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Comparative Analysis of Health Expenditures in Turkey and OECD Countries: CRITIC-Based Hellwig and TOPSIS Approaches

Pınar Nur Dalgıç[1]

[1] Yozgat Bozok University, Faculty of Economics and Administrative Sciences, Department of Health Management, Yozgat, Türkiye

ABSTRACT

Purpose: The objective of this study is to comparatively analyse health expenditures in Turkey and OECD countries using 2023–2024 data. Given the limited number of studies combining the Hellwig and TOPSIS methods with recent datasets, this study addresses this gap by providing a more consistent and data-driven cross-country comparison of health expenditures.

Methods: In the present study, a quintet of criteria were employed: per capita total health expenditure, public and private health expenditures, the share of health expenditure in GDP, and retail pharmaceutical expenditure. The evaluation of all criteria was conducted from the perspective of their potential benefit. Criterion weights were determined using the CRITIC method, and the analysis was conducted by integrating the Hellwig and TOPSIS methods, resulting in the ranking of countries.

Results: The results show that both methods yield largely similar rankings, with the United States and Switzerland at the top, followed by Germany, Canada, Austria, and Australia. Norway, the Netherlands, Sweden, and Finland are positioned in the middle group, while Turkey consistently ranks at the bottom. Overall, substantial differences are observed across OECD countries in both the level and composition of health expenditures.

Conclusion: There are significant differences among OECD countries in both the level and composition of health expenditures. The findings indicate that Turkey is below the OECD average across all indicators and remains in the lowest group in terms of health expenditure, highlighting the need to strengthen health financing. In this context, it is recommended to gradually increase public health expenditure as a share of GDP, strengthen primary health care services, develop performance-based budgeting for preventive services, and implement resource allocation mechanisms to reduce regional disparities in health expenditures.

Keywords: OECD, Health expenditures, Hellwig method, TOPSIS, CRITIC, Health economics

ÖZET

Amaç: Bu çalışmanın amacı, Türkiye ve OECD ülkelerinin sağlık harcamalarını 2023–2024 verileri kullanılarak karşılaştırmalı olarak analiz etmektir. Hellwig ve TOPSIS yöntemlerini güncel veri setleriyle birlikte kullanan çalışmaların sınırlı olması, bu çalışmanın temel araştırma boşluğunu oluşturmaktadır. Bu bağlamda çalışma, sağlık harcamalarının daha tutarlı ve veri temelli bir yaklaşımla ülkeler arası karşılaştırılmasını sağlamayı amaçlamaktadır.

Yöntem: Bu çalışmada beş kriter kullanılmıştır: kişi başı toplam sağlık harcaması, kamu ve özel sağlık harcamaları, GSYİH içindeki sağlık harcaması payı ve perakende ilaç harcaması. Tüm kriterler fayda yönlü olarak değerlendirilmiştir. Kriter ağırlıkları CRITIC yöntemi ile belirlenmiş ve analiz Hellwig ve TOPSIS yöntemlerinin entegre edilmesiyle gerçekleştirilmiş, ülkelerin sıralamaları elde edilmiştir.

Bulgular: Bulgular, her iki yöntemin büyük ölçüde benzer sıralamalar ürettiğini göstermektedir. ABD ve İsviçre en üst sırada yer alırken, Almanya, Kanada, Avusturya ve Avustralya bu ülkeleri takip etmektedir. Norveç, Hollanda, İsveç ve Finlandiya orta grupta yer alırken Türkiye sürekli olarak en alt sırada konumlanmıştır. Genel olarak OECD ülkeleri arasında sağlık harcamalarının düzeyi ve bileşimi açısından önemli farklılıklar olduğu görülmektedir.

Sonuç: OECD ülkeleri arasında sağlık harcamalarının düzeyi ve bileşimi açısından önemli farklılıklar bulunmaktadır. Bulgular, Türkiye'nin tüm göstergelerde OECD ortalamasının altında yer aldığını ve sağlık harcamaları açısından en alt grupta konumlandığını göstermekte olup, sağlık finansmanının güçlendirilmesi gerekliliğine işaret etmektedir. Bu kapsamda kamu sağlık harcamalarının GSYİH içindeki payının kademeli olarak artırılması, birinci basamak sağlık hizmetlerinin güçlendirilmesi, koruyucu sağlık hizmetleri için performans temelli bütçeleme sistemlerinin geliştirilmesi ve bölgesel sağlık harcaması eşitsizliklerini azaltmaya yönelik kaynak tahsis mekanizmalarının uygulanması önerilmektedir.

