**GÜSBD 2021; 10(4): 588 - 596** **Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi** **Araştırma Makalesi**
GUJHS 2021; 10(4): 588 - 596 Gümüşhane University Journal of Health Sciences Original Article

# Evaluation of the Performance of E7 Countries in Terms of Women's Health Status: DEA Analysis

Kadınların Sağlık Düzeyi Açısından E7 Ülkelerinin Performansının Değerlendirilmesi: VZA Analizi

Yeter DEMİR USLU[1], Erman GEDİKLİ[2], Emre YILMAZ[3], Rümeysa TURABOĞLU[4]

## ABSTRACT

The aim of this study is to compare the relative effectiveness of the health systems' performance on the health status of women according to the education level of women, their income level and the ratio of health expenditures to GDP of E7 countries. For this purpose, 4 inputs and 2 output variables were determined. As a result of the correlation analysis conducted before the analysis, the input variable "Education level (Population with at least secondary education, 15 years and over, female)", which is among the input variables and has a high correlation with other variables, was excluded from the analysis. The input oriented CCR-DEA model was used in the study. The analysis results in India, Indonesia and Turkey techniques fully effective; Russia was 93% efficient, China 87.49%, Mexico 84.93% and Brazil 82.3%. Unlike countries that enabled the analysis results with values below the average in Turkey while the input variables have values above the average in the output variables. Therefore, it is for example among the E7 countries with the highest number to have access to the technical activities to other countries in terms of the number of reference Turkey.

**Keywords:** Data envelopment analysis, E7 countries, Women's health

## ÖZ

Bu çalışmanın amacı E7 ülkelerindeki kadınların eğitim düzeyi, gelir durumları ve sağlık harcamalarının ülkelerin GSYH'ye oranı verilerine göre sağlık sistemlerinin kadınların sağlık düzeyi üzerindeki performansının göreli etkinliğini karşılaştırmaktır. Bu amaçla 4 girdi ve 2 çıktı değişken belirlenmiştir. Analiz öncesinde yapılan korelasyon analizi sonucunda girdi ve değişkenler arasında yer alan ve diğer değişkenler ile yüksek korelasyona sahip "Eğitim Düzeyi (En az orta öğretim eğitimi almış nüfus oranı, 15 yaş ve üstü, kadın)" girdi değişkeni analizin dışında tutulmuştur. Çalışmada girdi yönelimli CCR-VZA modeli kullanılmıştır. Değerlendirmeler sonucunda Hindistan, Endonezya ve Türkiye teknik olarak tam etkin; Rusya %93, Çin %87,49, Meksika %84,93 ve Brezilya ise %82,3 düzeyinde etkin çıkmıştır. Analiz sonucu etkin olan ülkelerden farklı olarak Türkiye girdi değişkenlerinde ortalamanın altında değerlere sahip iken; çıktı değişkenlerinde de ortalamanın üstünde değerlere sahiptir. Bu sebeple, E7 ülkeleri arasında Türkiye referans olma düzeyi bakımından en yüksek sayıya sahip olmasıyla diğer ülkelere teknik etkinliğe ulaşabilmeleri için örnek teşkil etmektedir.

**Anahtar Kelimeler:** E7 ülkeleri, Kadın sağlığı, Veri zarflama analizi

*Ethics committee approval was obtained from Istanbul Medipol University Non-Invasive Clinical Research Ethics Committee with the number (Date:01/04/2021 Decision No:385).*

[1] Professor, Yeter DEMİR USLU, Management Strategy, Istanbul Medipol University, Health Management, yuslu@medipol.edu.tr, ORCID: 0000-0002-8529-6466
[2] Lecturer, Erman GEDİKLİ, Health Management, Istanbul Medipol University, Health Management, egedikli@medipol.edu.tr, ORCID: 0000-0002-5508-194X
[3] Research Assistant, Emre YILMAZ, Health Management, Istanbul Medipol University,Health Management, emreyilmaz@medipol.edu.tr, ORCID: 0000-0003-4502-9846
[4] Master Student, Rümeysa TURABOĞLU, Health Management, Istanbul Medipol University Institute of Health Sciences, Health Management, rumeysa.turaboglu@std.medipol.edu.tr, ORCID: 0000-0003-0578-8100

