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*Araştırma Makalesi*

# VOS VIEWER ANALYSIS ON OBESITY IN ECONOMICS

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***Abstract***

*This study aims to contribute to the literature by presenting popular scientific studies on obesity in the field of economics, based on the bibliometric data of scientific publications indexed in the Web of Science database between 1994-2022. For this purpose, bibliometric analysis technique, VOS Viewer, is utilized. In this study, which is based on numerous literature publications on obesity, the link between the most important thematic areas published by obesity researchers and the authors is visualized on the map. This study presents a systematic review of the literature on the economic dimensions of obesity, from the first publication in 1994 to the present.*

***Keywords:*** *Obesity, Obesity Economy, VOS Viewer, Macro Economy.*

# EKONOMİ ALANINDAKİ OBEZİTE ÇALIŞMALARI ÜZERİNE VOS VIEWER ANALİZİ

***Öz***

*Bu çalışma, 1994-2022 yılları arasında Web of Science veri tabanında indekslenen bilimsel yayınların bibliyometrik verilerine dayalı, ekonomi alanında obezite ile ilgili popüler bilimsel çalışmaları sunarak literatüre katkı sağlamayı amaçlamaktadır. Bu amaçla bibliyometrik analiz tekniği olan VOS Viewer'dan yararlanılmıştır. Obezite ile ilgili çok sayıda literatür yayınına dayanan bu çalışmada, obezite araştırmacıları tarafından yayınlanan en önemli tematik alanlar ile yazarlar arasındaki bağlantı harita üzerinde görselleştirilmiştir. Bu çalışma, 1994 yılındaki ilk yayından günümüze obezitenin ekonomik boyutlarına ilişkin literatürün sistematik bir incelemesini sunmaktadır.*

***Anahtar Kelimeler:*** *Obezite, Obezite Ekonomisi, VOS Viewer, Makro Ekonomi.*

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## INTRODUCTION

Obesity is a growing concern worldwide, regardless of the developed and developing economies. Obesity "which is defined as the accumulation of fat at a level that poses a risk for health, is also expressed as a body mass index greater than 30". The rise in the daily calorie intake of individuals also rises the obesity rates. The average daily calorie intake of an adult individual is about 2000 calories. A calorie intake above this naturally causes weight gain and obesity (Sağın and Karasaç, 2020: 185-186).

This increase in the prevalance of obesity has led to the implementation of organized policies by health organizations, non-governmental organizations and the state, and in this context, the implementation of obesity prevention and control program through the World Health Organization and the health ministries of the countries (Kılıç et al., 2017: 52).

The main purpose of this study is to identify and show popular scientific research studies on obesity based on bibliometric data of publications in the Web of Science database between 1994-2022. By performing VOS Viewer, a popular visualization software for bibliometric analysis, publications on obesity in the field of economics will be emphasized. To the best of our knowledge, this study is one of the few ever applied the VOS Viewer analysis in the obesity research field. Thus motivated our study and we aimed to fulfill this gap in the literature.

In the study, first of all, the economic determinants of obesity and its economic effects were defined in detail. In the next step, the data and methodology used in this study are explained. In the following stages, the results of the research are presented and then the conclusion part is passed.

### Economic Determinants of Obesity

Obesity is an increasingly significant problem both for the developed and developing countries. In developing countries, income increase, urbanization, changing living conditions, globalization of food production and markets have an impact on obesity (Sipahi, 2021: 549).

A considerable amount of literature has been published on the causes of obesity, which plays a significant role on the health problems of recent times and affects more and more people every day. The present studies demonstrate that there are different variables that cause obesity. Since obesity is basically a health problem, studies on this subject mostly consist of studies in the field of health. On the other hand, many variables such as technology, economic growth, urbanization and health expenditures are also shown as effective factors on obesity (Sağın and Karasaç, 2020).

The economic determinants of obesity have been investigated with increasing interest by researchers in recent years, and as a result, an intense literature has emerged on the subject. According to İpek (2019: 58-59), it is possible to basically

divide the studies on the socio-economic determinants of obesity into two groups. The first group of studies deals with the relationship between obesity and social status in terms of country comparisons. The second group of studies, on the other hand, investigates the relationship in question based on micro data sets collected on an individual basis.