Anahtar Kelimeler: OECD, sağlık harcamaları, Hellwig yöntemi, TOPSIS, CRITIC, sağlık ekonomisi

Pınar Nur DALGIÇ
0009-0002-0534-6767

Correspondence: Pınar Nur Dalgıç
Yozgat Bozok University, Faculty of Economics and Administrative Sciences, Department of Health Management Yozgat, Türkiye
Phone: +90 0354 242 10 41
E-mail: dalgicpinarnur@gmail.com

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Health expenditures are pivotal in evaluating a nation's health system financial capacity, resource allocation, and the efficacy of its health policies. It is evident that such expenditures not only constitute the costs associated with the delivery of healthcare services, but also serve as a reliable indicator of the system's sustainability, accessibility, and the quality of care it provides. A multitude of factors have been identified as contributing to the sustained increase in health expenditures. These include economic growth, demographic changes, technological advancements, and increasing demand for health services (1). Furthermore, population ageing, the rising prevalence of chronic diseases, and increasing medical technology costs are significant factors influencing both the overall level and composition of health spending (2). However, recent studies have indicated that health expenditures are not merely a performance indicator associated with health outcomes, but also reflect the financial capacity and resource mobilisation level that countries can allocate to their health systems. Consequently, health expenditures are regarded as a metric that reflects the extent to which economic resources are allocated to the health sector by the public and private sectors, and is challenging to measure directly (1,2,3).

Specifically, indicators such as per capita health expenditure, total health expenditure, and the share of health expenditure in GDP are frequently utilised in cross-country comparisons to assess the financial capacity of health systems. These indicators reflect the level and structure of economic resources allocated to the health sector rather than the efficiency of the health system itself (4). International comparisons indicate that, particularly among OECD countries, health expenditures exhibit significant differences in both level and structure. In high-income countries, per capita spending and the proportion of GDP allocated to health are higher, whereas in middle- and low-income countries, expenditure levels remain comparatively constrained (3,4). Nevertheless, increased expenditure does not necessarily result in equivalent health benefits. Cutler and McClellan, along with other researchers in the field, have emphasised that increases in health expenditure do not necessarily result in direct, linear relationships with health outcomes. They have also highlighted that system efficiency is closely related to effective resource allocation. Consequently, when analysing health systems, it is imperative to consider not only total expenditure but also the composition, distribution, and efficiency of spending (5).

Within the context of Türkiye, there has been a steady increase in the proportion of health expenditures to total GDP. This is accompanied by significant variations in the distribution of expenditures between the public and private sectors, as well as in per capita health expenditure levels. In the extant literature, the application of multi criteria decision making (MCDM) methods to evaluate the performance of health systems in Turkey is limited. In particular, TOPSIS and AHP methods have primarily been applied in comparisons across provinces or healthcare institutions (6, 7). Conversely, although the Hellwig method provides a synthetic performance measure based on the distance to an ideal reference point, it is rarely used in the analysis of health expenditures in both the international literature and the Turkish context (8, 9).

The primary objective of this study is to comparatively evaluate Turkey's health expenditures with those of OECD countries and to analyse countries' health expenditure indicators within a MCDM framework using up to date data. The study does not treat health expenditures as a unidimensional indicator, but rather as a multidimensional set of indicators. These indicators reflect the financial structure of health systems and the distribution of resources.

Material and Methods

1.1. Objective and Scope of the Study

The present study aims to compare the health expenditures of Turkey and other OECD countries. The Hellwig and TOPSIS methods, which are among the MCDM techniques, will be used in this study, with CRITIC-based weighting. The study is based on five core health expenditure indicators that enable international comparison and cover the 2023-2024 period. The primary rationale for the selection of data from 2023-2024 is to guarantee access to the most recent and comparable health expenditure indicators available in the OECD database, thereby ensuring data consistency. The analysis encompassed a total of 35 OECD countries; however, Mexico, Colombia, and Costa Rica were excluded due to missing data in several key indicators for recent years. Consequently, these countries were not included in the study scope.

