

Review

# Education and Diet in the Scientific Literature: A Study of the Productive, Structural, and Dynamic Development in Web of Science

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**Abstract:** Nutrition-related education is necessary to protect and improve the health status of schoolchildren and to minimize the risk of future diseases. The objective of this research was to analyze the trajectory and transcendence of the concepts “education” and “diet” in the Web of Science literature. The methodology focused on bibliometry, analyzing both the performance and the structural and dynamic development of the concepts through a co-word analysis. A total of 1247 documents were analyzed, and the results show that scientific production experienced a turning point in 2009, in comparison to the level of production reported in previous years. The medium of papers and the language of English were the most common. In relation to the research topic, before 2014, scientific production focused on medical and disease-related aspects; however, since 2014, it has focused on disease prevention and feeding. It was therefore concluded that the theme “diet and education” has been researched for more than 20 years, although it is only in the last decade that it has become more relevant—particularly studies focusing on disease prevention and the type of food, specifically fruit, which is presented as the most outstanding issue for researchers in this field of knowledge.

**Keywords:** diet; education; bibliometric analysis; scientific production; scientific mapping; Web of Science

## 1. Introduction

Nutrition assumes a fundamental role to protect and promote an optimal state of health. Therefore, the follow-up of a diet in schoolchildren is important, as they are classified as a sensitive group in nutritional terms, meaning that they are at greater risk of malnutrition or poor diet for effective growth and development [1].

Diet is considered a key element for disease prevention, and thus, dietary recommendations from specialists should be followed in order to maintain and preserve a good state of health [2].

The World Health Organization states that many young people around the world have high rates of both overweight and obesity. This is generated as a result of not performing enough physical activity, in addition to not following a healthy diet [3]. Overweight and obesity are considered a serious public health problem, not only in developed countries, but also proliferating in developing countries [4]. This situation is causing a high mortality rate closely linked to a poor-quality diet [5].

In this sense, education plays a primary role in establishing good eating habits in people [6]. Specifically, dietary education can promote the adequate behavior of adolescents in the face of their

inadequate diet [7]. In line with this, it has been observed that youths follow a diet with a high sugar content, which is detrimental to their health [8].

It has been proven that a four-week-long nutritional education program can help to improve dietary and nutritional patterns in adolescents [9]. Along these lines, other experts postulate that a diet education of only 20 min can cause a positive impact on young people's knowledge about nutrition [10].

These actions allow students to increase their knowledge about aspects related to nutrition and to change their attitude toward the intake of certain foods harmful to health [11]. Also, the continuity of these programs over time results in the consolidation and durability of a healthy lifestyle [12].

In primary education, it is important to apply training programs linked to the development of adequate dietary guidelines [13]. This is justified in the constant transformations that the human body undergoes in the first years of life [14] and in the personality development assumed by students at this stage [15], with the purpose of establishing healthy habits at a nutritional level that have a special impact on diet and that last for a lifetime [16]. The literature reflects the importance of carrying out training tasks in terms of nutrition and active lifestyles in order to raise awareness about good healthy habits and, thus, to prevent the proliferation of diseases at an early age [17].

Experts recommend a quality nutritional education for the development of adequate eating habits, especially in diabetic people [18] and those with heart problems or cardiovascular risk [19], in order to ensure a good state of health.

Traditional practices to boost eating habits among people have shown little importance in improving dietary patterns [20]. Therefore, nutritional training activities based on electronic resources such as mobile devices are increasing, proving to be effective for the implementation of a dietary follow-up [21]. In addition, innovative dietary education programs are being carried out through educational technology based on e-learning to reduce the barriers that some people may have to access a nutritional training program [22]. In addition, due to advances in technology, it is already possible to carry out dietary interventions using mobile applications [23], as well as health education through emerging technologies such as augmented reality [24].

Very few students and families have optimal knowledge regarding nutrition and dietetics, and those who do gained this knowledge from informal learning through self-study or through the recommendations of people they are close to in their environment [25]. In a survey of pre-university students, a need for these adolescents to receive nutritional information by specialists was observed, since the training they had already received was by nonexperts in the field of nutrition and dietetics [26]. A quality dietary education provided by qualified professionals can increase the indicators of obesity reduction and can facilitate the improvement of psychological factors [27].

Not only is it important to educate and instill in students good dietary guidelines, but also teachers of educational centers and staff in charge of school canteens must receive specific training related to the development of adequate diets where the supply of food that provides energy, fats, and saturated fatty acids is controlled [28].

The application of training programs related to active and healthy lifestyles, where the practice of physical activity is encouraged and the follow-up of a diet adjusted to the needs of each person, implies an improvement in biomedical parameters such as blood pressure, body mass index, fat reduction in body folds, and cholesterol [29]. In addition, the follow-up of dietary guidelines has been proven to have a positive impact on students' academic performance, obtaining better results than students with poor nutritional habits [30].

Marketing campaigns are already being used to encourage families to contribute to improving the diet offered to children, as well as to combat a sedentary lifestyle that currently affects the younger population [31]. Likewise, the demand for organic food is growing, but its consumption is not growing at the same rate, which is due to the value of the product [32]. A diet based on organic farming should be promoted [33]. However, all of this depends, to a large extent, on values of a social, emotional, and epistemic type that are related to the consumer's intentions [34].

Therefore, it is essential to follow dietary guidelines to promote an optimal state of health and to acquire all of the nutrients that the human body needs to function effectively in the different actions of daily life. In the same way, with correct feeding, the possibility of suffering diseases such as diabetes or hypertension is reduced. In this sense, schools assume an important role in both training and promoting healthy habits concerning food [35].