Economic statements to explain the increase in obesity tend to focus on changes that encourage people to consume more or burn fewer calories. These can be summarized as follows (Cawley, 2010).

- **Food Prices**: Food and beverages are bought and sold in free market conditions all over the world. Prices of less nutritious foods have increased, while the price of energydense foods has fallen (Güneş and Gedik, 2020: 493, Cawley, 2010). In addition, changing working and living patterns increase the consumption of fast food (Sağın and Karasaç, 2020).
- **Agricultural Policies**: The reason for the decrease in food prices may be agricultural policies. However, numerous studies have accomplished that such policies have limited effect on consumer prices of energy-dense foods (Tibet and Yıldırım, 2018, Cawley, 2010).
- **Income**: Income has the potential to both increase and decrease the incidence of obesity (Tibet and Yıldırım, 2018). Hruby and Hu (2015: 7) stated, "as late as the mid-20th century, the USA and Europe could link wealth directly with obesity-the wealthier an individual, the higher the likelihood of being overweight." As consumers' income rise, they may prefer healthier and more costly foods over inexpensive energy dense food. This can prevent weight gain. However, increased income may be a trigger for weight gain, causing people to consume more calories (Cawley, 2010, Sipahi, 2020).
- **Technology**: Technological changes that reduce the need for physical exertion have spread obesity-related health problems (Güneş and Gedik, 2020: 493, Cawley, 2010). Furthermore revolutionary technological developments in the methods used for mass production and preservation of food in the last century make it possible to consume more food in less time and may play a role in increasing the risk of obesity (Tibet and Yıldırım, 2018).
- **Urbanization**: Increasing urbanization is a factor that triggers obesity. Considering that people who have to live in rural areas move more and burn more calories, it is concluded that urbanization reduces the amount of movement of individuals. With urbanization, working conditions are changing and individuals are working in areas that do not require movement, such as desk jobs (Sağın and Karasaç, 2020).
- **Patience**: Market forces greatly favor short-term rather than long-term choices, overconsumption, and inactive behavior (Güneş and Gedik, 2020: 493, Tibet and Yıldırım, 2018). The findings of some theories suggest that

obese people are more likely to engage in risky behaviors such as smoking and drinking alcohol (Cawley, 2010).

- **Increases in women's participation in the laborforce:** It is stated that there is a relatively strong positive relationship between female labor force participation and obesity rates (Gomis-Porqueras et al., 2011: 2). With the participation of women in the workforce, the consumption of easy-to-prepare foods or out-of-home consumption also increases (Sipahi, 2020).

**Economic Effects of Obesity**

Okunogbe et al. (2021) reveal that "the multifactorial and chronic nature of overweight and obesity leads to economic impacts for individuals and nations". In addition to being an economic burden on the national health system, obesity has a negative impact on both the health of the individual and the public health due to worsening morbidity and increased risk of mortality (Omer, 2020).

As the process of combating obesity is costly, obesity is not just a personal problem in its current form, it has become a public problem with a serious cost (Kılıç et al., 2017: 52). The economic effects of obesity are divided into two subgroups as "direct" and "indirect" effects. Not all studies on the economic burden of obesity focus on a single type of cost. Instead, studies on the cost of obesity take place in three different ways, taking into account direct costs, indirect costs, or both (Blouin, 2014).

Direct costs "refer to health service delivery to treat obesity-related health problems" (Blouin, 2014). Hammond and Levine (2010) highlight that "obesity is linked with higher risk for several serious health conditions, such as hypertension, type 2 diabetes, hypercholesterolemia, coronary heart disease, stroke, asthma and arthritis. Direct medical spending on diagnosis and treatment of these conditions, therefore, is likely to increase with rising obesity levels". On the other hand, compared with underweight individuals, obese people are more likely to use medication, use home health care, be hospitalized, and have surgery (Okunogbe et al., 2021).