1.2. Criteria Used in the Study

The health expenditure indicators included in the analysis were selected because they are among the most fundamental and commonly used indicators in the health economics literature for comparing health systems across countries and regions (10,11,12). The share of health expenditure in GDP reflects the economic importance of the health system (10), per capita public and private health expenditures reflect the financing structure (13), per capita retail pharmaceutical expenditure reflects expenditure composition (10), and per capita total health expenditure reflects the overall financial magnitude of the health system (14). All criteria used in the study were treated as benefit oriented, where higher values indicate greater resource allocation and spending intensity in the health system. However, this does not directly imply higher health system performance, but rather indicates higher levels of expenditure across different components of health spending.

The criteria used in the study are as follows:

- **C1:** Share of health expenditures in GDP (%) – Data Year: 2024
- **C2:** Per capita public health expenditure (USD, PPP) – Data Year: 2024
- **C3:** Per capita private health expenditure (USD, PPP) – Data Year: 2024
- **C4:** Per capita retail pharmaceutical expenditure (USD, PPP) – Data Year: 2023
- **C5:** Per capita total health expenditure (USD, PPP) – Data Year: 2024

*Note: PPP = Purchasing Power Parity

1.3. Study Limitations

The present study is subject to several limitations. Initially, it should be noted that although the OECD comprises 38 member countries, the analysis did not include Mexico, Colombia and Costa Rica. This was due to the unavailability of recent and complete data for the five health expenditure indicators used, resulting in a study sample of 35 countries. As MCDM necessitates complete and comparable data for all criteria, countries with missing data are not subject to evaluation. Secondly, the analysis is restricted exclusively to health expenditures, thus confining the study to the five selected health expenditure indicators.

1.4. Data Analysis

In this study, data analysis was conducted using CRITIC-based weighting in conjunction with the Hellwig and TOPSIS methods. The OECD health expenditure data were initially entered into a Microsoft Excel spreadsheet. Following the identification and removal of any missing values, the dataset was then normalised. Initially, the criterion weights were objectively determined using the CRITIC method and incorporated into the analysis. Subsequently, the Hellwig method was employed to calculate distances to the ideal solution, while the TOPSIS method was applied to compute relative closeness coefficients based on positive and negative ideal solutions.

1.4.1. CRITIC Method

In the context of MCDM processes, the relative importance of criteria is often determined by objective approaches. Among these, the CRITIC (Criteria Importance Through Intercriteria Correlation) method is a weighting technique that was developed by Diakoulaki et al. (15). The method under discussion here calculates weights by simultaneously considering the contrast intensity of the criteria and the degree of conflict among them. The CRITIC methodology is comprised of the following steps (15):

Step 1. Construction of the Decision Matrix: The initial stage in MCDM problems is the construction of the decision matrix, which contains the performance values of alternatives with respect to each criterion. Subsequently, the decision matrix is normalized to express the criterion values on a common scale. In an MCDM problem with alternatives and criteria , the decision matrix is represented as follows:

$$X = [x_{ij}]_{mxn} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix} \tag{1}$$

Step 2. Construction of the Correlation Matrix: In the second step, in order to determine the degree of interrelationships among criteria, pearson correlation coefficients between criteria and are calculated using Equation (2), based on the normalized values obtained from the decision matrix.

$$P_{jk} = \frac{\sum_{i=1}^{m} (\mathrm{r_{ij}} - \bar{\mathrm{r}}_\mathrm{j}) \cdot (\mathrm{r_{ik}} - \bar{\mathrm{r}}_\mathrm{k})}{\sqrt{\sum_{i=1}^{m} (\mathrm{r_{ij}} - \bar{\mathrm{r}}_\mathrm{j})^2 \cdot \sum_{i=1}^{m} (\mathrm{r_{ik}} - \bar{\mathrm{r}}_\mathrm{k})^2}} \quad (2)$$

Step 3. Calculation of the Information Content of Criteria: In this step, the information content (Cj) is calculated based on the standard deviation of each criterion and the conflict between criteria. To combine these two components and obtain the total information content, Equation (3) is used, while the standard deviation (σj) included in this equation is computed using Equation (4).

$$C_j = \sigma_j \sum_{k=1}^{n} (1 - P_{jk}) \quad (3)$$

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{m} (r_{ij} - \bar{r_j})^2}{m}} \quad (4)$$

Step 4. Calculation of Criterion Weights: In the final step of the method, criterion weights are obtained by dividing each criterion's (value by the sum of all) values using Equation (5).

