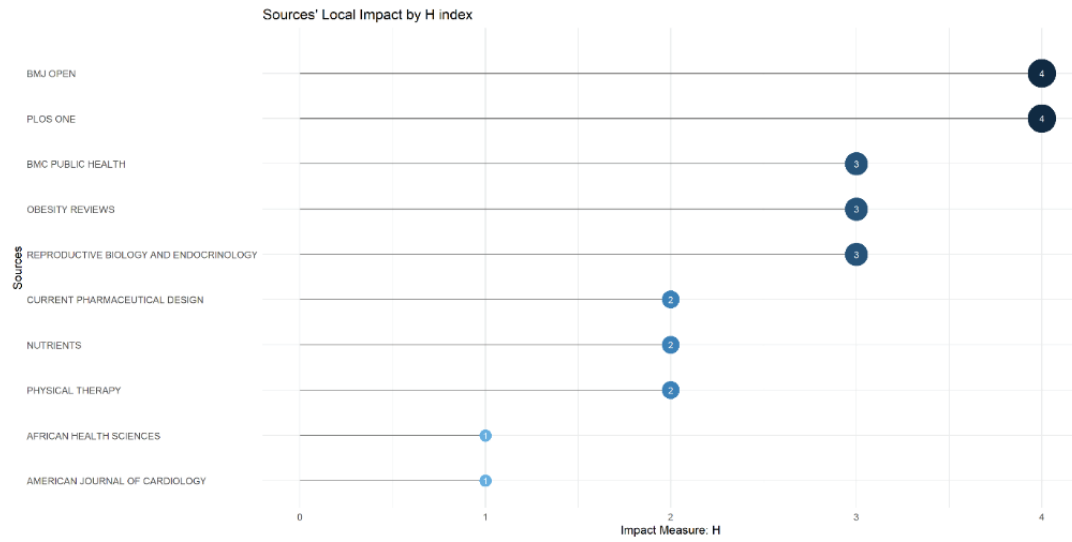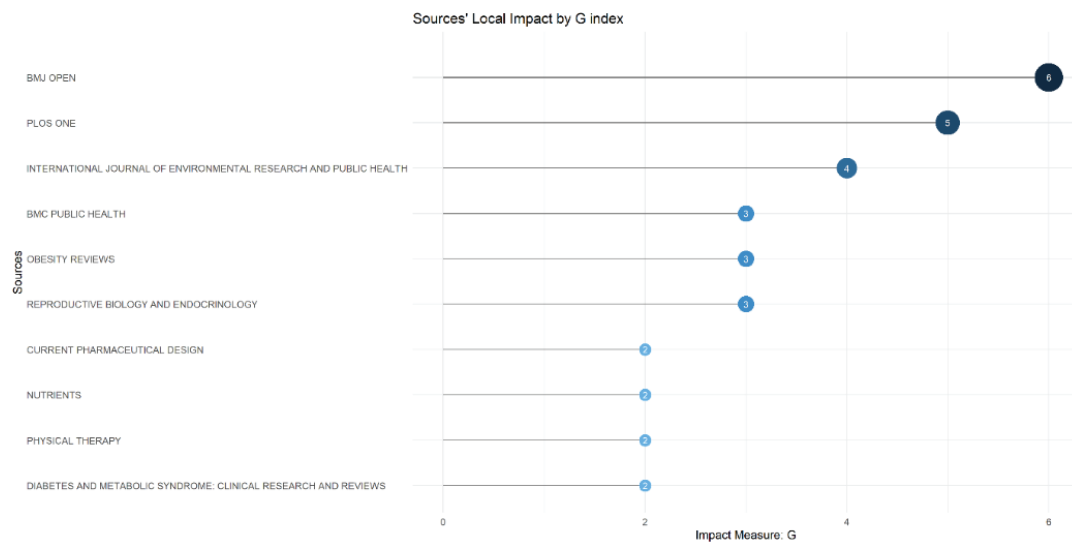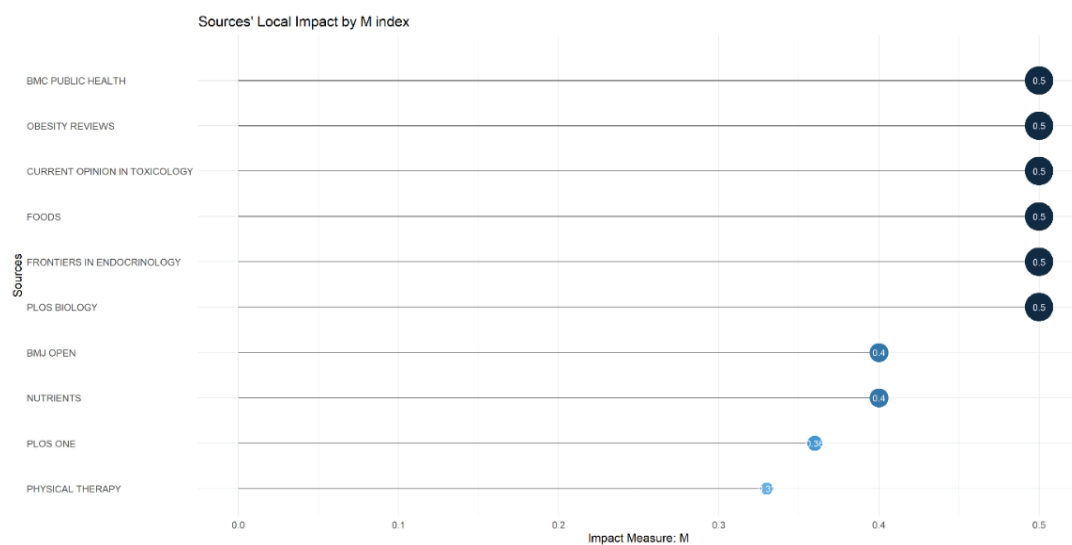
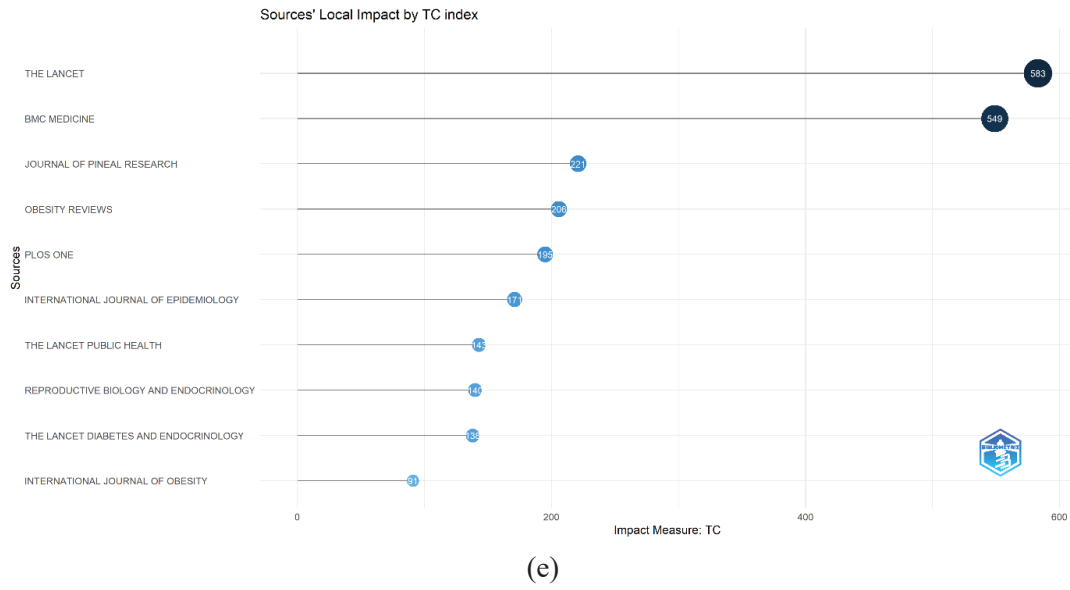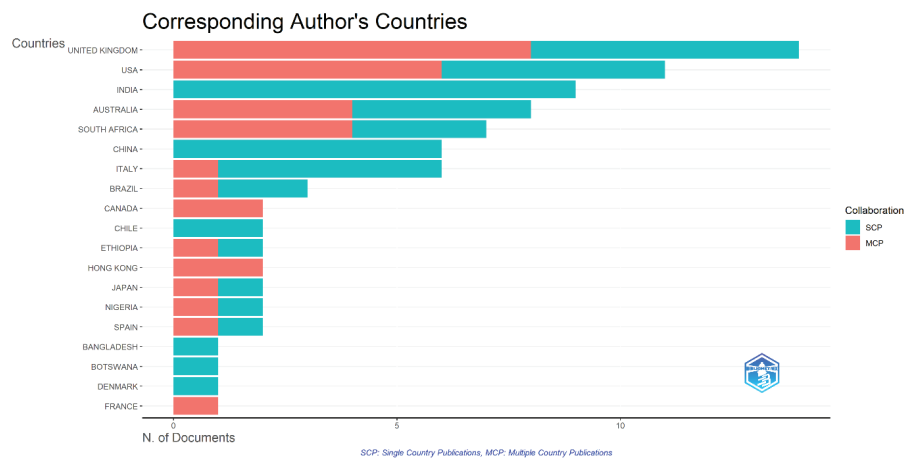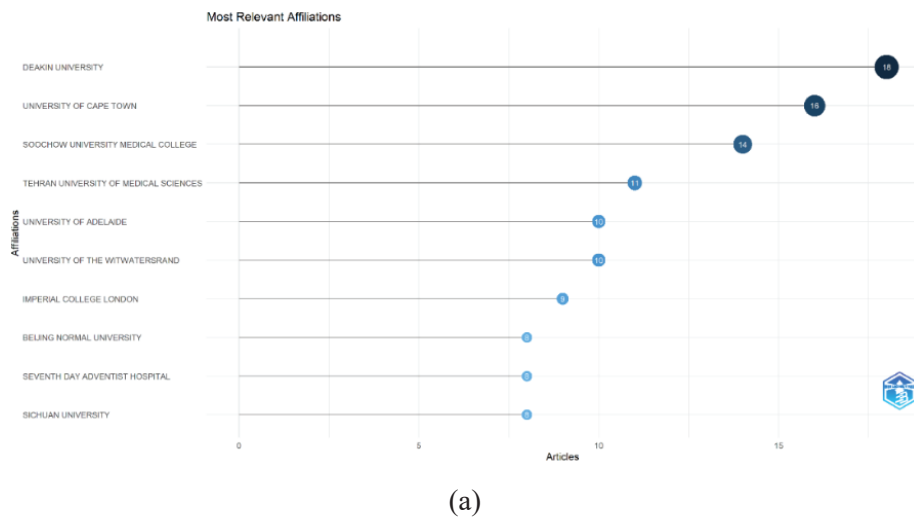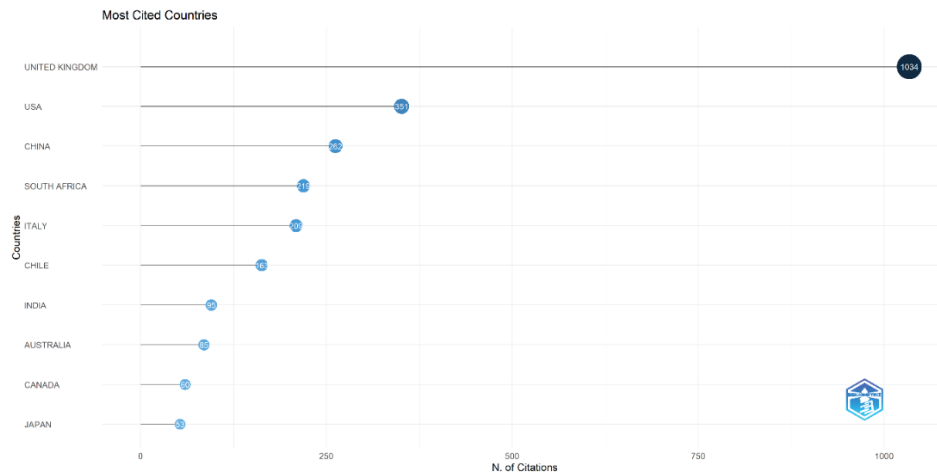**Figure 4.**   Source Analysis (a) Most Relevant Sources; (b) Source Local Impact by H-Index; (c) Source Local Impact by G—Index; (d) Source Local Impact by M—Index; (e) Source Local Impact by Total Citations (TC) Index