**İletişim /** Corresponding Author: Erman GEDİKLİ
**e-posta**/e-mail: egedikli@medipol.edu.tr

**Geliş Tarihi /** Received: 02.04.2021
**Kabul Tarihi/**Accepted: 31.08.2021

## INTRODUCTION

Health Policies and the general health of societies focus on the health, as well as providing health services fairly or reducing health inequalities of individuals. Understanding the relationships between socio-economic development and health is critical to preventing inequalities in health.[1] As a matter of fact, it is accepted that people with high socio-economic development status have better health status indicators. Education, income living and working conditions and stress situations are among the social and economic factors related to the health of individuals.[2,3] At the same time, the health status of individuals has an impact on productivity, active participation in work life, and well-being. Thus, the health of individuals enables them to be productive in business life and to contribute to the country's capital.[4] For these reasons, it is inevitable that there is a reciprocal rather than a one-way relationship between the economic conditions of the countries and their health indicators.

It is assumed that the increase in income and increased awareness through socio-economic development programs will result in more enlightened health seeking behavior and thus relative improvements in the health status of women and the poor. Studies of the general population have found a link between low socio-economic status and poor health called "socio-economic inequality in health".[5] Many studies in the literature have shown that individuals' health differences depend on their gender and age. Many women around the world have low health status due to both socio-economic and biological reasons.[6]

The purpose of this study is to test the efficiency of the health systems' performance on the health status of women according to the education level of women, their income levels and the ratio of health expenditure to GDP of the E7 countries, which are grouped as major developing countries.

### Socio-Economic Development and Women's Health

Policies aimed at protecting, expanding, and improving public health form the basis of sustainable development.[7] The quality and intensity of health problems vary according to the development status of societies. With the increase in the status of development, the increase in formal and non-formal education activities indirectly increases health awareness. In addition, the widespread use of mass media has an important role in raising health awareness.[8] Therefore, socio-economic development efforts are seen as an important tool for accessing and using health services. It also contributes to the advancement of gender equality in most low- and middle-income countries, particularly by increasing women's income, autonomy, and security against marital violence.[9]

Socio-economic status is expressed as a broad concept that includes variables such as individuals' income, education, and occupation.[10] Income and low level of education are accepted as priority variables. Income level among these variables is a basic socio-economic determinant of health.[7-11] In particular, it can be said that women with a high-income wife and financial freedom have better opportunities to benefit from financial and social resources than women in other income groups.[12]

There is a significant relationship between the development levels of countries and women's health. It is a well-known fact that in a developed country, more funds are allocated than in underdeveloped or developing countries, both for the protection of women's health and for the diagnosis, treatment, and rehabilitation of diseases. As the status of development increases, women's perspectives on health-related events also change and their awareness about health increases.

In layoffs, which often occur in connection with economic crises, women are first fired because they work in less qualified positions. The 1992 UN report found that the

number of women living in poverty in rural areas has increased by almost 50% in the last 20 years. The 1995 UN development report stated that 70% of the world's poor are women.[13]

Education is another variable that affects socio-economic health inequality and is closely related to financial freedom and security, sustainable employment opportunities and social success. In particular, the type of education provided can expand or narrow the dimensions of this problem. [14]

Life expectancy at birth, which is among the priority indicators in expressing the health status of societies, is important.[15] Life expectancy at birth as a measure of mortality is one of the most widely used indicators of population health.[11] In addition, life expectancy is an important indicator for evaluating the economic and social development of a country or region. Therefore, it also includes various socio-economic preconditions such as improving health, raising low education levels, reducing unemployment and insecurity, and improving living conditions. [16]