All of the above serves to present the state-of-the-issue rationale drawn from recent studies in the impact literature. This has led to the completion of this study, due to the gap found in science as a consequence of the absence of research that reflects, from a bibliometric perspective in particular, the evolution and current state of dietetic education. Likewise, it was necessary to carry out this study because it deals with a very sensitive topic at present, and to reveal to the scientific community all of its scientific projection from the first studies until today.

## 2. Justification and Objectives

The purpose of this research was to analyze, from a novel analytical approach, the path and transcendence of the concepts of “education” and “diet” (EDIE) in the impact literature collected from the Web of Science (WoS) database, in its entirety, with the intention of showing the Scientific Community the status of the issue of research development related to said terminology.

The novelty presented by this study, with respect to other works with the same intention [36], comes from the bibliometric analysis technique used. This technique not only focuses on the quantification of bibliometric indicators, but also on the dynamic and structural development of the delimited constructs, as reflected in other works [37,38]. Therefore, this research helps to reduce the gap found in the impact literature of this field of knowledge, by not finding any study of the same characteristics as the one presented in this manuscript.

The objectives formulated in this research are as follows: (a) to determine the performance and the production of scientific literature based on “diet” and “education”; (b) to determine the scientific evolution of the terms mentioned; (c) to establish the most outstanding topics in the field of study based on these terms; (d) to identify the most influential authors in the impact literature in relation to the concepts analyzed.

## 3. Materials and Methods

### 3.1. Research Design

This study followed a bibliometric research methodology, taking as reference other previous studies of high impact literature [39–44]. The reason why this research technique was used is reflected in the potentialities that Scientometrics reports have in aspects related to quantifying, evaluating, and estimating the scientific evolution of the field of knowledge in question [45].

This paper analyzes both the performance and the structural and dynamic development concerning “diet” and “education” through a co-word analysis [46]. This was done by taking the h-index and the volume of citations as the main indicators [47] for the preparation of scientific maps to analyze parameters such as performance and location and to determine conceptual subdomains, in order to establish thematic development [48]. In addition, other indicators such as the g-index, the hg-index, and the q2-index were taken into account to provide more information on the thematic metrics.

In this research, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-P) matrix analysis protocol was respected and various analytical tracking and documentary quantification techniques were used through the configuration of controlling variables at the literary level.

### 3.2. Procedure and Data Analysis

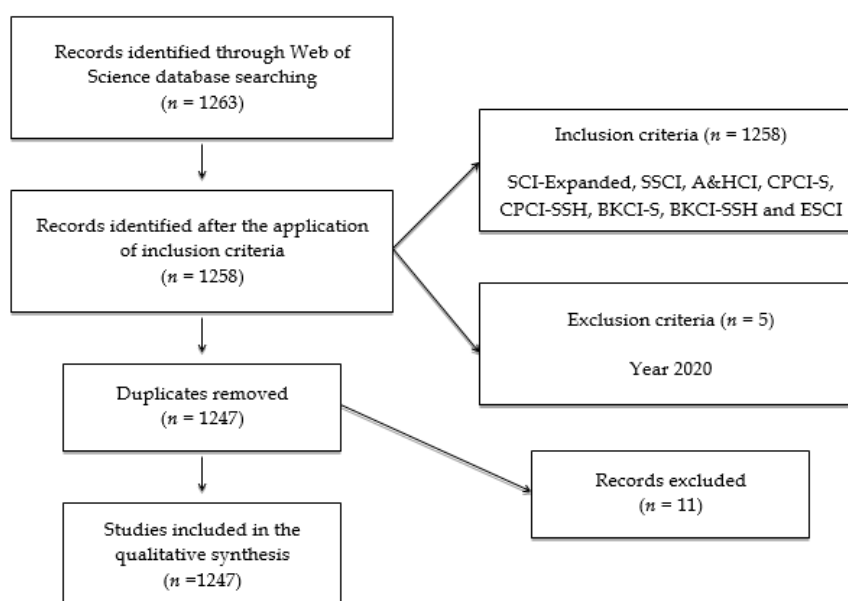
This investigation was carried out at different times. First, the database from which to extract the literary productions was selected. We chose WoS because it is a repository that contains a large

volume of impact work. Second, the keywords to be entered into the WoS search tool were selected. For this, the information provided by the editors of the special issue titled “Nutrition Education in Medicine” of MDPI’s *Nutrients* journal was analyzed. A consultation was then carried out in the Education Resources Information Center (ERIC) and United Nations Educational, Scientific and Cultural Organization (UNESCO) thesauri, with the intention of using the standardized terms found in the Scientific Community. Finally, the key words used were “diet” and “education.” At first, a search was carried out by topic in WoS, of the keywords “diet” and “education,” with the following search equation: [TOPIC] “diet” AND [TOPIC] “education.” This type of search locates one of these words in either the title, the abstract, or the keywords; that is, if the word appears in any one of these three sections, it was included among the documents located. In this case, a total of 11,478 documents were obtained, of which the majority did not refer to the objectives set out in this investigation. These documents focused on other aspects of a medical nature. Due to this, another search was made, making a modification in the equation presented above: [TOPIC] “diet” AND [TITLE] “education.” In this new search, attention was focused on the word “education” being in the title of the various documents, yielding a total of 1263 articles, obtaining, in this case, a scientific publication related to the objectives of this research.

The search process occurred in January 2020 to cover the entire literary volume of 2019 and previous years. The search result specified an analysis unit of 1263 documents. These documents were analyzed to rule out repeated or poorly indexed publications. In addition, various inclusion criteria were established (Table 1) in order to collect the most relevant and significant productions. Based on these criteria, the final sample was refined to 1247 scientific publications (Figure 1).