Blouin, (2014) defines the indirect costs as loss of productivity when individuals leave work temporarily (absence) or permanently due to health problems. According to the World Obesity Federation (2021) "Indirect economic effects include the costs of productivity losses and reductions in human capital from premature deaths". Table 1 below summarizes the indirect economic impacts of obesity under seven subheadings.

**Table 1:** Indirect Economic Impacts of Obesity

| | |
|---|---|
| **Absenteeism** | Studies on the estimation of the absenteeism costs of overweight and obesity constitute the most up-to-date and detailed productivity cost studies. In studies involving examples from different countries, it has been determined that employees who have obesity problems in general show more absenteeism than individuals without obesity. |

| | |
|---|---|
| **Presenteeism** | If obese individuals are found to be less productive in their working life, it is concluded that obesity causes loss of productivity. Studies involving many countries have reached results that support this situation. In other words, individuals with obesity show less capacity working performance when they are at work (presenteeism) than individuals without obesity. |
| **Disability** | Obesity can lead to a rise in disability benefits and disability insurance premiums, as well as a rise in absenteeism and presenteeism. In addition, the increase in persons with disabilities means higher costs for the government. |
| **Health insurance** | The health insurance market externality is another potential economic cost of obesity. |
| **Premature mortality** | The rise in premature deaths based on obesity points out potential losses to the economy in the future. |
| **Productivity** | In many studies, it has been stated that the productivity costs of obesity are considerable. On the other hand, it is pointed out that there may be significant differences in size between individual estimates in these studies. |
| **Unemployment and Wages** | Obesity has a negative impact on wages, increasing the probability of unemployment. |

**Sources:** Hammond and Levine, 2010; Okunogbe et al., 2021.

## DATA AND METHODOLOGY

Within the scope of this study, it is aimed to provide a systematic review of scientific literature of the articles published on the "obesity", by performing VOS Viewer software. Developed by Eck and Waltman (2021), VOS Viewer is an increasingly used software tool to create data-based maps and then visualize those maps (Yıldız and Tosun, 2021).

The systematic review of process in this study can be summarized as follows:

i) As an initial step, the research subject is determined. The "obesity", as the keyword of this study, was scanned by a title in Web of Science (WoS) database on 22.02.2022. 117.977 publications of different types on the concept of obesity found in the WoS database for the time period of 1994-2022.

ii) Second step is to filter the document types. After choosing only list of articles, the remaining 63.846 publications also have been filtered in order to the WoS categories, the studies only dealing with subject area "economics", has been selected.

iii) For the bibliometric analysis, 497 publications have been obtained for the criteria of the study. Bibliometric analysis is a technique to analyse the obtained publications in relation to the country of origin of their authors, most cited articles and, authors publishing the most works. Bibliometric analysis, with the help of VOS Viewer, also contains the frequency analysis, which demonstrates the frequency of key words displayed in the publications.

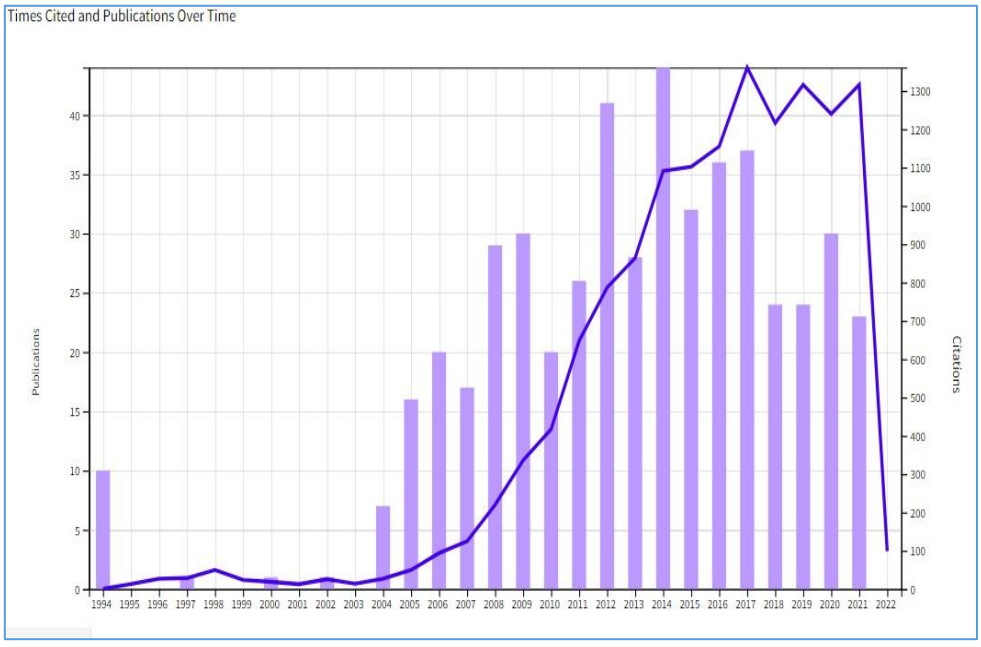
iv) For the last stage of the bibliometric analysis with VOS Viewer, the gathered data is processed. Then; i) the most used keywords with obesity ii) co-citation of the author network in the research field were visualized and illustrated on maps.