The indicators of the countries considered within the scope of socio-economic development and health status of women in the research are as follows;

1. The share of health expenditure in GDP (%)
2. Literacy rate (age 15 and over, female)
3. Proportion of population with at least secondary education (age 25 and over, female)
4. Labor force participation rate (15 years and older, female)
5. Life Expectancy at Birth (female)
6. Maternal Mortality Rate (per 100,000 live births)

## MATERIAL AND METHODS

The input-focused DEA method was used to measure the effects of the health systems of the E7 countries included in the study on the health status of women. In order for the method to be applied, input and output variables are determined first. Then, after determining the variables, correlation analysis is performed; In the variable group in which they were included, elimination was made among the highly and very high related variables. Finally, CCR-DEA model was applied for input by determining the final variables.

SPSS Package 25 and Frontier Analyst 4.3.0 programs were used for analysis.

### Aspect of Research Ethics

This study was decided to be ethically and scientifically appropriate by the Istanbul Medipol University Non-Invasive Ethics Committee (Date: 01/04/2021, Decision No: 385). The study was conducted in accordance with the Helsinki Declaration Principles.

### Data Envelopment Analysis

DEA is a method designed to estimate the relative efficiency of similar decision-making units (DMU) by comparing them with the same predetermined input and output data.[17] The measurement of productivity with DEA method is based on Farrell's study in 1957. The efficiency measure Farrell achieves over a single output/single input ratio was developed by Charnes, Cooper and Rhodes (CCR), and a multiple output/multiple input format was created. With this model, artificial inputs and outputs are created for each DM and efficiency scores are determined.[18] In addition to the CCR, the BBC (Banker, Charnes and Cooper) return on scale model can also be preferred according to the subjective characteristics of the data and research design.[19]

There is a fixed return to scale in the CCR model. With the CCR model, input and output-oriented analysis can be made. While the effective DMUs are the same in both oriented analyzes, different projections are taken among the inactive ones.[20] In the input-oriented model, it examines the level of input

combination and how it should be used to reach a particular output combination in the most efficient way.[21,22]

In this study, the input oriented CCR model was used in order to achieve the goal. According to the CCR model, where there are m inputs and s outputs, the output/ input ratio to be maximized for n DMUs in formulation numbered 1; In formulation number 2, the first constraint that ensures that the efficiency of DMP does not exceed 100% in cases where other DMUs use; The second constraint that ensures that input and output variables cannot have negative values is expressed mathematically in formulation number 3.

Aim function:

$$Max_{hk} = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \quad (1)$$

Constraint equations of the model

$$\frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \leq 1; j = 1, \dots, n \quad (2)$$

$$u_{rk} \geq 0,\ r = 1,2, \dots, s$$

$$v_{ik} \geq 0,\ i = 1,2, \dots, m \quad (3)$$

n: DMU number,

m: Number of entries,

s: Number of outputs,

$u_r$: Weight belonging to the rth output of the k'th DMU,

$v_i$: The weight of the i'th input of the k'th DMU,

$y_{rk}$: K'th output produced by DMU,

$x_{ik}$: K'th i'th input used by DMU.

**Application Stages of Data Envelopment Analysis**

In order for DEA to be applied successfully, the following steps should be followed;

Determination of Decision-Making Units: The first step of DEA is to select the decision units where comparative efficiency measurement will be made. The homogeneous structure of the selected units is very important in terms of the meaningful planned to be achieved. In addition, DMU numbers should be determined according to the number of variables in order for the analysis to reach meaningful results. In the literature, there are two different opinions on the determination of DMP numbers. In the first one, the DMU number must be at least one more than the number of input and output variables ($n \geq m+s+1$).[23] The other is that it must be $n \geq \max [mxs, 3(m+s)]$. [24]