**Table 1.** Production indicators and inclusion criteria.

Indicators	Criteria
Year of publication	$x \geq 1995$
Language	$x \geq 10$
Publication area	$x \geq 100$
Type of documents	$x \geq 20$
Organizations	$x \geq 20$
Authors	$x \geq 6$
Sources of origin	$x \geq 35$
Countries	$x \geq 15$
Citation	The four most cited documents



**Figure 1.** Flowchart according to the PRISMA Declaration.

Various tools were used for data analysis. To identify the year, type of document, institution, authors, media, country, language, and most cited documents, the Analyze Results and Create Citation Report tools were used, both typical of the WoS platform. SciMAT was used to study the structural development and longitudinal dynamism of the scientific publications, following the recommendations of the experts [49]. This software allowed to perform the following actions in the thematic-level co-word analysis:

- **Recognition:** This consisted of analyzing the keywords of all of the reported scientific productions ( $n = 3826$ ) and generating a map of co-occurrence through nodes. This gave rise to a standardized network of co-words. In this way, the most relevant keywords were obtained ( $n = 3783$ ), and with a clustering algorithm, the themes were defined, as well as the concepts with the greatest attraction among them.
- **Reproduction:** This was produced with the development of a strategic diagram and a thematic network based on the principles of centrality and density. The graphic representation was configured as four sectors: (1) Higher-right = brings together motor and relevant issues; (2) upper-left = consolidated but isolated topics; (3) lower-left = issues in development or disappearance; and (4) lower-right: cross-cutting issues with little development.
- **Determination:** This was carried out through a study of the evolution of the nodes in time intervals. Four intervals (i.e.,  $I_1 = 1995\text{--}2008$ ,  $I_2 = 2009\text{--}2013$ ,  $I_3 = 2014\text{--}2016$ , and  $I_4 = 2017\text{--}2019$ ) were established to classify and to analyze the reported documents. However, for the authors, a single interval was defined (i.e.,  $I_X = 1995\text{--}2019$ ) that covers all of the reported productions. The strength of association was determined by the volume of common keywords at the configured intervals.
- **Performance:** This was obtained through the connections found between the keywords and the other concepts of the node. For this, the unit of analysis that determines the unit of assessment, which contains the keywords established by the authors in the documents, the keywords established by WoS, and the keywords of the authors in different publications, was analyzed. Another indicator, namely, the frequency threshold, was used to determine the minimum frequency of the intervals, with  $n = 3$  for the first and third intervals and  $n = 4$  for the second and fourth intervals. The type of network allowed to develop a network of co-occurrence of keywords and authors (co-words—co-authors). The coincidence union value allowed to articulate the established intervals (four intervals for the keywords and one for the years of production of the authors). The normalization measure determined the binding threshold, revealing the minimum connection of the occurrence (keywords =  $I_1 \geq 2$ ;  $I_2 \geq 2$ ;  $I_3 \geq 2$ ;  $I_4 \geq 2$ ; authors =  $I_X \geq 3$ ). In order to normalize the connections, the equivalence index  $e_{ij} = cij2/Root (ci - cj)$  was made. The clustering algorithm, through simple centers, was used to make the map of topics and related subnets. The evolutionary measure, through the Jaccard index, served to determine the measure of similarity that developed the evolution map and the transition map through the inclusion rate (Table 2).

**Table 2.** Production indicators and inclusion criteria at SciMAT.

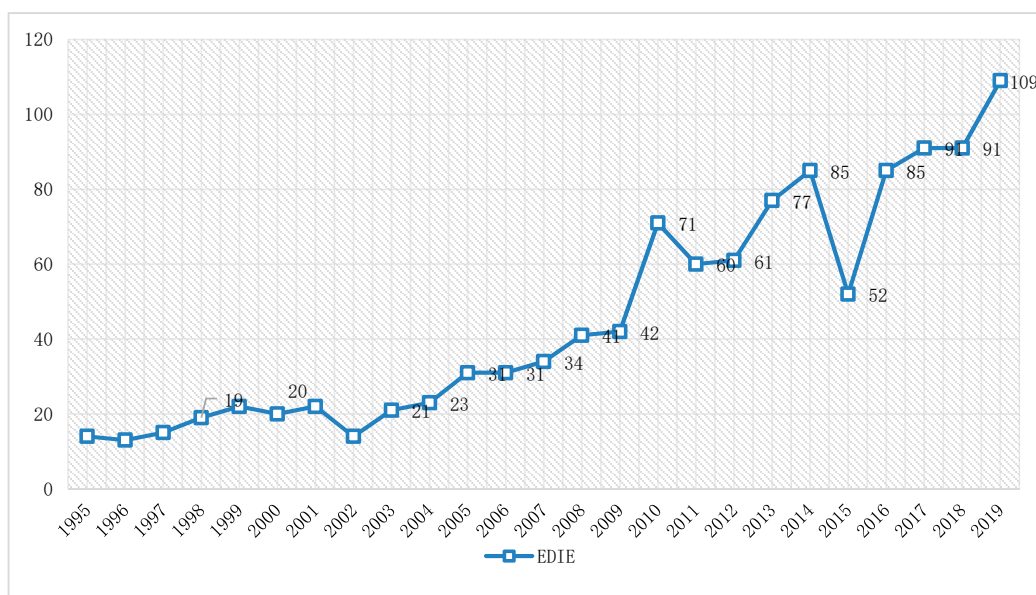
Configuration	Values
Analysis unit	Keywords authors, keywords WoS
Frequency threshold	Keywords: $I_1 = (3)$ , $I_2 = (4)$ , $I_3 = (3)$ , $I_4 = (4)$ Authors: $I_X = (3)$
Network type	Co-occurrence
Co-occurrence union value threshold	Keywords: $I_1 = (2)$ , $I_2 = (2)$ , $I_3 = (2)$ , $I_4 = (2)$ Authors: $I_X = (3)$
Normalization measure	Equivalence index
Clustering algorithm	Maximum size: 9; minimum size: 3
Evolutionary measure	Jaccard index
Overlapping measure	Inclusion rate

**Note:**  $I_1$ : The interval from 1995 to 2008;  $I_2$ : the interval from 2009 to 2013;  $I_3$ : the interval from 2014 to 2016;  $I_4$ : the interval from 2017 to 2019;  $I_X$ : 1995–2019. WoS, Web of Science.