c.   Authors

(a)

(b)

(c)

Figure 5. Network Analysis for Co-Authorship And Countries ; (a) Most Relevant Affiliations; (b) Countries of Leading Correspond Authors; (c) Global Trends of The Most Cited Countries on Publications Health Policy with Obesity Issues

The top authors from 2014 to 2023 are shown in Figure 5a. It presents the top two authors who have published widely between 2014-2023 and have the most series of contributions are Al Salmi and Hannawi. This is based on the writer's productivity over time: As shown in Figure 5b, this study also examined publications produced by organizations or author affiliations that support obesity-based research. Deakin University topped the list with 18 documents.

This study also considers the publication output of the corresponding author's country and active involvement in obesity-based research, which can be seen in Figure 5c, with the first highest country being the United Kingdom and the second being the USA. The top two countries had the same scores as the global trend. The countries most cited in health policy publications related to the problem of obesity are the UK (1034) and the second one is USA (351) (Figure 5d).

Table 5 presents a list of the top 10 total citation countries, with the UK having the highest Total Article Citations (TAC). Thus, articles from the United Kingdom were the best in terms of average quality. The countries with the largest average article citations (AAC) are Chile (81.50 AAC), the United Kingdom (73.90 AAC), China (43.70 AAC), and Canada (34.80), which have the highest number of articles and relatively fewer, but the average number of article citations is quite high (30.00).

Table 5. Contributions of The Top 10 Countries to The Total Citations

Country	TC	Average Article Citations	Number of Article
UK	1034	73.90	67
USA	351	31.90	78
China	262	43.70	60
South Africa	219	31.30	52
Italy	209	34.80	35
Chile	163	81.50	12
India	95	10.60	44
Australia	85	10.60	58
Canada	60	30.00	4
Japan	53	26.50	20

d. Analysis of Documents

Citation trends in health policy literature related to the incidence of obesity are very important for understanding the progress of research streams and gaps. Table 6 and Figure 6a present the top 20 most cited documents. The burden of disease due to NCD has become a more specific health plan for each country, especially for policy makers (Dandona et al., 2017). The emergence of an obesity epidemic due to reduced physical activity and changes in the food system has impacted the implementation of effective programs and policies in various sectors. This is supported by the government, private companies, key stakeholders, and civil society

(Di Cesare et al., 2019). This shows that health policies need to be designed and implemented by each country to prevent obesity, which has an impact on NCD. Figure 6b presents data on the most cited documents locally with a discussion of the NCD prevention and control policy plans. Figure 6c presents data on 102 documents that have been cited with 5.811 citations, with the number of citations reaching its peak in 2015 (482 citations).

Most Global Cited Documents

(a)

Most Local Cited References

(b)

Reference Publication Year Spectroscopy

(c)
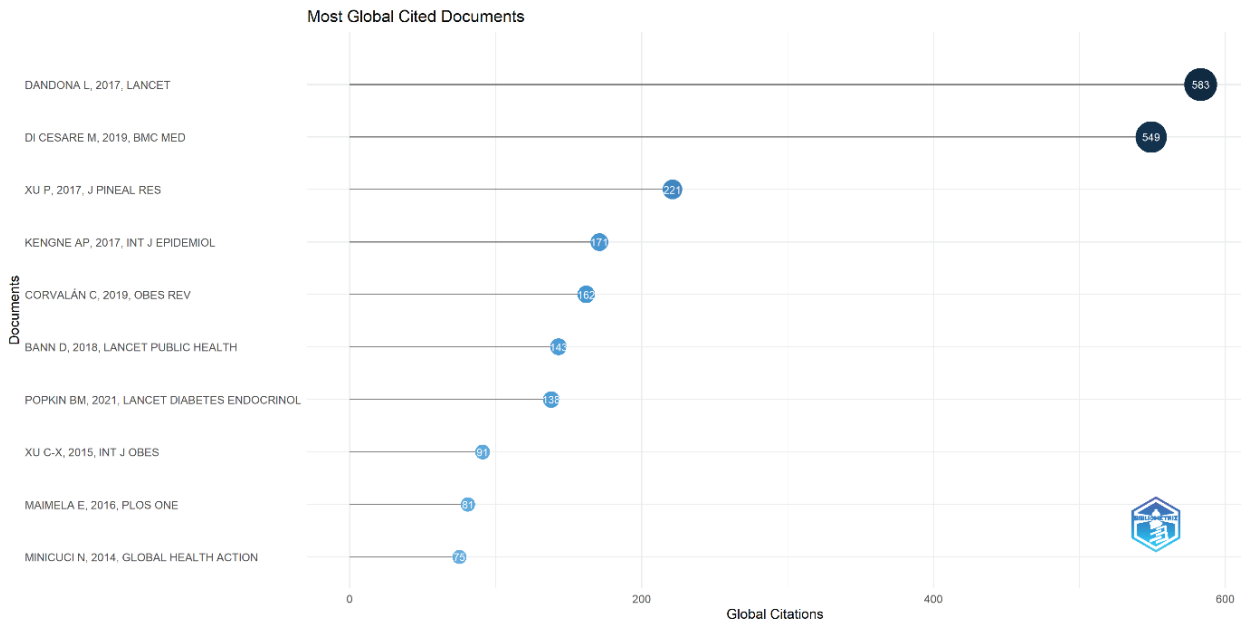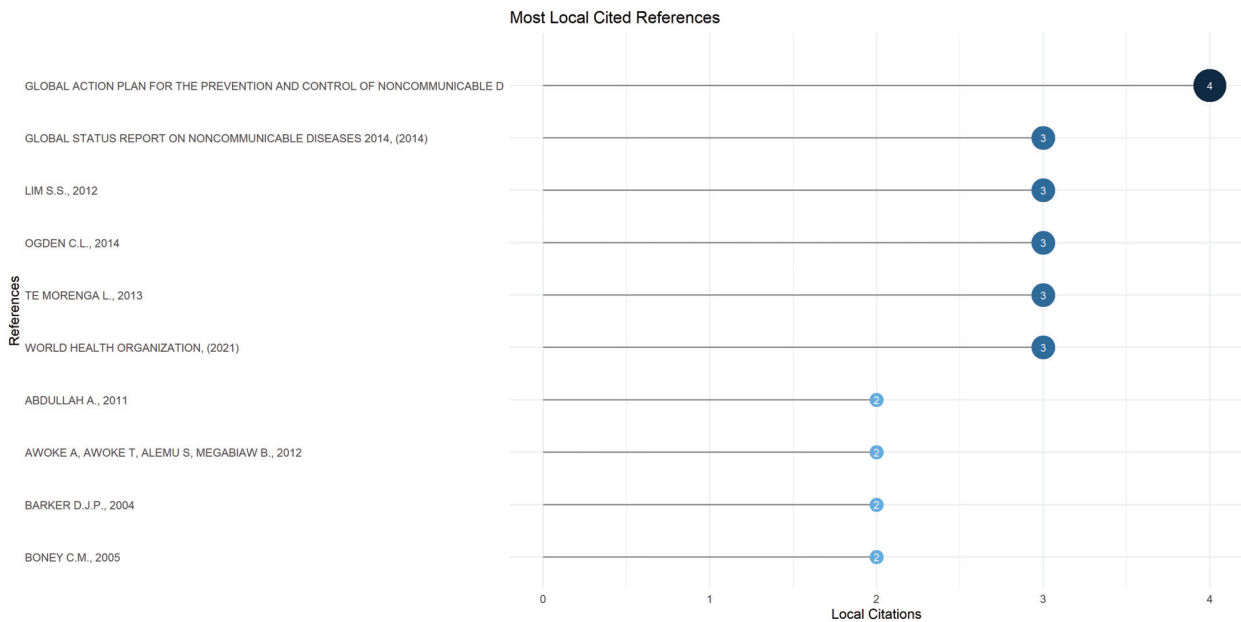
Figure 6.   Documents citation (a) Top 10 Most Global Cited Documents; (b) Top 10 Most Local Cited References; (c) Reference Publication Year Spectroscopy (RPYS)