Determination of Input and Output variables: Relative effectiveness of DMUs in DEA are determined according to input and output variables. All factors influencing the purpose should be taken into account. The increase in the number of input and output variables increases the number of DMUs and decreases the decomposition capability of the model. For these reasons, it is preferred to have a reasonable level rather than adding too many input-output variables.[19-25]

Selection of the model to be used: In the last stage, the most suitable DEA model is determined to achieve the determined goal, and the efficiency results of DMUs are calculated and the results are evaluated. [26]

**Limitation of Research**

The results of this analysis measure relative effectiveness, not absolute. So, it is not possible to state that the health systems of countries that are technically effective because of the DEA analysis are functioning perfectly. Also, using of certain data (fully accessible and current) in this study is among the most important limitations.

### Data Set Used

The data used in the study were obtained from WHO, World Bank Data and OECD (2019) data banks.

**Table 1: Used Input and Output Variables**

| Countries | Health Expenditures (%GSYH) ($m_1$) | Literacy Rate 15 years an older, female) ($m_2$) | Proportion of population with at least secondary education (age 25 and over, female) ($m_3$) | Labor force participation rate (15 years and older, female) ($m_4$) | Life expectancy at birth ($s_1$) | Maternal Survival Rate ($s_2$) |
|---|---|---|---|---|---|---|
| Brazil | 9,2 | 93 | 61,6 | 54,2 | 79 | 15,67 |
| China | 5,0 | 95 | 76,0 | 60,5 | 79 | 33,48 |
| India | 3,6 | 66 | 27,7 | 20,5 | 71 | 6,52 |
| Indonesia | 3,1 | 94 | 46,8 | 53,1 | 74 | 4,65 |
| Mexico | 5,5 | 95 | 62,2 | 44,2 | 78 | 29,30 |
| Russia | 5,3 | 100 | 96,3 | 54,8 | 78 | 57,82 |
| Turkey | 4,2 | 93 | 50,2 | 34,0 | 80 | 57,82 |
| **Mean, Std. Deviation** | **5,13±2** | **90,86 ±11,2** | **60,11±21,9** | **45,90±14,1** | **77±3,2** | **29,32±22,2** |

Data belonging to input and output variables must be in the same direction; In other words, whether it is positive, or negative is important in terms of achieving reliable results. In this respect, while the positive change in the "Life expected Life at Birth" variable, which is one of the output variables used in the study, is positive, the decrease in the "Maternal Mortality Rate" variable indicates positive results. For this reason, "Maternal Mortality Rate", which is among the output variables, was calculated according to the formulas used by Afonso and Abuyn in their 2006 studies and included in the model as "Maternal Survival Rate (AQR)".[27,28]

## RESULTS AND DISCUSSION

In the study, E7 countries as DMUs where the health status of women is expressed, according to input and output variables, an input-oriented CCR-DEA model was established and analyzed.

E7 countries, which are expressed as the fastest growing economies of the world; Brazil, China, India, Indonesia, Mexico, Russia and Turkey were included in the study. Since input and output variables will be the only factors that determine whether countries are effective or not, this is important in terms of determining the correct variables and the reliability of the data. It has been observed in the literature that different variables are used to compare health system and measure their effectiveness. In our study, variable selection was made by taking into account the factors that have proven to have an effect on women's health status. In this direction, 4 inputs and 2 output variables were determined.

### Input Variables

$m_1$: The share of health expenditures in GDP (%)

$m_2$: Literacy rate (age 15 and over, female)

$m_3$: The proportion of population with at least secondary education (age 25 and over, female)

$m_4$: Labor force participation rate (age 15 and over, female)

### Output Variables

$s_1$: Life Expectancy at Birth (Female)

$s_2$: Maternal Survival Rate

by performing correlation analysis of input and output variables were found to have a high and very high level of relationship between them were excluded from the analysis. Because using two different variables with the same direction in DEA may cause bias.[29] Correlation analysis results are summarized in Table 2 and Table 3.