To the best of our knowledge, this study is one of the few ever bibliometric studies to report related research in obesity field.

**RESULTS**

In the analysis process, firstly, the distribution of studies in the research field and the number of citations in the literature by years was examined. Graph 1. illustrates the times cited and publications since the first article 1994 to date. No article has been found before the year 1994 regarding the obesity literature. From 1994 to 2004, obesity, as a research topic did not receive much attention from researchers. In other words, there was little academic interest in the research area of obesity to the year 2004.

**Graph 1:** Times Cited and Publications Dealing With Obesity Over 1994-2022.




In 2014, the number of articles on obesity reached 44 (1091 citations). The most publications were published this year and indexed in the WOS database. Although the number of publications has decreased in the following years, obesity

is still a trending topic that attracts the attention of researchers. On the other hand, the greatest number of citations, reaching to 1361 citations with 37 publications, in the obesity research field was in 2017.

By examining the citation numbers and publication graph, the most cited publications in the field of obesity aroused curiosity, and the five most cited articles were examined.

The study of Cawley and Meyerhoefer (2012), the most cited article on obesity, focuses on the medical care costs of obesity, utilizing expenditure panel survey for the time interval, 2002-2005. The results of this investigation mirror the fact that the previous studies underestimated the medical costs of obesity. Based on this reason, it is argued that the economic justification for government intervention to decrease externalities in studies on obesity is underestimated.

The second most cited publication, by Cawley (2004), underlines the fact that there is no consensus about the relationship among body weight and wages. Therefore, he aimed in his study to investigate and generate more consistent predictions of the impacts of weight on wages by utilizing regression analysis. The results of the study indicate that the more white women weigh, the lower their salary.

The result of the study by Chou, Grossman and Saffer (2004), third most cited publication, indicates the triggers of the obesity in the US, such as; "per capita number of fast-food and full-service restaurants, the prices of a meal in each type of restaurant, food consumed at home, cigarettes, and alcohol, and clean indoor air laws".

One of the most cited study, by Burkhauser and Cawley (2008), points out that there is broad consensus in the medical literature that the use of body mass index (BMI) in obesity-related body measurement is inaccurated. The study achieved a number of findings unlike other studies that used BMI as an indicator of obesity. These; i) total body fat was negatively associated with employment for some groups, ii) fat-free mass was not significantly associated with employment for any group.