$$W_j = \frac{C_j}{\sum_{j=1}^{n} C_j} \quad (5)$$

1.4.2. Hellwig Method

The Hellwig method is a MCDM approach that evaluates the relative performance of alternatives by measuring their distances from an ideal reference point, thereby creating a synthetic performance indicator. The method was initially developed by Hellwig, and it provides a suitable framework for comparisons among multidimensional units such as countries, regions, or institutions. Its utilisation in academic studies pertaining to socioeconomic development, health, welfare, and regional comparisons is extensive (16). The Hellwig method is a process which can be summarised as follows:

Step 1. Construction of the Decision Matrix: A decision matrix is constructed using the observed values of each country with respect to each criterion .

$$z_{ij} = \frac{(x_{ij} - \bar{x}_j)}{s_j} \quad (6)$$

Step 2. Normalization: Z-score standardization is applied to make different measurement units comparable. Equation (6) shows the normalization formula, where represents the mean of the criterion and) the standard deviation.

Step 3. Determination of the Ideal Solution Vector: For each criterion, the maximum of the standardized values is taken, and the ideal solution vector is constructed (Equation 7):

$$z_j{}^* = max(z_{ij}) \quad (7)$$

Step 4. Calculation of Euclidean Distances: The distance of each country from the ideal solution is calculated using Equation (8).

$$d_i = \sqrt{\sum_{j=1}^{m} (z_{ij} - z_j{}^*)^2} \quad (8)$$

Step 5. Determination of the Critical Distance: The critical distance is calculated using the mean and standard deviation of the distances, as shown in Equation (9).

$$d_0 = \bar{d} + 2s_d \quad (9)$$

Step 6. Calculation of the Synthetic Measure (Hellwig Score): The performance score for each country is calculated as shown in Equation (10).

$$H_i = 1 - \frac{d_i}{d_0} \tag{10}$$

1.4.2. TOPSIS Method

The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method, developed by Hwang and Yoon, is an MCDM approach that ranks alternatives based on their proximity to an ideal solution. The fundamental principle of the method is that the alternative closest to the best solution point and farthest from the worst solution point exhibits the highest performance (17,18). The TOPSIS method consists of six steps. The application steps are as follows (19).

Step 1. Construction of the Decision Matrix: The decision matrix used in the TOPSIS method is the same as the one employed in the Hellwig method.

Step 2. Normalization of the Decision Matrix: In the second step, the decision matrix is normalized using vector normalization as shown in Equation (11), where) represents the value of alternative under criterion (18).

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}^{2}} \tag{11}$$

Step 3. Construction of the Weighted Normalized Decision Matrix: The normalized values are multiplied by the weight of each criterion ().

$$V_{ij} = wj * rij \tag{12}$$

Step 4. Determination of the Positive and Negative Ideal Solutions: At this stage, for benefit-oriented criteria, the maximum values in each column constitute the positive ideal solution, while for cost-oriented criteria, the minimum values form the negative ideal solution. Benefit and cost criteria are represented by the sets (and (), respectively (18).

$$A^{+} = \{(\max v_{ij} \mid j \in J), (\min v_{ij} \mid j \in J')\} \tag{13}$$

$$A^{-} = \{(\min v_{ij} \mid j \in J), (\max v_{ij} \mid j \in J')\} \tag{14}$$

Step 5. Calculation of Distances to the Positive and Negative Ideal Solutions: For each alternative, the distances to the positive and negative ideal solutions are calculated using the Euclidean distance.

$$S_i^{+} = \sqrt{\sum_{j=i}^{n} (v_{ij} - v_j^{+})^2} \tag{15}$$

$$S_i^{-} = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^{-})^2} \tag{16}$$

Step 6. Calculation of the Relative Closeness Coefficient and Ranking: The relative closeness of each alternative to the ideal solution is calculated using Equation (17). The closer the) value is to 1, the higher the performance of the alternative. Alternatives are ranked in descending order based on their () values.

$$C_i = \frac{s_i^{-}}{(s_i^{-} + s_i^{+})} \tag{17}$$

Results

2.1. Weights Obtained by the CRITIC Method

Table 1 presents the decision matrix used in the CRITIC, Hellwig, and TOPSIS methods.

Within the scope of the CRITIC method, objective criterion weights were calculated by considering standard deviation and the inter criterion correlation structure. The results are presented in Table 2. According to the analysis, the criteria with the highest information content are C3 (Cj=0.974; w=0.245) and C4 (Cj=0.959; w=0.242). This indicates that these criteria exhibit higher variability and lower redundancy compared to the other criteria. In contrast, C1 (w=0.169) has the lowest weight, contributing relatively less to the decision-making process.