**Table 2. Correlation Analysis Table for the Variables**

| | $m_1$ | $m_2$ | $m_3$ | $m_4$ | $s_1$ | $s_2$ |
|---|---|---|---|---|---|---|
| $m_1$ | 1,000 | | | | | |
| $m_2$ | ,327 | 1,000 | | | | |
| $m_3$ | ,643 | ,873* | 1,000 | | | |
| $m_4$ | ,393 | ,709 | ,786* | 1,000 | | |
| $s_1$ | ,436 | ,083 | ,400 | ,309 | 1,000 | |
| $s_2$ | ,360 | ,468 | ,685 | ,288 | ,670 | 1,000 |

* Correlation is significant at the 0.05 level.

When the table data is examined, it is seen that there is a high and very high relationship between some variables in the same group. In the data envelopment analysis to be conducted to measure efficiency in order to reach more realistic results, variables with high correlation between them were not used. Among the input variables, the variable "m3: The proportion of population with at least secondary education (age 25 and over, female)" was excluded from the analysis.

**Table 3. Correlation P Values of the Variables**

| | $m_1$ | $m_2$ | $m_3$ | $m_4$ | $s_1$ | $s_2$ |
|---|---|---|---|---|---|---|
| $m_1$ | . | | | | | |
| $m_2$ | ,474 | . | | | | |
| $m_3$ | ,119 | ,010 | . | | | |
| $m_4$ | ,383 | ,074 | ,036 | . | | |
| $s_1$ | ,328 | ,859 | ,374 | ,500 | . | |
| $s_2$ | ,427 | ,290 | ,090 | ,531 | ,100 | . |

For DEA to reach effective and accurate results, DMUs must be sufficient in number. There are different opinions on the number of DMUs. In the study, a total of 5 variables including 3 inputs and 2 outputs were used to analyze data from 7 countries. Thus, the condition that "DMU number must be at least one more than the number of input and output variables ($n \geq m + s + 1$)" is satisfied.[23]

**Table 4. DEA Results**

| Country | Effectiveness Score (%) | Reference Countries | Referencing |
|---|---|---|---|
| Brazil | 82,3 | India, Turkey | - |
| China | 87,49 | India, Turkey | - |
| India | 100 | India | 4 |
| Indonesia | 100 | Indonesia | 1 |
| Mexico | 84,93 | India, Turkey | - |
| Russia | 93 | Turkey | - |
| Turkey | 100 | Turkey | 5 |

In the study, the data of E7 countries, which are among the major developing countries, were grouped. The relative effectiveness of the health system of selected countries on women's health was analyzed using the input oriented CCR model, using the last year data available. Analysis results are summarized in Table 4.

According to Table 4 in India, we can say that technically efficient than the value of Indonesia and Turkey. Although India has very low inputs and outputs compared to other countries, it is a very striking result that it is technically efficient. With retrospective studies conducted in Indonesia in the past years, it was stated that the life expectancy of women increased more than men and that the death rate of female babies was lower, but the safety and accessibility of the data were also criticized.[30-32]

Again, in a study conducted in India in 2020, it was determined that there has been a decrease of 18% in infant mortality rates in the last thirty years, 60% in males and 57% in females in deaths under the age of five.[33] According to the results of the analysis, it can be said that India and Indonesia achieved these results by using their resources effectively. The most important difference between Turkey, India, and Indonesia only when the input variables with values below average output is variable with values above average. For this reason, Turkey is the country that most kindly reference.

Brazil, China, Mexico, and Russia are among the technically inactive countries. According to DEA results, countries with high status of health outcomes are not technically efficient and should not be considered as a failure of the system. The only reason for this result is that it achieves high health outcomes with high inputs. The reason why countries such as India and Indonesia are effective is that they have low inputs, as stated above.