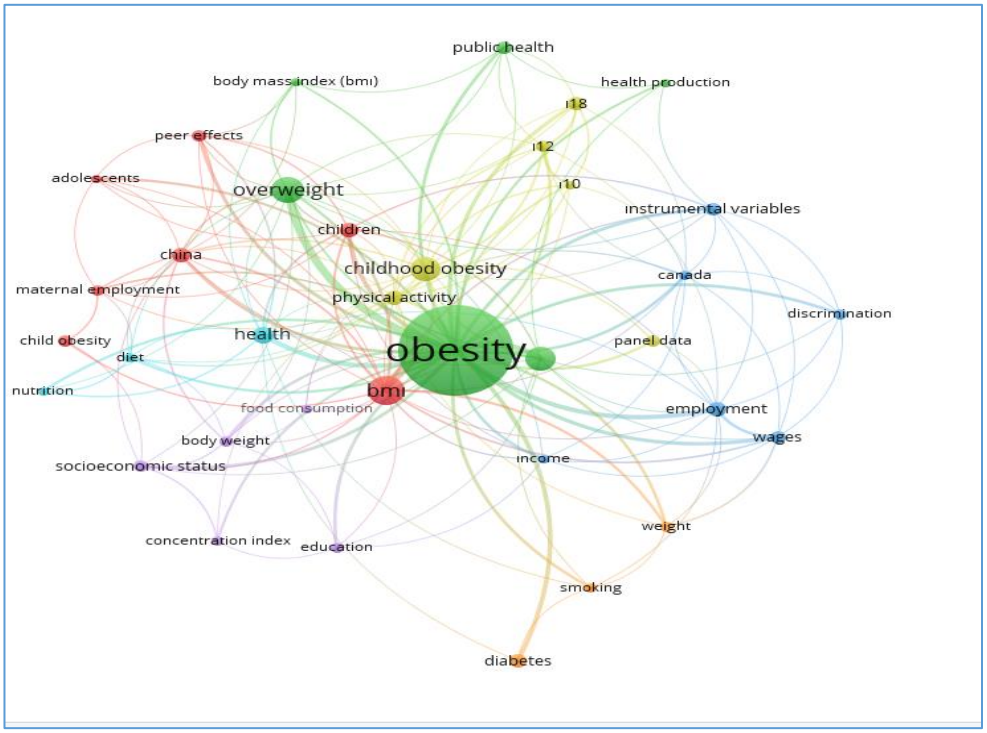
What is interesting in the study of Cohen-Cole and Fletcher (2008), the fifth most cited paper, is that, they investigated the question if obesity is contagious and searched the social network effect in the obesity epidemic by utilizing econometric analysis.

**Keyterms Co-Occurence Analysis**

After the citation and publication of the studies included in the bibliometric analysis were examined, the bibliometric analysis stage was started. In this process, the distribution of studies dealing with obesity and the economic dimension of obesity, published between 1994-2022, in terms of keywords was examined with the VOS Viewer program. The co-occurence of keyterms indicates the number of times the keywords appear in many publications (McAllister et al., 2021).

The data set analyzed by the VOS Viewer software is separated into clusters shown in different colours on the map. The fact that a term belongs to a certain cluster does not mean that it is not included with other terms. In addition, the fact that the terms are in the same cluster means that these terms are used together most frequently. Cluster names are determined by most of the terms a set contains (Glinska and Tomaszewska, 2017).

**Figure 1:** The Relationship Among Key Terms (Keyterms Occurence)




As seen from Figure 1, the gathered data were divided into seven clusters with a total of 36 words and 175 links performing the VOS Viewer software program. Also each link has a strength, these classified clusters and the items (listed form the highest frequency to the least) are the followings:

**i)** Cluster 1 (with red colour): BMI (40), children (13), china (12), child obesity (8), peer effects (8), maternal employment (7), adolescents (5),

**ii)** Cluster 2 (with green colour): obesity (278), overweight (33), body mass index (28), public health (10), body mass index (bmı) (5), health production (5),

**iii)** Cluster 3 (with dark blue colour): employment (13), instrumental variables (10), wages (10), discrimination (7), Canada (6), income (5),

**iv)** Cluster 4 (with yellow colour): childhood obesity (28), physical activity (13), ı18 (11), ı12 (9), panel data (8), ı10 (5),
**v)** Cluster 5 (with purple colour): socioeconomic status (9), body weight (7), education (7), concentration index (6), food consumption (5),
**vi)** Cluster 6 (with blue colour): health (15), diet (6), nutrition (5),
**vii)** Cluster 7 (with orange colour): weight (11), diabetes (7), smoking (6).