Table 1. Decision Matrix

No	OECD Countries	C1	C2	C3	C4	C5
1	USA	17,2	12402	2483	1713	14885
2	Germany	12,3	8080	1285	1158	9365
3	Austria	11,8	6408	1993	845	8401
4	Belgium	11	5722	2028	742	7750
5	United Kingdom	11,1	5486	1262	557	6747
6	Denmark	9,4	5900	1171	404	7071
7	France	11,5	6219	1148	813	7367
8	Netherlands	10	7017	1420	485	8436
9	Ireland	6,9	6068	1745	744	7813
10	Spain	9,2	3893	1452	673	5346
11	Sweden	11,3	6742	1129	651	7871
12	Switzerland	11,8	6771	3192	1061	9963
13	Italy	8,4	3835	133	846	5164
14	Iceland	9	5651	1119	582	6770
15	Canada	11,3	5125	2176	990	7301
16	Luxembourg	5,9	6937	1149	696	8087
17	Norway	9,7	8079	1314	519	9393
18	Portugal	10,2	3242	1970	622	5212
19	Turkey	4,7	1801	508	119	2309
20	Greece	8,1	2153	1454	921	3607
21	Japan	10,6	4908	882	983	5790
22	Finland	10,6	5415	1240	655	6655
23	Australia	10,3	5395	2074	872*	7469
24	New Zealand	10,1	4864	1232	272	6097
25	Czechia	8,5	4265	749	598	5014
26	Hungary	6,5	2419	884	699	3303
27	Poland	8,1	3342	942	523	4284
28	South Korea	8,4	2876	1921	851	4797
29	Slovakia	8,4	3266	755	718	4021
30	Chile	10,5	2065	1684	455	3749
31	Estonia	7,8	2886	882	458	3768
32	Slovenia	9,9	4807	720	770	5527
33	Israel	7,6	2989	1363	476	4352
34	Latvia	7,6	2066	1346	551	3411
35	Lithuania	7,6	2850	1409	484*	4259

Table 2. Standard Deviation, Information Content, and Weight Values of the Criteria

Criteria	σj	Cj	wj
C1	0,180	0,672	0,169
C2	0,209	0,683	0,172
C3	0,195	0,974	0,245
C4	0,177	0,959	0,242
C5	0,197	0,681	0,171

2.2. Findings Obtained Using the Hellwig Method

In accordance with the Hellwig method, following the construction of the decision matrix (Table 1), the criterion values were subjected to normalisation using Equation (6) in order to express them on a common scale, incorporating the weights determined by the CRITIC method (Table 3). In the Hellwig method, the ideal reference vector represents the best (highest) standardized values for each criterion within the decision matrix. Countries closer to the ideal reference point are considered to exhibit higher performance in terms of health expenditures. The ideal reference vector calculated using Equation (7) is as follows:

Table 3. Weighted Normalized Decision Matrix

No	OECD Countries	C1	C2	C3	C4	C5
1	USA	0,577	0,594	0,454	0,867	0,593
2	Germany	0,209	0,252	-0,038	0,392	0,210
3	Austria	0,171	0,120	0,253	0,124	0,144
4	Belgium	0,111	0,066	0,267	0,036	0,099
5	United Kingdom	0,118	0,047	-0,047	-0,123	0,029
6	Denmark	-0,009	-0,080	-0,085	-0,254	0,052
7	France	0,148	0,105	-0,094	0,096	0,072
8	Netherlands	0,036	0,169	0,017	-0,184	0,146
9	Ireland	-0,197	0,094	0,151	0,037	0,103
10	Spain	-0,024	-0,078	0,030	-0,023	-0,068
11	Sweden	0,133	0,147	-0,102	-0,042	0,107
12	Switzerland	0,171	0,149	0,746	0,309	0,252
13	Italy	-0,084	-0,083	-0,511	0,125	-0,080
14	Iceland	-0,039	0,061	-0,106	-0,101	0,031
15	Canada	0,133	0,019	0,328	0,248	0,068
16	Luxembourg	-0,272	0,162	-0,094	-0,003	0,122
17	Norway	0,013	0,173	-0,026	-0,155	0,212
18	Portugal	0,051	-0,130	0,243	-0,067	-0,077
19	Turkey	-0,107	-0,244	-0,357	-0,498	-0,278
20	Greece	-0,107	-0,216	0,031	0,189	-0,188
21	Japan	0,081	0,002	-0,204	0,242	-0,037
22	Finland	0,081	0,042	-0,056	-0,039	0,023
23	Australia	0,058	0,040	0,286	0,147	0,079
24	New Zealand	0,043	-0,002	-0,060	-0,367	-0,016
25	Czechia	-0,077	-0,049	-0,258	-0,088	-0,091
26	Hungary	-0,227	-0,195	-0,203	-0,001	-0,209
27	Poland	-0,107	-0,122	-0,179	-0,152	-0,141
28	South Korea	-0,084	-0,159	0,223	0,129	-0,106
29	Slovakia	-0,084	-0,128	-0,256	0,015	-0,159
30	Chile	0,073	-0,223	0,126	-0,210	-0,178
31	Estonia	-0,129	-0,158	-0,204	-0,207	-0,177
32	Slovenia	0,028	-0,006	-0,270	0,060	-0,055
33	Israel	-0,144	-0,150	-0,006	-0,192	-0,137
34	Latvia	-0,144	-0,223	-0,013	-0,128	-0,202
35	Lithuania	-0,144	-0,161	0,013	-0,185	-0,143