## 4. Results

### 4.1. Performance and Scientific Production

Of the 1263 documents analyzed to elaborate the temporal evolution of the development of the subject, the works produced from 1995 onward were represented (Figure 2), given that there were no adequate records of them in WoS. From this date, scientific production was irregular, with little incidence until 2009, prior to which the presentation of academic results was scarce. From 2010 onward, production has increased, although it is still irregular, as there was a considerable decrease in 2015 and a rebound from 2018 onward.



**Figure 2.** Evolution of the scientific production of diet in education in the Web of Science (WoS). EDIE: education and diet.

The language par excellence in this type of production is English, which is used well above the other languages (Table 3).

**Table 3.** Scientific language used in EDIE.

Language	<i>n</i>
English	1154
Spanish	49
German	15
Portuguese	13

The primary area where this subject is represented is Nutrition Dietetics, followed by Public Environmental Occupational Health, being the fields where education is most relevant in relation to diet (Table 4).

**Table 4.** Research areas.

Research Area	<i>n</i>
Nutrition Dietetics	375
Public Environmental Occupational Health	251
Education Educational Research	141
General Internal Medicine	112
Endocrinology Metabolism	109

With respect to the type of document that scientists use to present their results, this would be articles, being favored distinctly more than the rest of the production types (Table 5).

**Table 5.** Document types.

Document Types	<i>n</i>
Article	1036
Proceedings paper	87
Meeting abstract	83
Review	58
Editorial material	22

At the institutional level, there are three institutions that present an even production on the subject, namely, the Pennsylvania Commonwealth System of Higher Education (PCSHE), the University of California System, and the University of London. The rest of the institutions shown in Table 6 offer a relevant production, with hardly a distinction from the first three.

**Table 6.** Institution.

Institution	<i>n</i>
Pennsylvania Commonwealth System of Higher Education (PCSHE)	30
University of California System	29
University of London	29
University of North Carolina	26
United States Department of Agriculture (USDA)	25
Penn State University	22
National Institutes of Health (NIH USA)	20
University of Texas System	20

In reference to the most prolific authors, A.H. Lichtenstein and Y. Manios are the largest producers in EDIE, although their production is not much above the rest of the authors (Table 7).

**Table 7.** Authors.

Authors	<i>n</i>
Lichtenstein, A.H.	9
Manios, Y.	9
Schaefer, E.J.	8
Kafatos, A.	7
Campbell, N.R.C.	6
Feldman, R.D.	6
Hamet, P.	6
Khan, N.A.	6
Larochelle, P.	6
Leiter, L.A.	6
Ogilvie, R.I.	6
Padwal, R.	6
Pylypchuk, G.	6
Schiffrin, E.L.	6
Touyz, R.M.	6

The two main sources where the EDIE theme is presented are the Journal of the American Dietetic Association and Public Health Nutrition. The rest of the sources, although to a lesser extent, show a relevant production on this subject (Table 8).

**Table 8.** Source titles.

Source Titles	<i>n</i>
Journal of the American Dietetic Association	36
Public Health Nutrition	35
Journal of Nutrition Education and Behavior	26
American Journal of Clinical Nutrition	19
Nutrients	19
BMC Public Health	17
FASEB Journal	16
Patient Education and Counseling	15

The country most interested in EDIE is the United States, which is far above the rest of the other countries (Table 9).

**Table 9.** Countries.

Country	<i>n</i>
United States	482
England	99
Spain	69
Australia	64
Canada	63
China	38
Italy	37
Japan	36
Poland	36
Germany	35

The most frequently cited publication in the field of EDIE is undoubtedly that of Pi-Sunyer (1998). The rest also present high levels of citations, which indicates that such research is of relevance to the scientific community (Table 10).

**Table 10.** Most cited articles.

Reference	Citations
Pi-Sunyer, F.X. NHLBI Obesity Education Initiative Expert Panel on the identification, evaluation, and treatment of overweight and obesity in adults—The evidence report. <i>Obesity Research</i> 1998, 6, 51–209.	3802
Norris, S.L.; Lau, J.; Smith, S.J.; Schmid, C.H.; Engelgau, M.M. Self-management education for adults with type 2 diabetes—A meta-analysis of the effect on glycemic control. <i>Diabetes Care</i> 2002, 25, 1159–1171. <a href="https://doi.org/10.2337/diacare.25.7.1159">https://doi.org/10.2337/diacare.25.7.1159</a>	941
Whelton, P.K.; He, J.; Appel, L.J.; Cutler, J.A.; Havas, S.; Kotchen, T.A.; Roccella, E.J.; Stout, R.; Vallbona, C.; Winston, M.C.; Karimbakas, J. Primary prevention of hypertension—Clinical and public health advisory from the National High Blood Pressure Education Program. <i>JAMA- Journal of the American Medical Association</i> 2002, 288, 1882–1888. <a href="https://doi.org/10.1001/jama.288.15.1882">https://doi.org/10.1001/jama.288.15.1882</a>	849
Muers, G.L.; Miller, W.G.; Coresh, J.; Fleming, J.; Greenberg, N.; Greene, T.; Hostetter, T.; Levey, A.S.; Panteghini, M.; Welch, M.; Eckfeldt, J.H. Recommendations for improving serum creatinine measurement: A report from the laboratory working group of the National Kidney Disease Education Program. <i>Clinical Chemistry</i> 2006, 52, 5–18. <a href="https://doi.org/10.1373/clinchem.2005.0525144">https://doi.org/10.1373/clinchem.2005.0525144</a>	793
Pi-Sunyer, F.X. NHLBI Obesity Education Initiative Expert Panel on the identification, evaluation, and treatment of overweight and obesity in adults - The evidence report. <i>Obesity Research</i> 1998, 6, 51–209.	3802



#### 4.2. Structural and Thematic Development

The evolution of the keywords offers information about the words that appear or are included in a certain interval and also shows the coincidence between the established dates. In this case, the four intervals generated present a base regarding the subject matter, given that there is a coincidence of between 30% and 40% in their keywords. The development of the same in the established intervals remains stable, as far as quantity is concerned (Figure 3).