Table 6. Top 10 Most Global Cited Documents

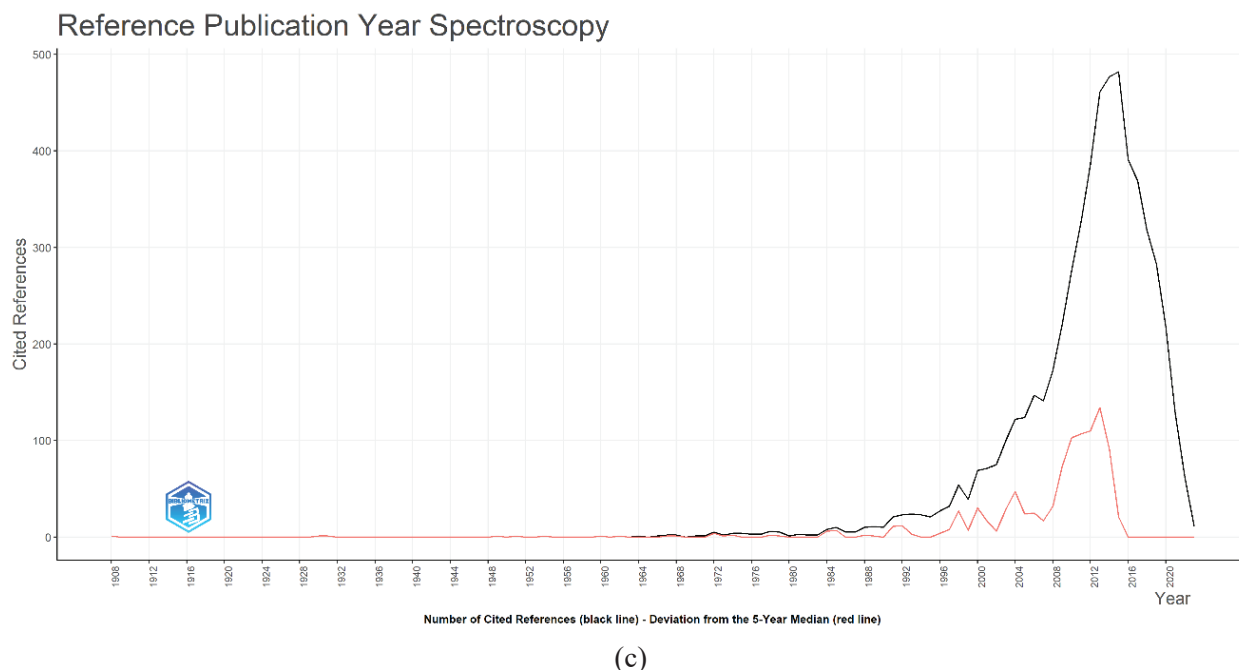| Paper	DOI	Total Citations	TC per Year	Normalized TC
DANDONA L, 2017, LANCET	10.1016/S0140-6736(17)32804-0	583	72.88	6.65
DI CESARE M, 2019, BMC MED	10.1186/s12916-019-1449-8	549	91.50	8.25
XU P, 2017, J PINEAL RES	10.1111/jpi.12399	221	27.63	2.52
KENGNE AP, 2017, INT J EPIDEMIOL	10.1093/ije/dyx078	171	21.38	1.95
CORVALÁN C, 2019, OBES REV	10.1111/obr.12802	162	27.00	2.43
BANN D, 2018, LANCET PUBLIC HEALTH	10.1016/S2468-2667(18)30045-8	143	20.43	4.92
POPKIN BM, 2021, LANCET DIABETES ENDOCRINOL	10.1016/S2213-8587(21)00078-4	138	34.50	6.41
XU C-X, 2015, INT J OBES	10.1038/ijo.2015.63	91	9.10	2.64
MAIMELA E, 2016, PLOS ONE	10.1371/journal.pone.0147926	81	9.00	2.12
MINICUCI N, 2014, GLOBAL HEALTH ACTION	10.3402/gha.v7.21292	75	6.82	1.58
MOLLAIOLI D, 2020, REPROD BIOL ENDOCRINOL	10.1186/s12958-019-0557-9	72	14.40	3.48
GREY K, 2021, BMJ GLOB HEALTH	10.1136/bmjgh-2020-003161	60	15.00	2.78
LUSTIG RH, 2020, NUTRIENTS	10.3390/nu12113401	55	11.00	2.66
RAWAL LB, 2018, PLOS ONE	10.1371/journal.pone.0205912	54	7.71	1.86
ZHOU Q, 2014, REPROD BIOL ENDOCRINOL	10.1186/1477-7827-12-127	49	4.45	1.04
JACOB CM, 2020, INT J GYNECOL OBSTET	10.1002/ijgo.13331	48	9.60	2.32
RI M, 2015, SURG TODAY	10.1007/s00595-015-1231-2	47	4.70	1.37
SINGHAL A, 2016, PROC NUTR SOC	10.1017/S0029665116000057	46	5.11	1.20
CALCATERRA V, 2020, BIOMOLECULES	10.3390/biom10091324	43	8.60	2.08
MOYNIHAN P, 2018, COMMUNITY DENT ORAL EPIDEMIOL	10.1111/cdoe.12353	42	6.00	1.44

e. Analysis and Co-Occurrence Network of Keywords

(a)

(b)

(c)

(d)