The comments to be made in this regard should be in the direction of the necessity of transferring the resource allocation to the optimum and appropriate areas. As interpreted in this study, the control or inclusion of decision makers is on input variables.

**Table 5: Target Input Values for Technically Ineffective Countries**

| | **Brazil** | | **China** | | **Mexico** | | **Russia** | |
|---|---|---|---|---|---|---|---|---|
| | Target | Potential Improvement (%) | Target | Potential Improvement (%) | Target | Potential Improvement (%) | Target | Potential Improvement (%) |
| **$m_1$** | 4,90 | -46,78 | 4,66 | -6,73 | 4,73 | -13,98 | 4,52 | -14,79 |
| **$m_2$** | 93 | 0 | 95 | 0 | 95 | 0 | 100 | 0 |
| **$m_4$** | 29,92 | -44,79 | 32,54 | -46,21 | 32,15 | -27,27 | 36,56 | -33,29 |

Table 5 shows which countries Brazil, China, Mexico and Russia can refer to be technically effective; The target values on the variables and the change rates required to achieve these targets are given in Table 6. In order for Brazil, China, Mexico and Russia to be technically efficient, the share of health expenditures in GDP is 46.78%, 6.73%, 13.98% and 14.79% respectively; It is recommended to decrease the labor force participation rate of women aged 15 and over by 44.79%, 46.21%, 27.27% and 33.29%, respectively. However, the reason for this result is the use of input-oriented analysis. So, the method is sourced. So that in this analysis, maximum output with the least input is aimed.

Inequality in income distribution in Brazil and Mexico; It can be said that it is caused by variables as women are poorer. Such that; According to a study conducted in Brazil between 2012 and 2017; Among all mortality

rates, it was found that the mortality rate of adult women with low-income levels was 14% higher.[34-35] Unlike Brazil, the inequality in the distribution of healthcare resources and geographic factors has affected the status of health in China.[36]

## CONCLUSION AND RECOMMENDATIONS

The relative efficiency analysis of the health systems of the countries included in the study on improving the health status of women was performed using DEA. In this context, socioeconomic input variables affecting the health status of women in E7 countries, which are defined as the main developing countries, and the health status indicators of the World Health Organization were included in the analysis as outputs. Correlation analysis was performed by making use of the literature in the selection of variables and its suitability for DEA was tested. The topics where decision makers can intervene in the evaluation of health systems can be listed as health expenditures, employment, and education policies for women. In this respect, the input oriented CCR model was employed to evaluate the relative efficiency of the countries. It is not possible to state that the health systems of countries that are technically effective because of the analysis are functioning perfectly.

Here, DEA determines which country or countries use the resources of the country's efficiency and inefficiently. Brazil, China, Mexico, and Russia are technically inefficient countries. The main reason for this result is that it achieves high health outcomes with high inputs. India, Indonesia, and Turkey have emerged as efficiency. Although India has very low inputs and outputs compared to other countries, it is a very striking result that it is technically efficient. Turkey is the most important difference between India and Indonesia, while just below average with values of input variables; the output is that the variables have above average values. For this reason, Turkey is considered to be the country most referenced.

In addition, efficiency measurement can be made by using not only DEA but also different methods to measure the efficiency of countries because DEA measures relative and technical efficiency. Researchers can re-do research on these topics using different methods and up to date data, and including different countries.