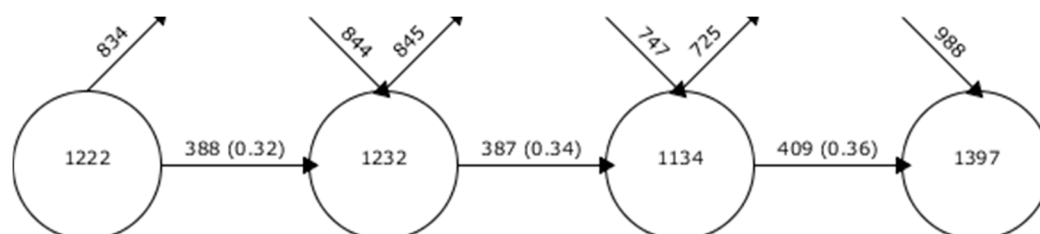


Figure 3. Continuity of keywords between contiguous intervals.

The academic performance in each of the intervals shows the topics with various bibliometric indicators, presenting, in this case, the h-index, the g-index, the hg-index, and the q2-index, thus offering information on the most relevant topics in each of the intervals marked. As presented in Table 11, in the first interval (1995–2008), the “diet” theme stands out from the rest, with some indicators that duplicate other intervals. In this case, “coronary-heart-disease” and “children” follow at a great distance. In the second interval (2009–2013), the most relevant theme is “physical-activity,” followed, with half of the bibliometric values, by “mellitus.” In the third interval (2014–2016), “childhood” stands out, followed by “nutrition.” In this interval, the distance between both themes is not very wide. In the last interval (2017–2019), the theme “fruit” is the most relevant, which is followed at a short distance by “children,” “behavior,” and “Mediterranean diet.”

Table 11. Thematic performance.

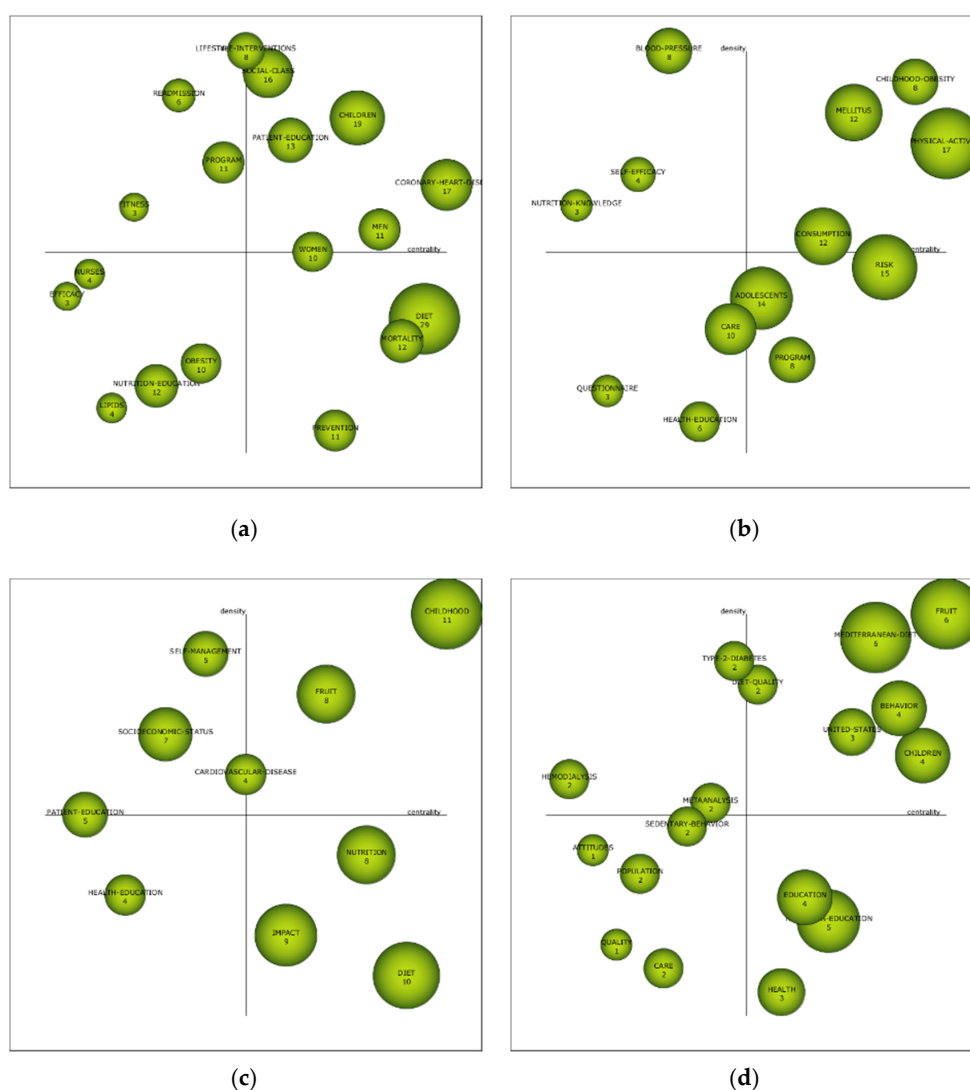
Interval 1995–2008						
Denomination	Works	h-Index	g-Index	hg-Index	q2-Index	Citations
Lifestyle-interventions	9	8	9	8.49	23.49	464
Coronary-heart-disease	28	17	28	21.82	30.02	2038
Children	28	19	28	23.07	32.03	1192
Patient-education	20	13	20	16.12	18.38	1463
Social-class	22	16	22	18.76	26.53	823
Program	17	11	17	13.67	18.17	358
Men	13	11	13	11.96	21.24	1396
Diet	60	29	56	40.3	35.72	3166
Prevention	15	11	15	12.85	19.34	605
Women	13	10	13	11.4	22.8	498
Nutrition-education	15	12	15	13.42	16.61	291
Mortality	13	12	13	12.49	20.2	1296
Obesity	11	10	11	10.49	21.21	636
Readmission	6	6	6	6	15.1	222
Fitness	3	3	3	3	14.18	253
Efficacy	3	3	3	3	9.49	87
Lipids	4	4	4	4	12.81	107
Nurses	4	4	4	4	11.14	99