- C1 = 0,577
- C2 = 0,594
- C3 = 0,746
- C4 = 0,867
- C5 = 0,593

Using Equation (8), the Euclidean distances of each country from the ideal reference vector were calculated. Lower distance values indicate that countries are closer to the ideal in terms of health expenditures. Within the framework of the Hellwig method, the critical distance value was computed using Equation (9), based on the distances of OECD countries from the ideal reference vector. The obtained value, d_0=2,329, represents the upper threshold against which countries performance levels relative to the ideal level of health expenditures are evaluated.

In the final stage, the distances of countries from the ideal values across the multi-criteria indicators (d_i) were calculated using Equation (10), and based on these distances, the Hellwig Index (H_i) was derived. The resulting (H_i) values indicate the integrated level of performance of the countries and are presented in Table 4.

Table 4. Euclidean Distances and Synthetic Measures (Hellwig Scores) of the Countries

No	OECD Countries	di	Hi
1	United States	0,292	0,871
2	Switzerland	0,889	0,607
3	Germany	1,113	0,508
4	Canada	1,167	0,484
5	Avustria	1,177	0,480
6	Avustralia	1,253	0,446
7	Belgium	1,288	0,431
8	France	1,412	0,376
9	Ireland	1,460	0,355
10	Sweden	1,476	0,348
11	Norway	1,510	0,333
12	Japan	1,512	0,332
13	Netherlands	1,520	0,329
14	South Korea	1,520	0,328
15	Finland	1,530	0,324
16	Portugal	1,541	0,319
17	United Kingdom	1,561	0,310
18	Spain	1,598	0,294
19	Luxembourg	1,610	0,289
20	Iceland	1,626	0,282
21	Greece	1,645	0,273
22	Slovenia	1,663	0,265
23	Denmark	1,687	0,254
24	Chile	1,749	0,227
25	New Zealand	1,784	0,212
26	Czechia	1,797	0,206
27	Slovakia	1,804	0,203
28	Lithuania	1,810	0,200
29	Israel	1,815	0,198
30	Latvia	1,840	0,187
31	Poland	1,847	0,184
32	Italy	1,865	0,176
33	Hungary	1,888	0,166
34	Estonia	1,927	0,149
35	Turkey	2,329	-0,029

When Table 4 is examined, the United States (Hi=0,871) stands out as the country with the highest integrated development score. Countries such as Switzerland (H_i)=0,607), Germany (H_i=0,508), and Canada (H_i=0,484) are also positioned close to the ideal values with relatively high Hi scores. In contrast, Turkey (H_i=-0,029) has the lowest Hi value among all countries and is located considerably far from the ideal values. The remaining countries are positioned at a moderate level according to their Hi values, indicating a medium level of development in cross-country comparisons.

2.3. Findings Obtained Using the TOPSIS Method

In this stage of the analysis, the TOPSIS method was applied. Since the decision matrix used in this stage has the same structure and values as the one employed in the CRITIC method (Table 1), it was taken as the initial matrix. Normalization was performed using Equation (11). Subsequently, weighted normalization was carried out based on the weights determined by the CRITIC method using Equation (12). The positive ideal (A^+) and negative ideal (A^-) solution values are calculated using Equations (13) and (14), respectively.