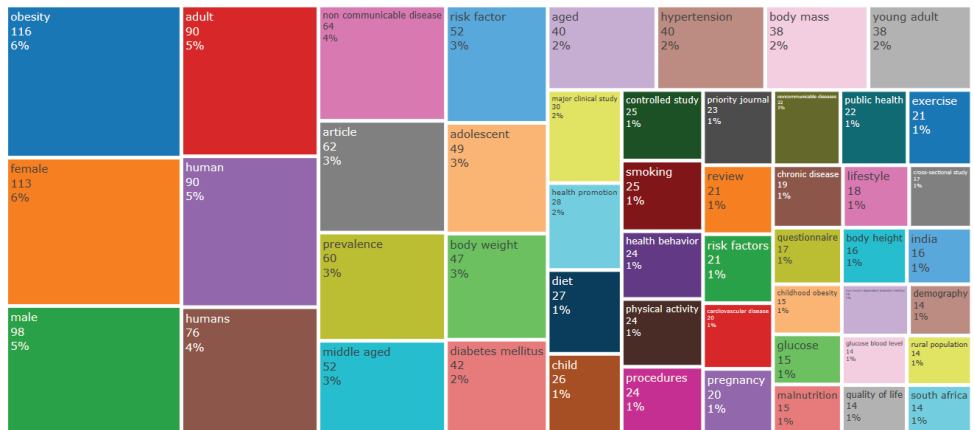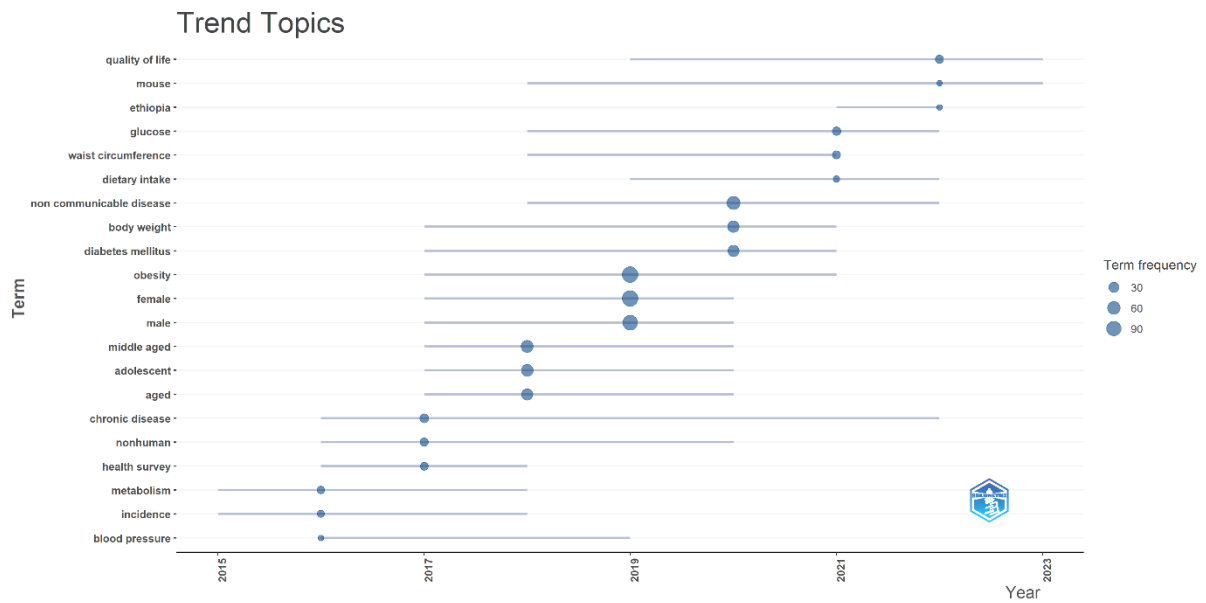**Figure 7.** Analysis and Co-Occurrence Network of Keywords: (a) Top 13 Most Relevant Keywords; (b) Author's Keywords Cloud; (c) One Treemap of Keywords Plus Terms; (d) Trend Topics of The Most Cited Countries on Publications Health Policy with Obesity Issues
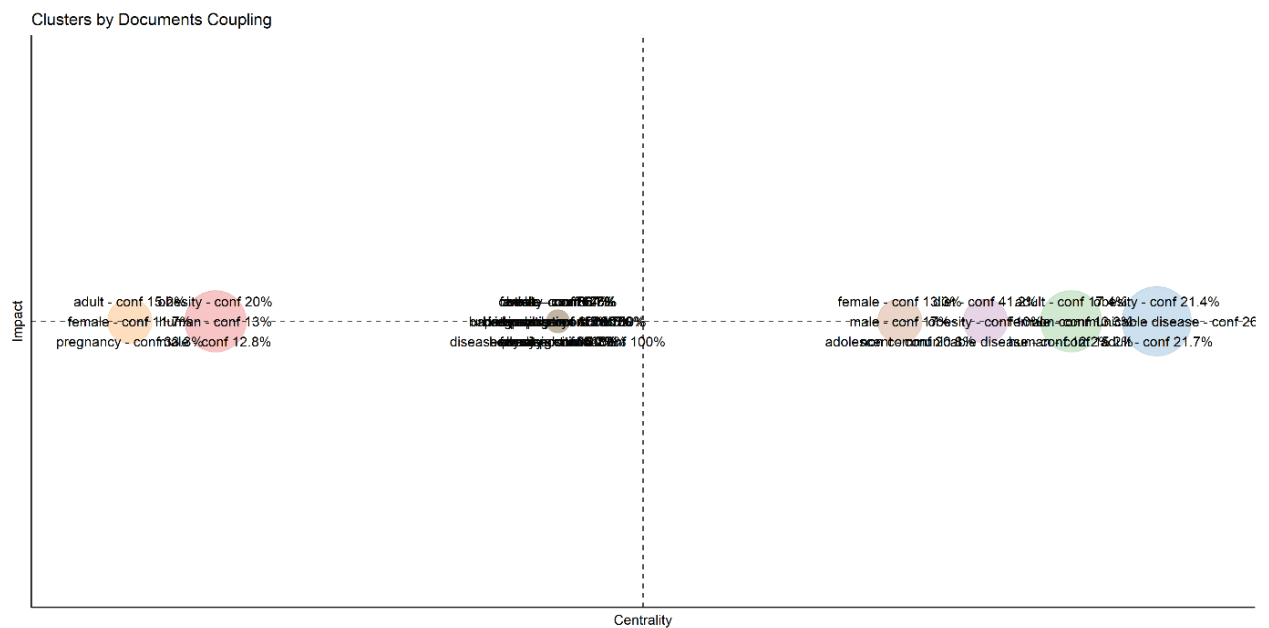
f. Clustering

Figure 8. Clusters by Documents Coupling

a. General Trends on Health Policy with Obesity Issues

A discussion of the data that has been analyzed can be seen in the figures and tables that have been presented. We hope that our findings can complement and become an option for research gaps in health policy on obesity worldwide. More importantly, these findings do not substitute for comprehensive research. If readers are interested, they can explore comparable articles in greater depth.

The topic of health policy, which is carried out as an effort to prevent obesity as a breaker of the chain of NCD events worldwide, is considered very important and an interesting topic. This can be used as a reference by policymakers to determine a healthy lifestyle and environmental system. The results are presented using bibliometric analysis, followed by visualization of data on health policies against obesity. The coverage is generated by journal contributions, authors, institutions, countries of highly cited papers, and keywords. Productivity increased from 2014 to 2018 and decreased until 2023. This finding shows that there are a decreasing number of studies on health policies. This approach shows that the countries involved in discussing this topic, both high- and low-income countries, have discussed the issues of obesity and health policy. In global health policy, there is a gap in the scientific literature, so it is hoped that there will be efforts to disseminate high-quality science throughout the world. This continues to implement a sustainable and distant model for the future by strengthening international expertise in health policy (Ghani et al., 2021). Based on Table 3, the UK is a high-income country that produces the most publications. Public health and health policy literature is dominated by authors and perspectives from high-income countries (United Nations, 2022).

Figure 9a present is a high-income country and produces the most publications. High-income countries dominate the list of authors and perspectives on public health literature and health policy (Figure 9b). Overall, China, the UK and the USA are ranked highest with Imperial College London as a research institution. Based on keywords, 'policy' has not become a trending keyword topic compared to others. This link continues in the journal sources on this topic which include high quality publications.

A thematic map with four quadrants based on theme classification is presented in Figure 10. First, motor themes explain the themes that have been developed and are important to the research field. This is shown in the upper right quadrant. Second, niche themes explain the special themes represented in the cluster in the upper left quadrant. Third, emerging or declining themes are experiencing growth in the form of two discussions. Finally, basic themes explain the transversal, general, and basic aspects of the research field. This quadrant section has not been well developed; therefore, it can be considered a basic research theme.
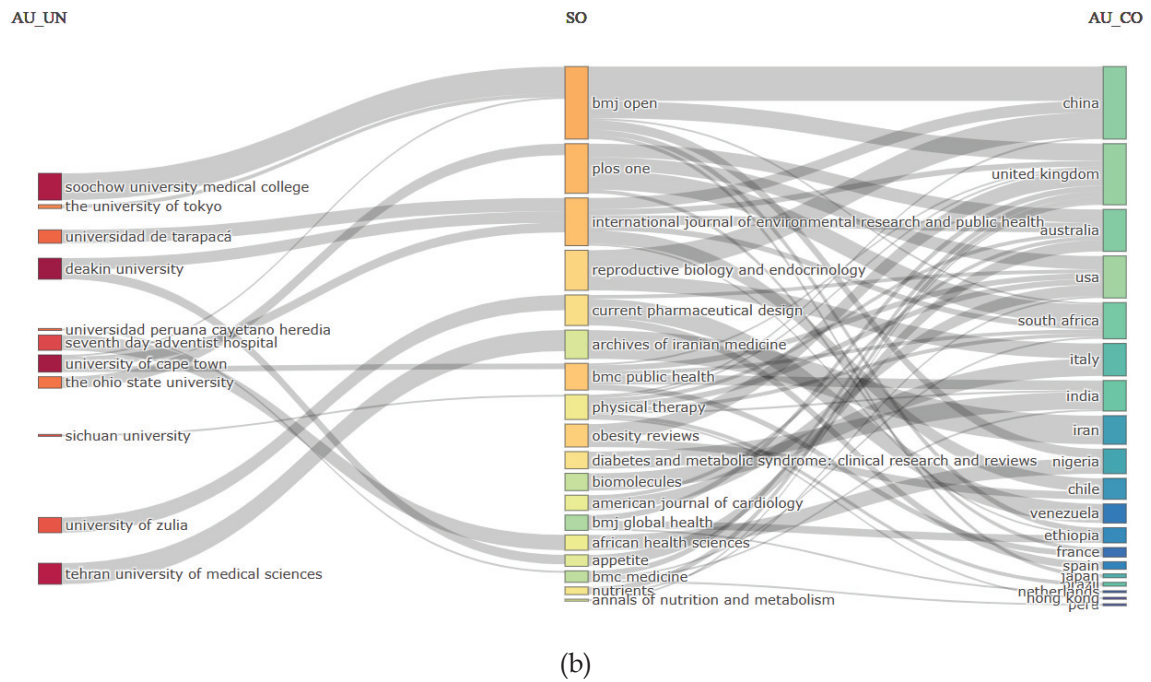