Table 11. Cont.

Interval 2009–2013						
Denomination	Works	h-Index	g-Index	hg-Index	q2-Index	Citations
Childhood-obesity	15	8	15	10.95	20.78	347
Mellitus	29	12	21	15.87	16.97	476
Blood-pressure	12	8	12	9.8	12.33	328
Physical-activity	60	17	25	20.62	22.58	806
Consumption	23	12	22	16.25	19.29	655
Risk	37	15	22	18.17	18.17	518
Care	14	10	14	11.83	15.17	250
Adolescents	22	14	21	17.15	21.49	566
Program	13	8	12	9.8	10.95	208
Health-education	11	6	10	7.75	12.25	131
Self-efficacy	5	4	5	4.47	6.32	77
Nutrition-knowledge	3	3	3	3	6	67
Questionnaire	4	3	4	3.46	4.58	33
Interval 2014–2016						
Denomination	Works	h-Index	g-Index	hg-Index	q2-Index	Citations
Childhood	40	11	19	14.46	16.25	440
Self-management	13	5	11	7.42	12.45	137
Fruit	18	8	11	9.38	9.8	150
Cardiovascular-disease	11	4	10	6.32	4.47	114
Socioeconomic-status	13	7	12	9.17	11.22	149
Nutrition	31	8	13	10.2	11.31	207
Diet	29	10	17	13.04	14.83	341
Impact	21	9	15	11.62	13.08	258
Patient-education	7	5	7	5.92	8.06	92
Health-education	7	4	5	4.47	5.29	30
Interval 2017–2019						
Denomination	Works	h-Index	g-Index	hg-Index	q2-Index	Citations
Fruit	46	6	15	9.49	10.95	251
Mediterranean-diet	32	6	14	9.17	9.49	227
Children	35	4	6	4.9	6.32	57
Behavior	34	4	6	4.9	5.29	53
United-States	10	3	6	4.24	5.74	38
Diet-quality	9	2	3	2.45	3.16	13
Nutrition-education	19	5	9	6.71	7.07	97
Type-2-Diabetes	8	2	5	3.16	8.37	41
Education	25	4	11	6.63	8.72	122
Health	16	3	6	4.24	5.74	43
Meta-analysis	11	2	4	2.83	4	18
Sedentary-behavior	5	2	3	2.45	3.16	9
Care	6	2	2	2	2.45	7
Population	5	2	3	2.45	6.46	10
Attitudes	4	1	1	1	1.41	4
Hemodialysis	4	2	2	2	3.16	9
Quality	3	1	1	1	1	1

The diagrams of the established intervals provide information on the relevance of each of the themes, through a process of grouping, bearing in mind Callon's indicators, which analyze the degree of interaction of a network with respect to the other networks from two perspectives: centrality, which measures the strength of external links with other topics, being the measure of the importance of a topic in the development of a certain field of research; and density, which analyzes the internal strength of the network, identifying the internal links between all key words grouped around a specific

topic, thus offering the degree of development of the field of study analyzed. The analysis of the four established diagrams shows that there is no common driving theme in any of the intervals, except in the last two, where “fruit” stands out as relevant within the scientific field. In the first interval, “patient education,” “children,” “coronary-heart-disease,” “men,” and “social-class” emerge as the driving theme; in the second interval, “mellitus,” “childhood obesity,” “physical-activity,” and “consumption”; in the third, “childhood” and “fruit”; and in the fourth, “fruit,” “Mediterranean-diet,” “behavior,” “United States,” and “children.” Focusing the analysis on the last interval, because it is the one that marks the new trends in research on the established field of study, the themes “attitudes,” “population,” “sedentary behavior,” “quality,” and “care” may be the new trends in research in this field, or may end up disappearing, given that their location in the diagram places them as unknown themes (Figure 4).



**Figure 4.** EDIE's strategic diagram by h-index. Note: (a) Interval 1995–2008; (b) interval 2009–2013; (c) interval 2014–2016; (d) interval 2017–2019.

#### 4.3. Thematic Evolution of the Terms

Thematic evolution represents the strength of the relationship established between the themes of the various intervals generated, bearing in mind the Jaccard index. Evolution occurs if a theme of a certain interval shares keywords with the previous or contiguous intervals. The more keywords an interval has in relation to the themes of consecutive intervals, the more solid will be their evolution. The two types of connections that can occur are a continuous line, where its connection is thematic,

and a discontinuous line, where its connection is through keywords. The thickness of the lines shows the strength of the relationship between the themes.