**REFERENCES**

1. Williams, J.S, Cunich, M. and Byles, J. (2013). "The impact of socioeconomic status on changes in the general and mental health of women over time: Evidence from a longitudinal study of Australian women". Int J Equity Health, 12 (1). doi:10.1186/1475-9276-12-25
2. WHO. (2011) "Closing the gap : policy into practice on social determinants of health : discussion paper".
3. Marmot, M. (2004). The Status Syndrome: How Social Standing Affects our Health and Longevity. Washington: Holt Paperbacks.
4. Boz, C, Önder, E. and Taş, N. (2018). "Comparison of Health Status Indicators with Multidimensional Scaling and The Multi Objective Optimization by Ratio Analysis". Sağlık ve Hemşirelik Yönetimi Dergisi, 5 (3), 179–187. doi:10.5222/shyd.2018.179
5. Demakakos, P, Nazroo, J, Breeze, E. and Marmot, M. (2008). "Socioeconomic status and health: The role of subjective social status". Soc Sci Med, 67 (2), 330–340. doi:10.1016/j.socscimed.2008.03.038
6. Cohen, M. (1994) "Impact of Poverty on Women's Health". Can Fam Physician, 40, 949–958.
7. Bayati, M, Akbarian, R. and Kavosi, Z. (2013). "Determinants of life expectancy in eastern Mediterranean region: A health production function". Int J Heal Policy Management, 1 (1), 57–61. doi:10.15171/ijhpm.2013.09
8. Arıkan, Ç. and Aktaş, A.M. (2008). "Türkiye'de Kadın Sağlığını Etkileyen Sosyoekonomik Faktörler ve Yoksulluk". Sos Polit Çalışmaları Der, 13 (13), 21–28. doi:10.21560/spcd.28791
9. Karim, R, Emmelin, M, Wamala, Andersson, S. and Lindberg, L. (2020). "Socioeconomic development initiatives and women's experiences of marital violence in rural Bangladesh". Int Soc Work Published, doi:10.1177/0020872820962198
10. Shavers, V.L. (2007) "Measurement of socioeconomic status in health disparities research". J Natl Med Assoc, 99 (9), 1013–1023. doi:10.13016/avw3-9cvx
11. Miladinov, G. (2020). "Socioeconomic development and life expectancy relationship: evidence from the EU accession candidate countries". Genus, 76 (1), 2. doi:10.1186/s41118-019-0071-0
12. Ford, M.T. (2011). "Linking household income and work-family conflict: A moderated mediation study". Stress Heal, 27 (2), 144–162. doi:10.1002/smi.1328
13. Moghadam, V.M. (2005). "The "feminization of Poverty" and Women's Human Rights". UNESCO.
14. Daoud, N, Soskolne, V. and Manor, O. (2019). "Educational inequalities in self-rated health within the Arab minority in Israel: explanatory factors". Eur J Public Health, 19 (5), 477–483. doi:10.1093/eurpub/ckp080
15. Erdoğan, E, Ener, M. and Arıca, F. (2013). "The Strategic Role of Infant Mortality in the Process of Economic Growth: An Application for High Income OECD Countries. Procedia". Soc Behav Sci, 99, 19 -25. doi: 10.1016/j.sbspro.2013.10.467
16. Bilas, V, Franc, S. and Bošnjak, M. (2014) "Determinant factors of life expectancy at birth in the European Union countries". Coll Antropol, 38 (1), 1–9.
17. Kutlar, A. and Kartal, M. (2004). "Cumhuriyet Üniversitesinin Verimlilik Analizi: Fakülteler Düzeyinde Veri Zarflama Yöntemiyle Bir Uygulama". Kocaeli Üniversitesi Sos Bilim Dergisi, 2 (8), 49–79.
18. Bal, H. and Örkçü, H.H. (2010). "Combining The Discriminant Analysis and The Data Envelopment Analysis in View of Multiple Criteria Decision Making: A New Model". Gazi Üniversitesi Fen Bilim Dergisi, 18 (3), 355–364.