(a)

(b)

Figure 9. Three-Field Plots (a) Countries (AU_CO), Institutions (AU_UN), and Titles (TI_TM); (b) Institutions (AU_UN), Journals (SO), and Countries (AU_CO)
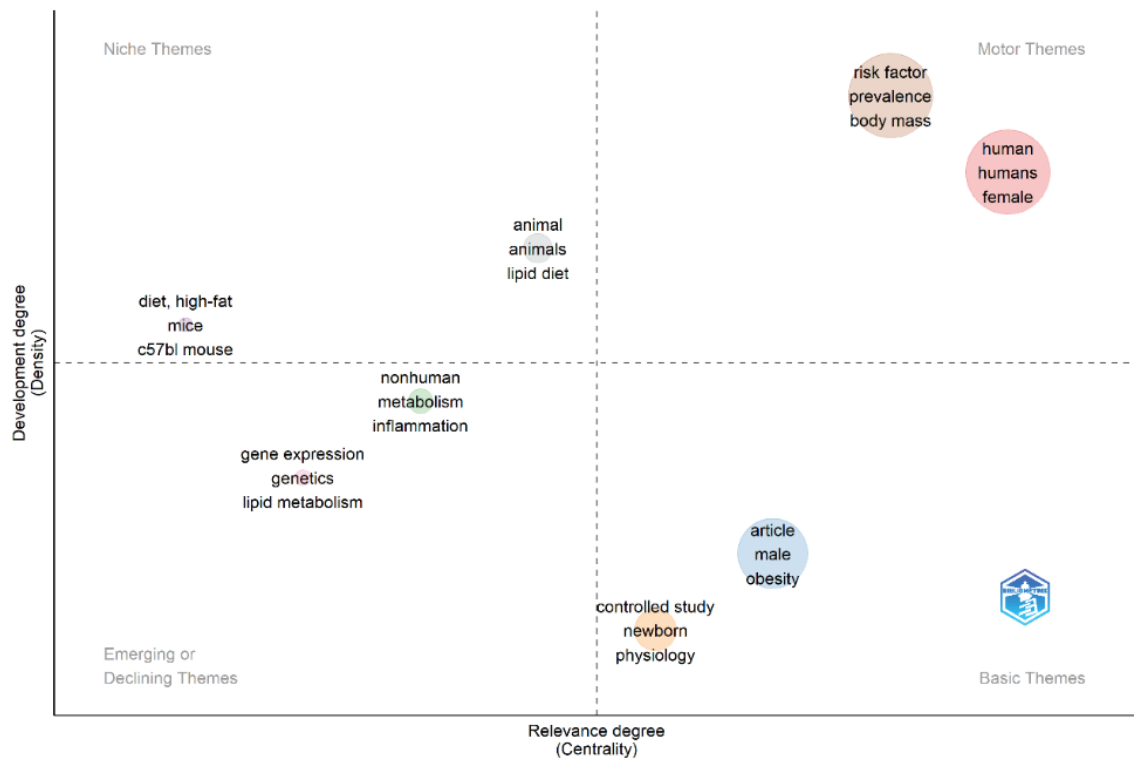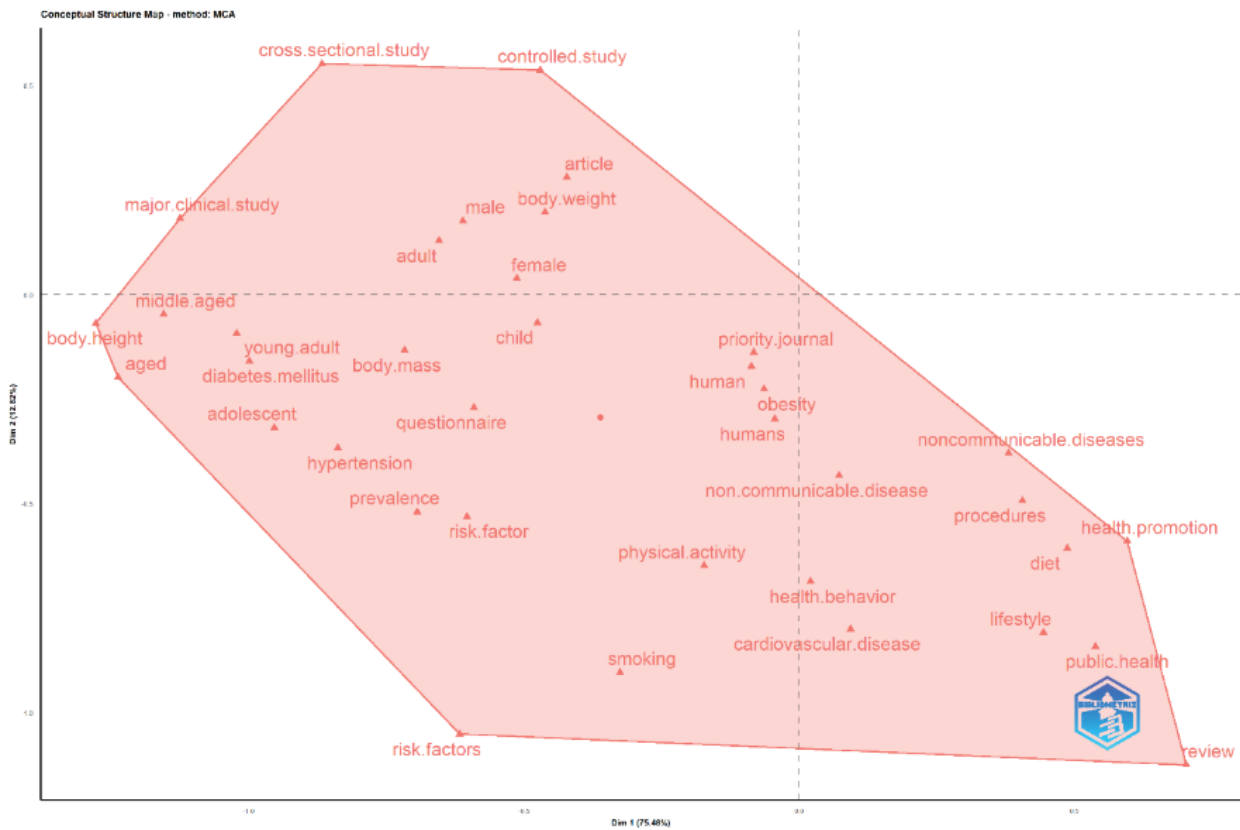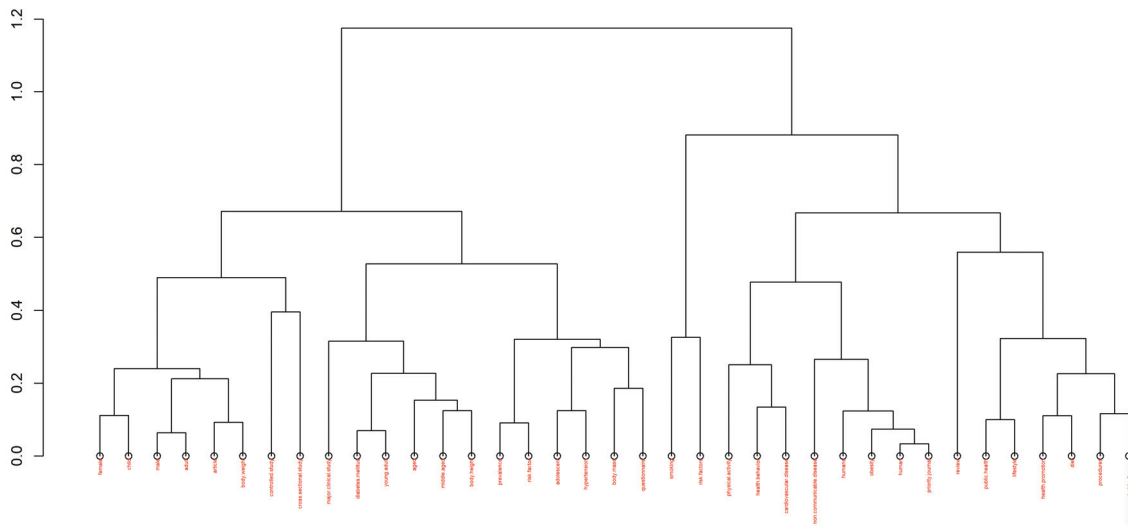

Figure 10. Thematic Map Based Cluster.

b. Conceptual Structure of Factorial Analysis of keywords and Thematic Evolution

(a)

(b)

Figure 11.   Conceptual Structure: (a) Word Map of Factorial Analysis of Author's Keywords Plus using Multiple Correspondence Analysis with and (b) Topic Dendrogram of Word Map of Factorial Analysis of Author's Keywords

Bibliometric analysis using Biblioshiny produces Multiple Correspondence Analysis (MCA) to construct K-means and conceptual groupings of subject areas against groups of publications that have similarities. This is done to analyze words together because new latent variables or factors have been discovered. MCA presents data with points in the Euclidean space (Abafe et al., 2022).

c. Outlook of future research on health policy with obesity issues

From the results in Figure 14a, the data visualization obtained via VosViewer is based on keywords in the Scopus journal. There are three color groups, red, blue, and green, which indicate clusters related to keywords. Each color has a node size in the word visible in the image, representing the weight of each keyword with the largest size. The largest node "ncd" indicates the greatest discussion weight. The word "ncd" is the most commonly used word in research. The strength of the relationship between nodes is reflected by the distance between them. Stronger connections are illustrated in a shorter range.