From the figure above we can see that, the distance between two keywords points out the relatedness of the keywords in terms of co-occurence links. In other words, as the relevance among two keywords rises, the distance among them also decreases (Eck and Waltman (2021). Also, another substantial point to mention in here is that, just as each cluster has a different colour, each keyword node is represented by its colour. The more keywords that represent a node, the larger the node and the greater the number of network connections on other nodes (McAllister et al., 2021). In addition, based on the results shown in Figure 1, it can be stated that the most used keyword according to the frequency of co-occurrence in a publication is "obesity". After the keyword obesity, the other most used keywords in the top five are BMI, overweight, body mass index (bmı) and childhood obesity, respectively

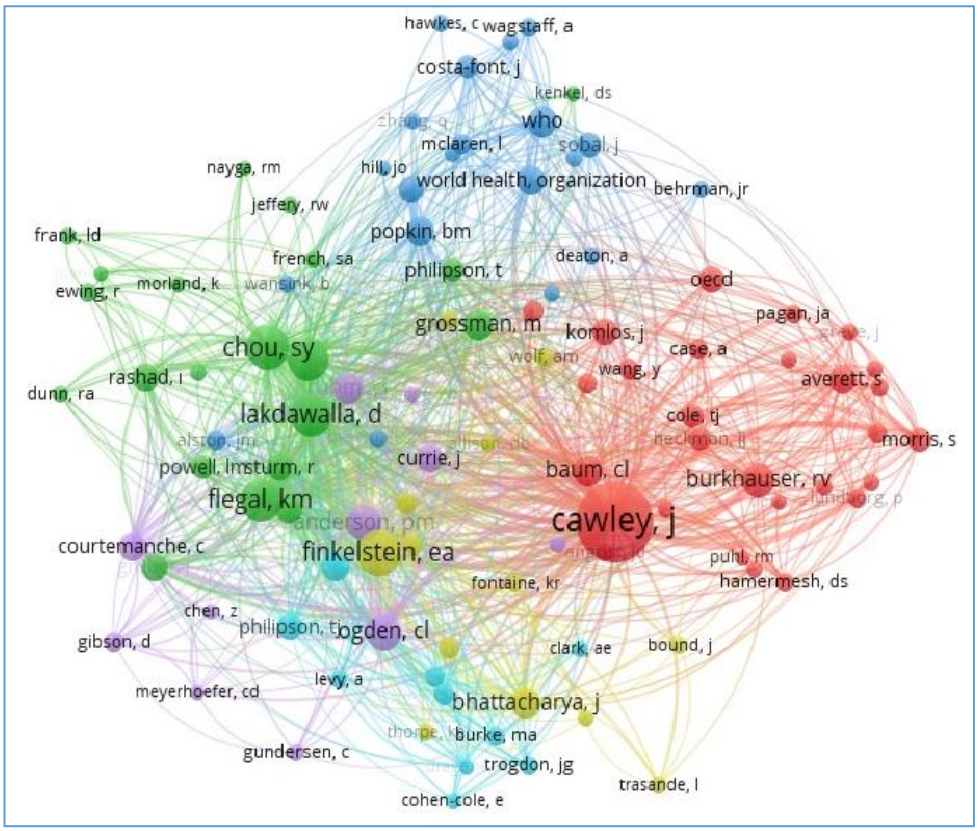
**Author Co-Citation Analysis**

White and Griffith (1981), Fabregat-Aibar et al. (2019) suggested that the intellectual structure of scientific disciplines can be learned through co-citation analysis. In other words, author co-citation analysis means that the series of articles published by an author is understood as the "author". Authors whose publications are often seen as interrelated and repeatedly cited in this way in subsequent works tend to converge on the map. On the other hand, authors that are rarely or never cited together are located relatively further away on the map. In other words, the co-citation analysis of authors concludes that the more often two authors are cited together, the closer the relationship is among them (White and Griffith, 1981).