Based on the results obtained in Figure 5, it can be determined that there is a conceptual gap in EDIE, given that there is not a theme that is repeated in the four intervals, although there is an evolution of various themes over time, where there is a connection but the field of research varies, as can be seen in “diet,” “patient-education,” or “nutrition-education.” Thematic evolution in this field of research begins to be established in the third and fourth intervals, where the “fruit” theme stands out with strength and continuity over time. It should also be pointed out that, between the first and second intervals and the second and third intervals, the connections are mainly thematic, something that does not occur between the third and fourth intervals, where the connections are mainly of key words. Furthermore, in general, in the first and second intervals, the themes are focused on aspects more related to diseases, while in the second and third intervals they are oriented toward food, which marks a before and after in this field of research.

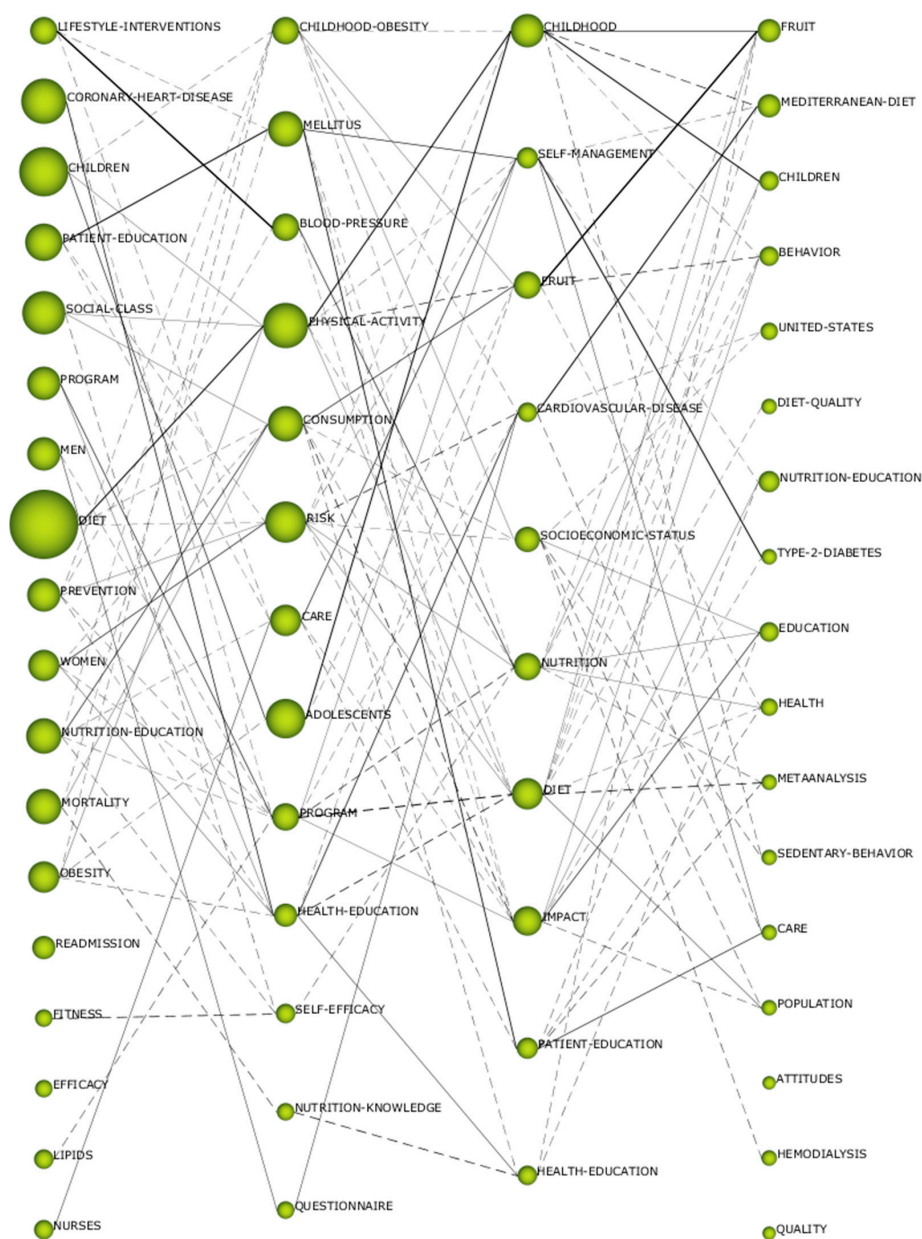


Figure 5. Thematic evolution by h-index.

#### 4.4. Authors with a Higher Relevance Index

Bearing in mind the results offered in Figure 6, it can be determined that there are relevant authors in EDIE, such as Khan, Mahon, or Leiter, or even unknown authors, who may become relevant or who may disappear in the coming years, such as Kafatos, Schaefer, or Carey.

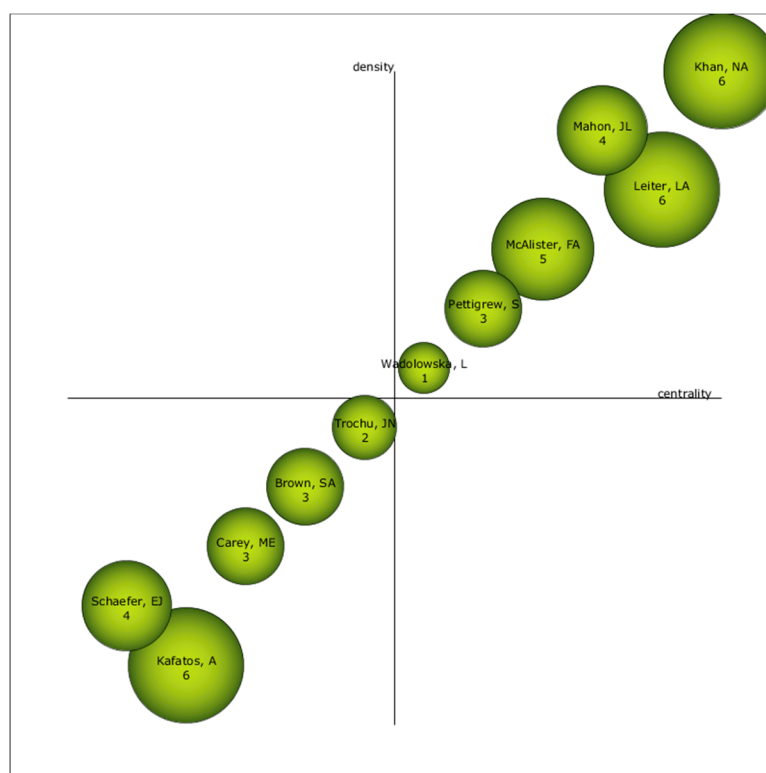


Figure 6. Strategic authoring diagram.