In the overlay visualization, it is shown that the circle with a dark color indicates that the research is the oldest and the bright image is the newest. Figure 14b shows that the keywords that indicate the old type of research are "physical activity" and "nutrition." The circle with the lightest color indicates that research is still being conducted. Figure 14b shows that the stains are light colored, or the latest research refers to the keywords "policy" and "man" man'. The policy node has many networks connected to other nodes of different colors. The policy nodes in yellow are newly conducted research that shows the relationship between the policy network and man, diet, and life. This research discusses topics related to policy and obesity, but in image visualization, there is no recent research because the obesity node is blue. From the image above, it can be concluded that keywords with lighter colors are classified as a type of research that is still rarely carried out by researchers; therefore, further research is needed.

The visualization in Figure 14c shows that the brighter the colors are, this shows that a lot of research has been carried out regarding that word or topic. The dark blue color or basic color does not contain words and is referred to as a region; further away from the lighter color indicates that there has not been much research on this topic. On the topics of "NCD," "weight" and "obesity" most research is carried out based on the brightest colors.

Figure 12. Co-occurrence network mapping showcasing trendy topics from 2014 - 2023. Classified based on five (5) Word Minimum Frequency and Number of Words per Year (>3 words), with a longer wick signifying the year of word first and last occurrence.
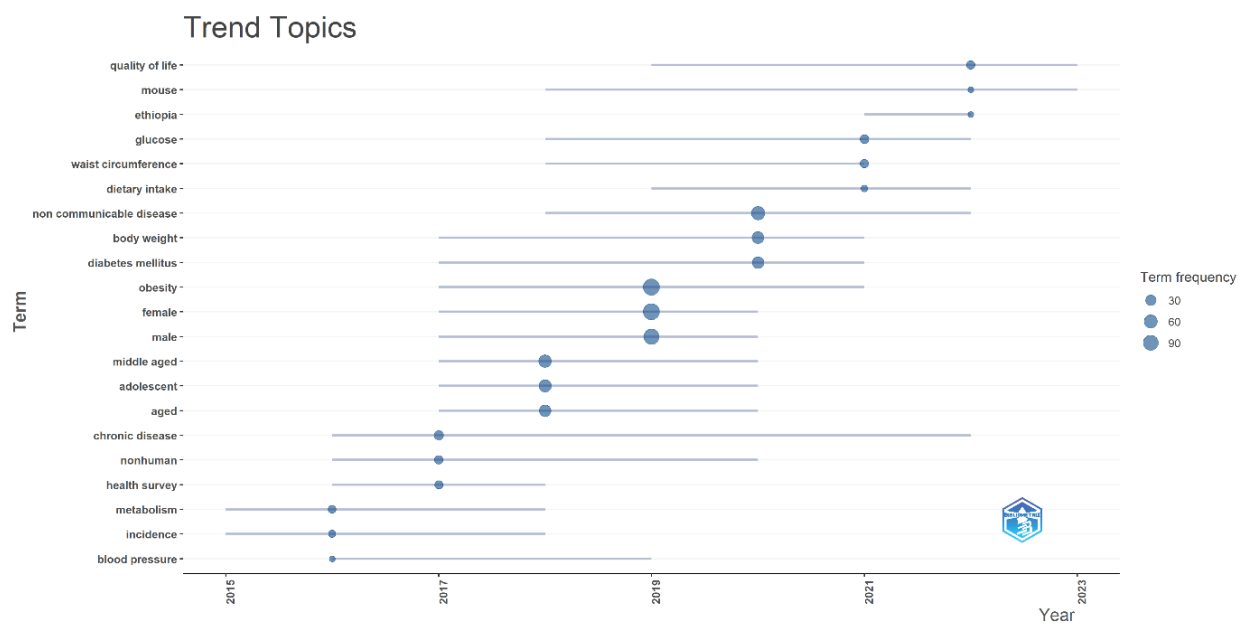
Figure 13.   Co-occurrence network mapping showcasing trendy topics from 2014 - 2023. Classified based on five (5) Word Minimum Frequency and Number of Words per Year (>5 words), with a longer wick signifying the year of word first and last occurrence