Figure 2 demonstrates the results of an analysis utilizing all articles on obesity in 1994-2022. On the co-citation network map of authors, each node represents an author, and the size of the node is determined by the number of published articles, links and link strength of an each author. In addition, the nodes in the clusters are connected by lines (McAllister et al., 2021). In other words, the more citations to the author, the bigger the node. This also explains why author Cawley J., the most cited (454 citations) and highest link strength (total link strength 6293) in the field of obesity research, has the largest node in the red cluster on the map. As mentioned earlier, each colour represents a different cluster, and in this study, the VOS Viewer software divided the data from scientific studies in the field of obesity into six separate clusters in the author co-citation analysis. Cluster 1, highlighted in red, has the largest number of authors (28 authors), while cluster 6 has the least number of

authors (10 authors). The second cluster in green consists of 21 authors. The 3 authors with the largest node in the green cluster, Chou, Phlegal and Lakdawalla have 148,142 and 134 citations, respectively. It is seen that the third cluster, shown in dark blue, consists of 20 authors, and the first two most cited authors in this cluster are WHO (69) and Popkin, Bm (66). Finkelstein with 158 citations and Bhattacharya with 73 citations are the most cited authors among the 13 authors in the fourth cluster shown in yellow. In the last cluster with the fewest groups of authors (represented in light blue), the most cited authors are Becker (68 citations) and Philipson (54 citations) (Fabregat-Aibar et al., 2019).

**Figure 2**: Co-citation Network of Authors of Obesity




## CONCLUSION

The purpose of this study is to contribute to the literature by presenting popular scientific studies on obesity in the field of economics. To achieve this purpose, a bibliometric analysis technique, VOS Viewer software, is utilized.

Accordingly, two methods were used in the analysis, namely keyword analysis and author co-citation analysis, respectively.

The data of the publications related to the research area among 1994 to 2022 were accessed from the Web of Science database. Prior to keyword and author network analyses, publications and citations were observed. While there was no article related to the obesity literature before 1994, it was determined that the subject of the study did not receive enough attention between the years 1994-2004. After 2004, fluctuating changes were observed in the number of publications. In 2014, the number of publications reached the highest level with 44 articles and 1091 citations. In other words, the most productive year in terms of the number of publications, was 2014. Although the increase in the number of publications was not as high as in 2014 in other years, the issue of obesity continued to attract the attention of researchers as a trending topic.

The authors' co-citation network helped to identify the most influential authors in obesity research in terms of citations and overall link strength. Top author in the authors' co-citation network was Cawley J. with 454 citations and total link strength 6293 in the field of obesity research.

According to the results of the analysis made with the VOS Viewer program, the keyword network map related to obesity was visualized. The 36 most used keywords and 175 links in publications related to obesity were highlighted on the map by dividing them into clusters of 7 different colors. It can be stated that the most used keyword according to the frequency of co-occurrence in a publication is "obesity". After the keyword obesity, the other most used keywords in the top five are BMI, overweight, body mass index (bmı) and childhood obesity, respectively. It is also worth noting that, the most cited articles about obesity and its economic dimension are focused on generally; the medical care costs of obesity, the relationship among body weight and wages, the prices of food as a trigger of the obesity, the association between body fat and employment and also a question tried to be answered if obesity is contagious by using econometric analysis.

Although obesity and related publications are mostly in 2014, studies on the economic dimension of obesity are currently ongoing. The reasons why obesity is a trending topic that attracts the attention of researchers can be summarized as follows; the fact that the age of obesity has come down to a much earlier age in the world, obesity causes many health problems, obese people who work for wages encounter problems and it is a burden on the health system of many developed countries, especially the United States of America.

The main limitations of this study must be mentioned. The VOS Viewer software, which is used with increasing interest today, is insufficient to resolve overlaping when an academic study is included in different databases. In other words, the same studies are repeatedly included in the bibliometric analysis and

misleading results can be reached in the data. Therefore, data were obtained from a single database (WOS) for bibliometric analysis to avoid duplication.

In conclusion, this study could guide further research in this area by presenting the most and highly cited publications for researchers. In future studies, it may be suggested to expand the analysis by filtering academic publications examining obesity and its economic dimension from other databases such as Scopus and Google Scholar. In addition, by including future studies on the same subject, the time interval of the analysis can be extended and it can be determined whether the attractiveness of the subject continues with the change in the number of publications and authors.

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