Table 5. S_i^+, S_i^-, and C_i Values of the Countries

No	OECD Countries	S_i+	S_i-	C_i*
1	United States	0,292	2,267	0,886
2	Switzerland	0,889	1,718	0,659
3	Germany	1,113	1,351	0,548
4	Canada	1,167	1,302	0,527
5	Avustria	1,177	1,251	0,515
6	Avustralia	1,253	1,198	0,489
7	Belgium	1,288	1,163	0,474
8	France	1,412	1,015	0,418
9	Ireland	1,460	1,006	0,408
10	South Korea	1,520	1,023	0,402
11	Sweden	1,476	0,960	0,394
12	Japan	1,512	0,978	0,393
13	Portugal	1,541	0,989	0,391
14	Norway	1,510	0,953	0,387
15	Netherlands	1,520	0,941	0,383
16	Finland	1,530	0,887	0,367
17	United Kingdom	1,561	0,875	0,359
18	Greece	1,645	0,916	0,358
19	Luxembourg	1,610	0,867	0,350
20	Spain	1,598	0,839	0,344
21	Iceland	1,626	0,784	0,325
22	Slovenia	1,663	0,792	0,323
23	Chile	1,749	0,830	0,322
24	Denmark	1,687	0,761	0,311
25	New Zealand	1,784	0,715	0,286
26	Italy	1,865	0,728	0,281
27	Lithuania	1,810	0,667	0,269
28	Slovakia	1,804	0,658	0,267
29	Latvia	1,840	0,662	0,265
30	Israel	1,815	0,652	0,264
31	Czechia	1,797	0,622	0,257
32	Hungary	1,888	0,606	0,243
33	Poland	1,847	0,573	0,237
34	Estonia	1,927	0,501	0,206
35	Turkey	2,329	0,154	0,062

- A^+ values: C1= 0,577, C2= 0,594, C3 = 0,746, C4 = 0,867, C5 = 0,593
- A^- values: C1= -0,362, C2= -0,244, C3 = 0,511, C4 = 0,498, C5 = 0,278

After calculating the positive ideal solution (A^+) and the negative ideal solution (A^-), the distance between the i-th alternative and the positive ideal solution (S_i^+), as well as the distance between the i-th alternative and the negative ideal solution (S_i^-), were computed using Equations (15) and (16). The calculated values were then substituted into the formula presented in Equation (17) to obtain the closeness coefficients (C_i^*). The calculated values are presented in Table 5, along with the country rankings from best to worst performance.

Discussion

The present study employed a comparative analysis of the health expenditures of Turkey and other OECD countries. This was achieved by utilising CRITIC-based objective weighting within the framework of the Hellwig and TOPSIS methods. The findings indicate that Turkey remains below the OECD average across all health expenditure indicators and is consistently ranked among the lowest positions in both methods. This finding indicates that Turkey's level of health expenditure is comparatively low in relation to OECD countries, and that the allocation of resources to the health system remains constrained across expenditure components. However, it is important to note that this finding should not be directly interpreted as indicating low health system performance. Alternatively, this may be indicative of a comparatively lower level of financial resources allocated to the health system and lower spending intensity (6,7).

It is noteworthy that the United States is positioned at the top of the rankings according to both the Hellwig and TOPSIS results. Utilising the Hellwig index, with a value of H_i=0,871 and the TOPSIS method, with a score of Ci*=0,886, the United States exhibits a significantly superior performance, by a substantial margin. This outcome is associated with the United States' health expenditures being well above the OECD average in terms of total health spending, per capita expenditure, and other financial indicators. However, despite the United States' highest level of health expenditure among OECD countries, there is no demonstrable correlation between expenditure and health outcomes. This finding indicates that increased expenditure does not necessarily result in improved health outcomes. In the United States, the high cost of healthcare services, the dominance of the private sector, and inequalities in access are considered key factors limiting the conversion of expenditures into health outcomes (20, 21, 22). Germany and Switzerland, despite having lower or comparable levels of health expenditure than the United States, achieve better health outcomes and more balanced health system performance (Smith et al., 2022). In these countries, universal health insurance coverage, robust primary care systems, and more efficient resource allocation contribute to a more effective conversion of spending into outcomes (23).