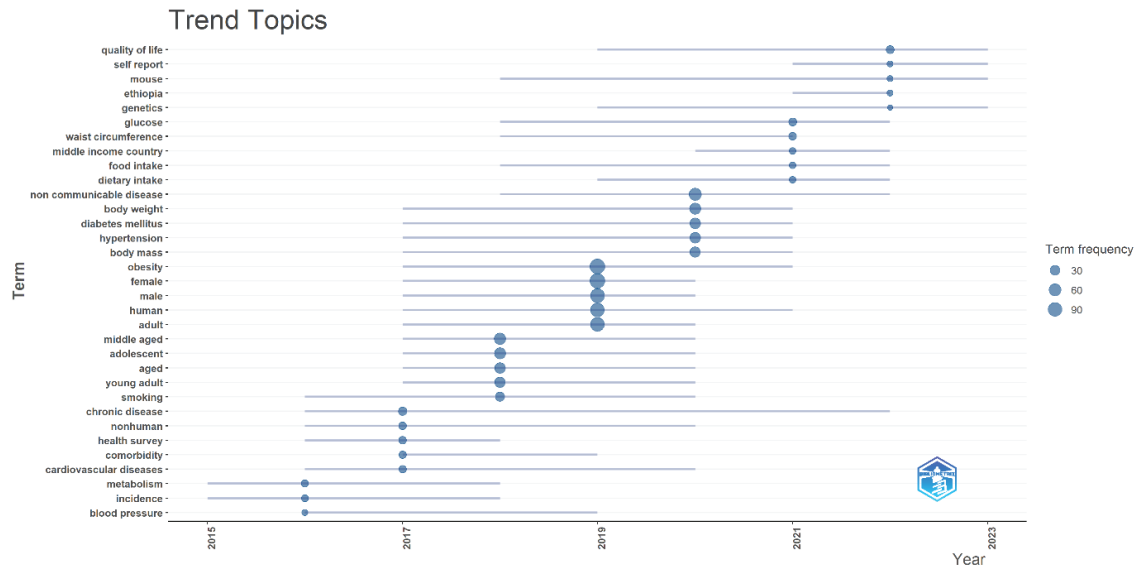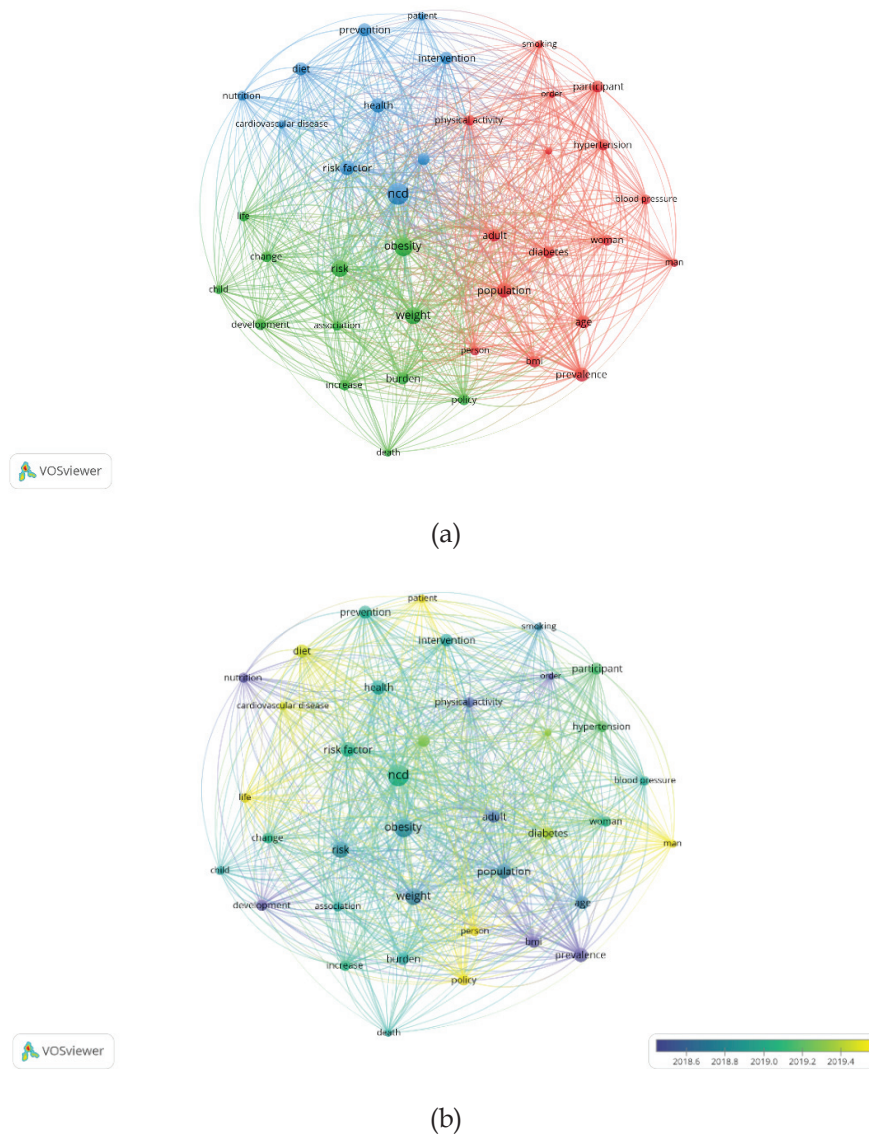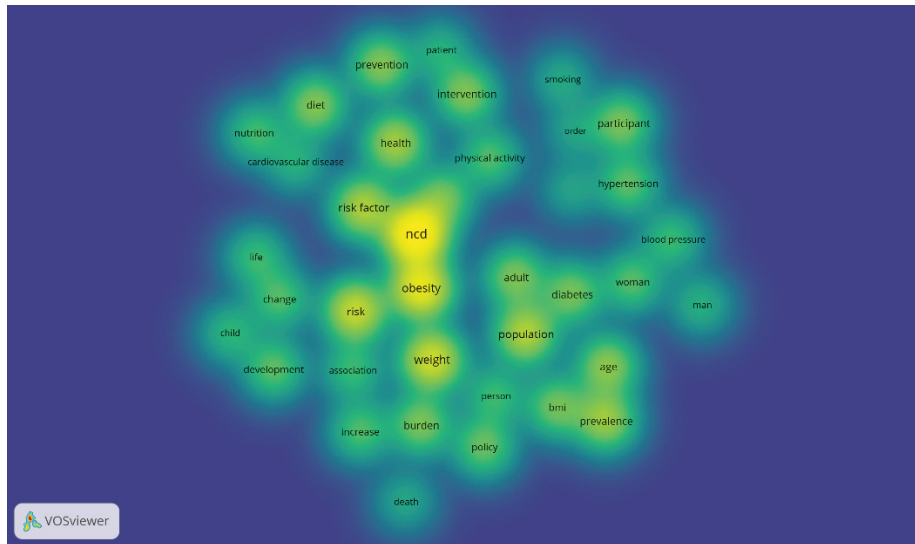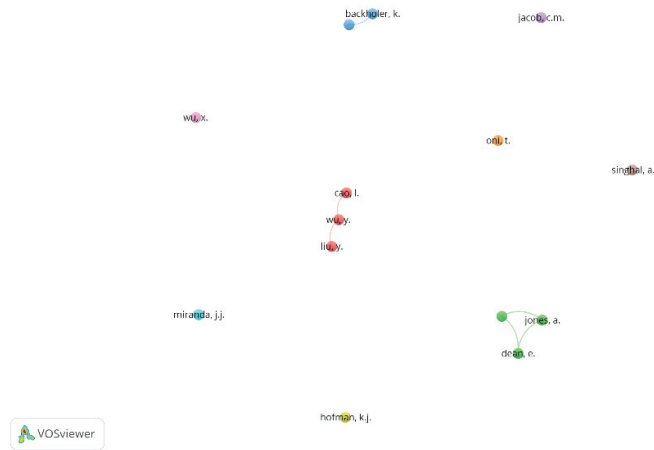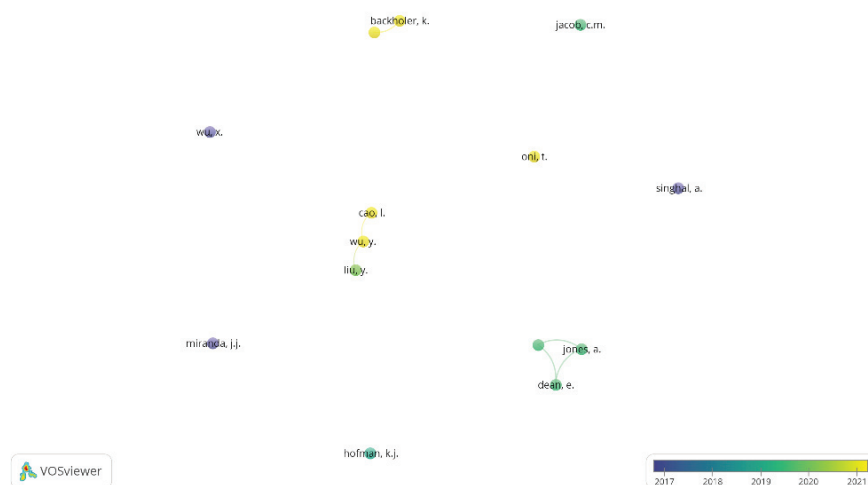

(a)

(b)

(c)

Figure 14. (a) Keywords Clusters Overview; (b) Keyword Map-Overlay Visualization Based on Text Data; and (c) Bibliometric Keywords Map-Density Visualization Mode of Brand Attitude Based on Text Data.
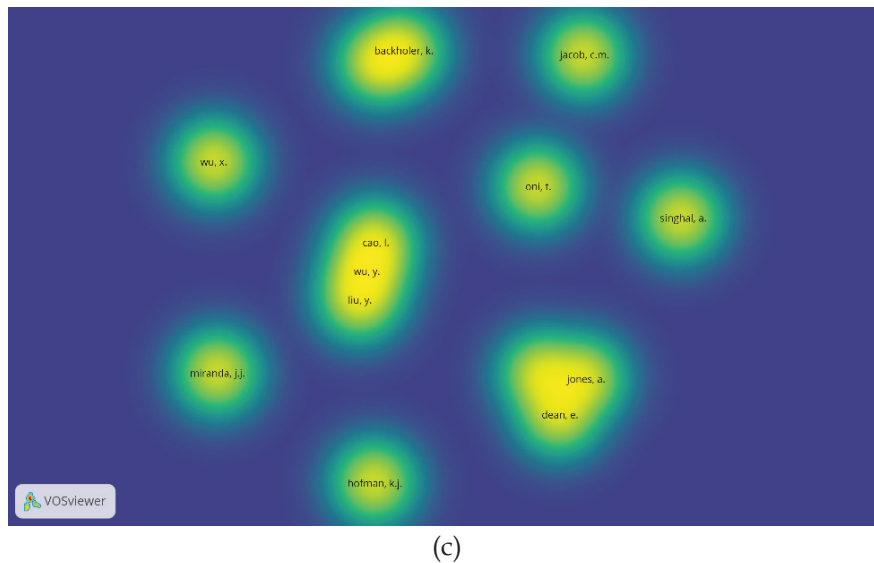

(a)

(b)

(c)

Figure 15. (a) Authors Clusters Overview; (b) Authors Map-Overlay Visualization Based on Bibliographic Data; and (c) Bibliometric Authors Map-Density Visualization Mode of Brand Attitude Based Bibliographic Data

Figure (a) shows the relationship between the researchers divided into nine clusters. Clusters 1 and 2 are shown with dark blue and light blue nodes, namely Backholer, K. and Miranda, J. J. Cluster 3 has purple, namely, Jacob, C. M. Cluster 4 has pink, namely Wu, X. Cluster 5 has orange, namely Oni, T. Cluster 6 has brown, namely Singhal, A. Cluster 7 is dark green, namely Hotman, K, J. Cluster 8 has a red color, research members consist of Cao, L., Wu, Y. and Liu, Y. Cluster 9 has a light green color, members consist of Jones, A., and Dean, E. The relationships formed between researchers are still limited, so they can open opportunities for researchers to collaborate in expanding research. Figure (b) shows an overlay visualization that shows traces of the author's experience in the research. This mapping is characterized by the existence of nodes that connect researchers. There are color variants, namely dark, medium, and light, that have meaning. The dark color on the node indicates that the research was conducted in the past within the stated period. The research conducted by Liu, Y. was quoted by Cao, L., and Wu, Y., because the visualization color of Liu, Y.'s research is darker than that of Cao, L., and Wu, Y.'s research.

From the results of the density visualization shown in Figure (c), it can be identified that there is no density or emphasis on the nodes, which means that researchers who research in the fields of policy, obesity, and NCD do not have a binding relationship with each other except for research conducted by Cao, L., Wu, Y., Liu, Y., Jones, A., and Dean, E., and they show the color of the brightest node density. In other words, the authors conducted research by citing several collaborative studies in the field related to research on the topics of policy, obesity, and NCD.

d. A view of future research and health policy design

In this study, health policy as the main search key showed that this was no bigger trend in the topics studied than NCDs and obesity. Policy topics have not yet attracted the attention of researchers for in-depth discussion. Health policies should focus on a multifaceted approach that addresses the factors that influence each other and contribute to the prevention of obesity. WHO states the importance of addressing the root causes of obesity, including unhealthy eating patterns, lack of physical activity and socio-economic factors. This requires a comprehensive approach that includes policy changes, individual behavior changes, and community-based initiatives (CDC 2023a). The linkages in Figure 14 clearly indicate the effects of obesity. Therefore, decision makers need policy solutions to consider adapting policies in an effort to avoid the threat of impacts, especially large health costs (CDC, 2022).