## 5. Discussion and Conclusions

Food is one of the most influential factors in people's health [1,2,5]. Experts recommend following a correct diet by adhering to dietary guidelines established by professionals [27]. In today's society, nutrition and dietetics are assuming an important value [32]. In addition to a sedentary lifestyle, obesity is affecting a large part of the population because they do not follow the appropriate nutritional recommendations for a proper diet [3,4]. As a consequence of this worrying situation, educational centers are carrying out initiatives and training programs to encourage the promotion of dietary education with the aim of improving students' knowledge [6,7,9–11] and to encourage an active and healthy life in order to reduce the possibility of suffering from certain diseases resulting from a poor diet [17–19].

Unlike other studies related to the subject [36], this paper investigated the dynamic and structural development of the concepts "diet" and "education" in order to reveal new findings on the state of the art, using a novel technique, namely, analysis of bibliometric indicators. The results obtained highlight that the previously established objectives in this study were achieved.

As for the scientific production reporting on "diet" and "education," the results reveal that it experienced a turning point in 2009; prior to 2009, scientific documents dealing with both of these subjects were scarce and irregular, while from 2009 onward, the production grew, albeit irregularly, since in the years 2011–2012 and 2015, the production decreased.

The most common medium and language used by the scientific community to present their work is papers and English, respectively. The latter is related to the great interest that the United States has in this field of production. Within the area of research, Nutrition Dietetics, Public Environmental

Occupational Health, the Journal of American Dietetic Association, Public Health Nutrition, and the Journal of Nutrition Education and Behavior are the most prominent. In terms of higher education, PCSHE, the University of California System, and the University of London are the most productive institutions regarding publications on “diet” and “education,” while the most prolific authors on the subject are Lichtenstein, Manios, and Schaefer, not coinciding with the most cited authors, given that Pi-Sunyer (1998) is the most cited author in this field of knowledge, with a total of 3802 citations.

The evolution of “diet” and “education” throughout scientific production maintains a consolidated research base, given that there is a high percentage of coincidence in the key words of the intervals established for this study, but this fact is not reflected in the topics dealt with in each of them, seeing as very few are repeated between the intervals. It can also be observed that scientific production has a before and after in 2014, given that in the intervals prior to this date, the most common key words refer to medical- and disease-related aspects, while from 2014, the themes are more focused on prevention and the type of diet.

In all of the intervals analyzed, there is no theme that is based on time as a driving force; on the contrary, there is a great variety between the established dates, which marks new fields and new visions for researchers when studying “diet” and “education.” It is in the last two intervals, since 2014, where a driving theme is glimpsed, which marks the trends of the investigations at that moment and not in the very near future as is the case for “fruit,” with studies focusing on diet, obesity, young people, and feeding in schools.

When considering the near future in this field of research, we must bear in mind the themes “attitudes,” “sedentary-behavior,” “population,” “quality,” and “care,” which, given their position in the 2017–2019 interval, may be the new trends and, therefore, will become the most relevant themes for the scientific community.

It can be concluded that the subjects of “diet” and “education” have been analyzed by the scientific community for more than 20 years. However, it is only in the last 10 years that these subjects have reached more relevance, focusing on aspects more related to disease prevention, primarily in terms of the type of feeding, with emphasis on fruit, which appears to be the main focus of investigators in this field of knowledge.

The aim of this research was to offer researchers new trends in the near future regarding the most relevant and interesting topics for the scientific community, as well as to highlight the aspects on which research has been based in recent times to provide a basis on which to start, develop, or guide their studies.

As a theoretical implication, this study provides specific information on the term diet in the educational field. That is, it analyzes the studies that refer to the actions developed in the educational field to train students on diet. In addition, it analyzes the diet programs applied in the different educational centers. From this perspective, the authors related to this subject are able to obtain concise information on the most prolific and current lines of research in this field of study.

As a practical implication, this study is useful for the educational community involved in the teaching of this subject to understand the most current trends, both at a pedagogical and at a didactic level. In addition, it helps to identify the most current topics and the most relevant and appropriate theoretical aspects to train students to develop an adequate diet.

There are several limitations presented in this research. The first relates to the purification of the data presented in WoS, where repeated documents are presented or are not related to the subject matter of the study. The second is related to the establishment of the intervals, which, in this case, is a question of equity, given that the researchers sought at all times to maintain a similar number of documents in each of the intervals. Thirdly, the parameters marked in this study were established according to the researchers’ own criteria, which sought to present the results in accordance with their size and relevance. Finally, another limitation of this study is found in the analysis of the h-index. Other experts in this type of research [50] consider that it is not an objective indicator to establish the relevance or impact of researchers. For this reason, the data presented here should be viewed with

caution, given that the change in the parameters established in this research may lead to a variation in the number of and the connections in the subjects presented. As future lines of research, we propose to develop practical applications and pedagogical actions in the educational field focused on diet. A study can also be performed on other databases, such as SCOPUS or Google Scholar, as well as an analytical analysis of the literature using more advanced techniques, as other studies suggest [51].

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