It has been observed that Central and Eastern European countries (for example Poland, Hungary, Slovakia, Latvia, Estonia, and Lithuania) are concentrated in the lower rankings in both methods. This phenomenon can be attributed to the below-average levels of per capita health expenditure and total health budget in the region. In a similar manner, nations such as Chile and Greece are situated within the lower-middle and lower categories, thereby reflecting the repercussions of economic vulnerabilities and constrained public resources on health expenditure. A salient finding of this study is that Turkey ranks last in both methods. Turkey's per capita total health expenditure (USD 2,309, PPP) and public expenditure (USD 1,801, PPP) are both well below the OECD average, while its share of GDP at 4.7% is among the lowest across OECD countries. In the study conducted by Çetintürk and Gençtürk (24), the health expenditures of OECD countries between 2003 and 2017 were evaluated, and it was found that Turkey had lower health expenditures compared to other OECD countries. The study by Sayılı et al. (25) sought to compare health indicators and health expenditures of Turkey and OECD countries. The results indicated that Turkey ranked last among OECD countries in terms of health expenditures. In the study conducted by Uslu et al. (6), it was determined that the United States and Switzerland were positioned at the top of the ranking, while Turkey was positioned below OECD countries in terms of health expenditures. The extant literature on Turkey and other OECD countries demonstrates that Turkey is generally classified in the low-expenditure group. The relationship between health expenditure and economic growth remains limited. The present findings are consistent with the extant literature (6, 24, 26, 27, 28).

The underlying reasons for Turkey's low ranking are not limited to the level of health expenditure alone. The factors influencing this outcome are manifold. These include the low share of health expenditure in GDP, the relatively lower per capita income compared to the OECD average, and structural differences in the allocation of financial resources within the health system (29). Furthermore, regional disparities in access to health services, coupled with the concentration of private expenditures in specific areas, have the potential to result in an imbalanced distribution of health spending (30). However, a direct and linear relationship between the level of health expenditure and health outcomes may not be evident. Despite relatively low levels of public expenditure on health, Turkey has achieved notable improvements in some key health indicators, such as increases in life expectancy and reductions in infant mortality rates. This finding suggests that the implementation of reforms within the health system, coupled with the efficacy of service delivery mechanisms, has yielded favourable outcomes in specific domains. However, it is important to acknowledge that persistently low expenditure levels may impose limitations on the quality of healthcare services, equity in access, and the sustainability of advanced healthcare services in the long term (29, 30).

Conclusion

In this study, a comparative analysis of the health expenditures of OECD countries was conducted utilising CRITIC-based weighting within the framework of the Hellwig and TOPSIS methods. The findings indicate that both methods produce largely consistent rankings. The findings at the country level demonstrate that nations with elevated levels of per capita health expenditure and a greater proportion of health expenditure in GDP consistently demonstrate superior performance. The United States and Switzerland are positioned at the top of the rankings, with Germany, Austria, and Canada occupying the upper echelons of the upper group. Turkey, on the other hand, consistently achieves the lowest ranking in both assessment methods.

Turkey's comparatively low level of health expenditure relative to the OECD average suggests the presence of a structural constraint within the financing structure of the health system. This scenario has the potential to exert medium- and long-term pressure on sustainability and service capacity. However, it should be noted that the solution is not limited to increasing expenditure alone; it also requires the restructuring of resource allocation. As a policy recommendation, it is suggested to strengthen the population-based capitation financing model in primary health care services and to expand the use of performance- and output-based payment systems in hospitals. Furthermore, the integration of mandatory health technology assessment (HTA) applications into reimbursement processes for pharmaceutical and medical technology expenditures is imperative for enhancing cost-effectiveness in resource allocation. In order to reduce regional disparities, the establishment of a central equalization fund based on population and disease burden is recommended, along with a more equitable distribution of resources. Moreover, it is imperative not only to augment health expenditures, but also to oversee their efficacy through the establishment of performance monitoring systems predicated on output and health outcome indicators.

In future research, health expenditures should be examined not only in terms of financial magnitude but also in relation to health outcomes such as life expectancy, infant mortality, preventable mortality, and quality of care. Such an approach would facilitate a more nuanced understanding of the non-linear relationship between expenditure levels and health outcomes, as well as a more precise evaluation of resource allocation efficiency.

Declarations

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Conflict of Interest

None declared.

Availability of data and material

All materials used in this study are detailed within the manuscript, and additional information can be requested from the corresponding author.

Authors' contributions

The author solely conceived, designed, and executed the research, including data analysis and manuscript preparation.

Ethics Approval

In this study since secondary data were used, there is no need for ethics committee approval.

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