Figure 16. Keyword "Policy" Map-Overlay Visualization Based on Text Data.

The results of analyses based on Figure 17, "policy" is associated with various health impacts from obesity. This can provide suggestions for future research and policy by systematically and comprehensively compiling health policies.

1) Policy on using taxes on unhealthy food
   Taxes on unhealthy foods aim to reduce the consumption of unhealthy foods and reverse economic incentives towards excessive energy-dense and unhealthy foods. Some countries impose sales taxes on sugary drinks and fast-food. Most people consume unhealthy foods because they are cheaper. This encourages individuals to choose healthy foods to form a healthy body (Fox & Horowitz, 2013; Kalamov & Runkel, 2021). Consumption of sugar-sweetened beverages (SSBs) increases body weight and BMI in children and adults (Nguyen et al., 2022). Consumption of UPF and sugary drinks is more common in obese individuals. Identifying risk factors for the new world order is essential to help individuals make lifestyle changes and prevent their development and complications (Kobayashi et al., 2023). This study showed that taxing sweet sugar is an effective policy for reducing sugar consumption. Lifestyle changes to prevent complications and their development require identification of risk factors.

2) Food subsidy policy
   Food prices are a risk factor for obesity, and access to fruits and vegetables can protect against obesity. Thus, effective policies can be designed to reduce the circulation of unhealthy food and expand its supply of healthy food (Fox & Horowitz, 2013; Kalamov & Runkel, 2021). Food insecurity occurs with reduced access to the quantity and quality of healthy food; therefore, processed high-energy foods are more easily accessible, causing obesity (Carvajal-Aldaz et al., 2022).

3) Early Care and Education (ECE) Policies
   According to the Centers for Disease Control and Prevention, policies to improve nutrition, physical activity, and breastfeeding need to be implemented to prevent obesity in children. The focus is on supporting healthy eating patterns and active living in various situations to combat the ongoing obesity epidemic (CDC, 2023b). ECE policies and regulations have been implemented in several countries by taking into account the factors in each country to achieve the goal of reducing obesity rates can be achieved (Bertram & Pascal, 2016; Buscemi et al., 2014). ECE programs should also focus on these areas to prevent childhood obesity. The information in this program includes regular consumption of minimally processed foods and drinking

water, encouraging breastfeeding, limiting media viewing and access to screen media, limiting sitting activities, and encouraging outdoor play opportunities (Ramos et al., 2021).

4) Health in All Policies (HiAP)

Integration is necessary and mandatory across sectors, with the principle of integrating health considerations that aims to improve the level of public health for policymakers. It is hoped that this can be implemented by all countries and implemented by all elements of society (CDC, 2016). It is hoped that this activity will be implemented by the government in collaboration with other sectors with the support of the layers of government as policymakers. Public policies at various government levels can encourage health equity and public health (WHO, 2014).

Health in All Policy (HiAP) is a collaborative approach aimed at improving public health and health equity, which involves integrating health considerations into policymaking across multiple sectors. Factors outside one's control, such as income, living conditions, and education, have a direct effect on health. HiAP encourages decision-makers in various sectors to consider health outcomes, including health-related benefits, harms, and costs, when making policies that impact health (WHO, 2018).

Evidence of the success of the Health in All Policies (HiAP) program worldwide can be seen in several examples of its implementation, which have shown a positive impact on public health. One prominent example is Finland, which has ranked among the best in the world in terms of health. Finland has integrated HiAP principles into health policy by involving various sectors, including cities, the business community, research community, education sector, and society. Thus, Finnish health programs such as "Health 2015" and the "Health in All Policies" principle have sought to increase life expectancy, reduce inequality, and prevent various public health problems (Miranti & Nisai, 2015).

HiAP encourages decision-makers across sectors to consider health outcomes, including health-related benefits, harms, and costs, when creating policies that impact health. The benefits of HiAP include producing more effective policies that address the root causes of health problems and ultimately improve health
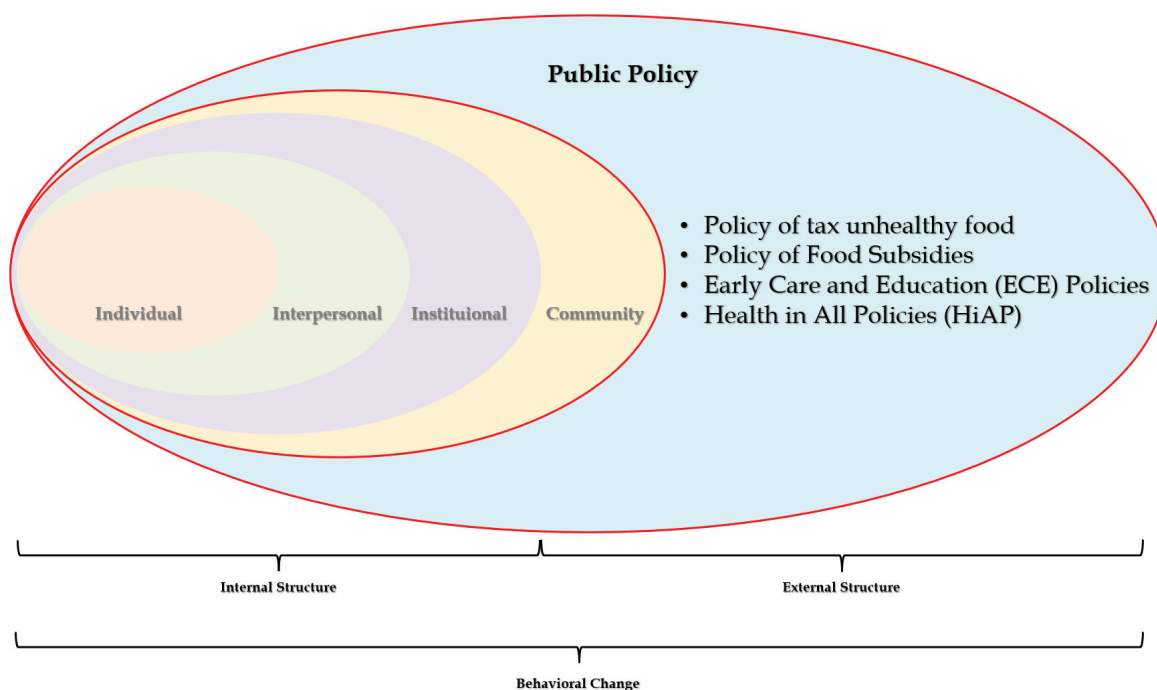

Figure 17. Recommended Health Policies According To The Ecological Model. Modified from McLeroy et al., 1988s

status and can produce cost savings by preventing health problems and reducing health service costs. Overall, the benefits of HiAP, including improved health outcomes, increased collaboration, increased health equity, and cost savings outweigh its limitations. However, these challenges must be overcome by providing adequate resources, training, and support to ensure the successful implementation of HiAP (Kemenkes RI, 2020).

HiAP is the main strategy to achieve the Sustainable Development Goals (SDGs) 2030 agenda, which is a whole of society and emphasizes a whole-of-government approach to leave no one behind. It is also recognized as an important component of primary health services and has been recommended by the World Health Organization (WHO); therefore, it is hoped that the HiAP policy can be implemented by all countries in the world (WHO, 2018).

CONCLUSION

This study examines and evaluates global scientific output in health policy research by analyzing records from the Scopus database, identifying current top researchers, and mapping their regional distribution and publications. This study used the Scopus database and then analyzed and evaluated the global scientific output regarding health policy research. The results are the identification of current research trends, determination of research gaps, and mapping of regional distribution and publications. The United Kingdom, the USA, and China have the highest productivity. The journal with the highest preference for publications on this topic was Plos One. We used Biblioshiny for Biblio-metrix analysis to evaluate how scientific research on health policy related to obesity has evolved, which perspectives have been most influential, and to highlight the research agenda driving the literature forward.

This suggests that most collaborations are limited to the country of origin, and that these affiliations could be a catalyst for expanding research worldwide on health policies concerning obesity and NCDs. Suggestions for the four health policies should be studied further and implemented

in each country with a high obesity problem to prevent obesity. These results were obtained based on data visualization and content analysis of articles sorted through bibliometric citation analysis and a literature review. Future policies should be developed and implemented in each country to address taxation on unhealthy food, food subsidy policies, early care and education (ECE) Policies, and Health in All Policies (HiAP).

Obesity policies vary in effectiveness and adoption, with significant regional disparities. Policies that place greater emphasis on environmental changes and reduce individual demands tend to be more effective. Sugar taxes have shown promising results in some contexts. To increase effectiveness, policies should consider social determinants of health and ensure consistent implementation across regions.

The limitations of this study include non-English language studies due to resource and time constraints, as well as language proficiency limitations within the research team. Although there is a potential for bias, its impact on the conclusions of systematic reviews is often minimal. To improve inclusiveness, better strategies are required in future studies.

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