19. Baysal, M, Alçılar, B, Çerçioğlu, H. and Toklu, B. (2005). "Türkiye'deki Devlet Üniversitelerinin 2004 Yılı Performanslarının, Veri Zarflama Analizi Yöntemiyle Belirlenip Buna Göre 2005 Yılı Bütçe Tahsislerinin Yapılması". Sak Üniversitesi Fen Bilim Enstitüsü Dergisi, 9 (1), 67–73.
20. Dinçer, E. (2011). Stratejik Planlama ve Veri Zarflama Analizinde Etkinlik Ölçümü. D&R- Kültür, Sanat ve Eğlence Dünyası Der Yayınları.
21. Charnes, A, Cooper, W.W. and Rhodes, E. (1981). "Evaluating Program and Managerial Efficiency: An Application of Data Envelopment Analysis to Program Follow Through". Manage Sci, 27 (6).
22. Çelikkaya, F. (2016). "Türkiye'nin Büyükşehir Belediyelerinin Etkinlik Analizi". Doktora Tezi. Gaziosmanpaşa Üniversitesi Sosyal Bilimler Enstitüsü, Tokat.
23. Bakırcı, F. (2006) "Üretimde Etkinlik ve Verimlilik Ölçümü Veri Zarflama Analizi Teori ve Uygulama". Atlas Yayınları.
24. 24.Cooper, W.W, Seiford, L.M. and Tone, K. (2007). "Data Envelopment Analysis". Springer US. doi:10.1007/978-0-387-45283-8_3
25. Savaş, F. (2015). "Veri Zarflama Analizi. Içinde: Önder E, Yıldırım BF, ed. Çok Kriterli Karar Verme Teknikleri". Dora Yayıncılık, 201–217.
26. Yolalan, R. (1993). "İşletmelerde Göreli Etkinlik Ölçümü". MPM Yayınları, 1993.
27. Afonso, A. and Aubyn, M.S. (2005). "Non-Parametric Approaches to Education and Health Efficiency in OECD Countries". J Appl Econ, 8 (2), 227–246. doi:10.1080/15140326.2005.12040626
28. Boz, C. and Önder, E. (2017). "OECD Ülkelerinin Sağlık Sistemi Performanslarının Değerlendirilmesi". Sos Güvence Dergisi, 6 (11).
29. Kocaman, A.M, Mutlu, M.E, Bayraktar, D. and Araz, Ö.M. (2012). "OECD Ülkelerinin Sağlık Sistemlerinin Etkinlik Analizi". Endüstri Mühendisliği Dergisi, 23 (4), 14–31.
30. Hajarisman, N. and Karyana, Y. (2016). "Geographic Modeling on the Infant Mortality Rate in West Java". Mimb J Sos dan Pembang, 32 (1), 194–205.
31. Sudharsanan, N. (2019). "The Association Between Socioeconomic Status and Adult Mortality in a Developing Country: Evidence From a Nationally Representative Longitudinal Survey of Indonesian Adults". Journals Gerontol Ser B, 74 (3), 484–495. doi:10.1093/geronb/gbx061
32. Mboi, N, Murty, Surbakti, I, Trihandini, I. et al. (2018). "On the road to universal health care in Indonesia, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016". Lancet, 392 (10147), 581–591. doi:10.1016/S0140-6736(18)30595-6
33. Pal, A, Yadav, J, Kumari, D. and Jitenkumar, Singh K. (2020). "Gender differentials and risk of infant and under five mortality in India. A comparative survival analysis". Child Youth Serv Rev, 118, 105477. doi:10.1016/j.childyouth.105477
34. Hone, T, Mirelman, A.J, Rasella, D. (2019). "Effect of economic recession and impact of health and social protection expenditures on adult mortality: a longitudinal analysis of 5565 Brazilian municipalities". Lancet Glob Heal, 7 (11), 1575–1583. doi:10.1016/S2214-109X(19)30409-7
35. Ramos, M.E, Gibaja-Romero, D.E. and Ochoa, S.A. (2020). "Gender inequality and gender-based poverty in Mexico". Heliyon, 6 (1), doi:10.1016/j.heliyon.2020.e03322
36. Jin, J, Wang, J, Ma, X, Wang, Y. and Li, R. (2015). "Equality of Medical Health Resource Allocation in China Based on the Gini Coefficient Method". PubMed Iran J Public Heal, 44 (4), 445–457.