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Evaluation of Health System Performance with MULTIMOORA Method: OECD Countries

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ABSTRACT

Purpose: The aim of this study is to compare the health system performances of OECD countries in the light of certain health and socio-economic indicators and to make country performance rankings with the MULTIMOORA method.

Methods: Firstly, health and socio-economic indicators were determined for the performance evaluation comparisons of the countries through literature review. The data of the indicators were obtained from reliable databases and analysed by MULTIMOORA method, which is one of the multi-criteria decision-making methods.

Results: According to the results of the analyses, the countries with the highest health system performance among 38 OECD countries are Japan, Sweden, Norway, Denmark and Germany, while the countries with the lowest performance are Latvia, Costa Rica, Türkiye, Mexico and Colombia, respectively.

Conclusion: As a result, in countries with high health system performance, access, quality and comprehensiveness of health services are ensured. Per capita expenditures for the health system are quite high. In countries with low performance, the limited resources allocated to the health system cause the service coverage index to remain low. High out-of-pocket expenditures drive especially low-income groups away from health services. In this context, low-performing countries need to improve their health systems by learning from the health systems of high-performing countries and developing strategies to overcome existing deficiencies.

Keywords: Health System, Performance Evaluation, Management, Multi-Criteria Decision Making, OECD.

ÖZET

Amaç: Bu çalışmanın amacı, OECD ülkelerinin sağlık sistemi performanslarını belirli sağlık ve sosyo-ekonomik göstergeler ışığında karşılaştırarak MULTIMOORA yöntemi ile ülke performans sıralamalarını yapmaktır.

Metot: Öncelikle literatür taraması ile ülkelerin performans değerlendirme karşılaştırmalarının yapılabilmesi için sağlık ve sosyo-ekonomik göstergeler belirlenmiştir. Göstergelere ait veriler güvenilir veri tabanlarından elde edilerek; çok kriterli karar verme yöntemlerinden biri olan MULTIMOORA yöntemi ile analiz edilmiştir.

Bulgular: Analiz sonuçlarına göre 38 OECD ülkesi arasından sağlık sistemi performansı en yüksek olan ülkeler sırasıyla; Japonya, İsveç, Norveç, Danimarka ve Almanya olur iken; performansı en düşük olan ülkeler ise sırasıyla; Letonya, Kosta Rika, Türkiye, Meksika ve Kolombiya olarak tespit edilmiştir.

Sonuç: Sonuç olarak, sağlık sistemi performansı yüksek olan ülkelerde sağlık hizmetlerine erişim, kalite ve kapsamlılık sağlanmıştır. Sağlık sistemi için yapılan kişi başına düşen harcamalar oldukça yüksektir. Performansı düşük olan ülkelerde ise sağlık sistemine ayrılan kaynakların kısıtlı olması, hizmet kapsamı endeksinin düşük kalmasına neden olmaktadır. Cepten yapılan harcamaların yüksekliği, özellikle düşük gelir gruplarını sağlık hizmetlerinden uzaklaştırmaktadır. Bu bağlamda, düşük performanslı ülkelerin, yüksek performanslı ülke sağlık sistemlerinden öğrenim sağlayarak ve mevcut eksikliklerini giderecek stratejiler geliştirerek sağlık sistemlerini iyileştirmesi gerekmektedir.

Anahtar Kelimeler: Sağlık Sistemi, Performans Değerlendirme, Yönetim, Çok Kriterli Karar Verme, OECD.

Evaluating health system performance is a critical process for improving the quality, accessibility and efficiency of health services. Performance measurements enable policy makers and managers to make data-driven decisions, which in turn enables more effective strategies for the delivery of health services (1). Indeed, evaluating health system performance against internationally comparable indicators allows countries to monitor progress, improve reforms and increase accountability within their health systems (2). The ability to analyze health system performance internationally by conducting broad assessments covering a variety of indicators also encourages collaboration and information sharing among countries. Such comparisons can stimulate efforts to improve the design and delivery of health services (3). Health system performance evaluations also play an important role in supporting evidence-based management and decision-making processes. Indeed, these evaluations create awareness of the efficiency and effectiveness of health service financing, resource allocation and service delivery, allowing policy makers to make evidence-based and rational choices to optimize health system performance (4).

Health systems are inherently complex and multidimensional structures. Therefore, it is insufficient to reduce performance measures to a single criterion and evaluate them accordingly. A comprehensive perspective through specific metrics is necessary to understand and evaluate the differences in health systems. Indeed, indicators included in studies in the literature provide a comprehensive framework for evaluating health outcomes, resource allocation, and the overall efficiency of health systems. Higher life expectancy is often associated with better access to health services, quality of care, and public health initiatives and supports (5). On the other hand, high maternal mortality rates may also be an indication of failures in health service delivery, including inadequate prenatal and postnatal care (6). Beyaztaş et al. (7) stated that infant mortality rate is an important indicator in determining the health levels of countries in international comparisons. Similarly, under-5 mortality rate is expressed as a valuable criterion in evaluating health system performance, as it is sensitive to changes in health policies and interventions (8). High out-of-pocket spending leads to inequalities in access to health services, disproportionately affecting low-income populations (9). On the other hand, it has been stated that countries with higher service coverage tend to have better health outcomes, including lower mortality rates among vulnerable populations (10). In addition, countries with high income inequality generally experience worse health outcomes, and it has been emphasized that socioeconomic factors and health system performance are interconnected (11). Indeed, MULTIMOORA allows objective ranking of countries' health performance by considering multiple criteria. In this context, the aim of the study is to compare the health system performances of Organization for Economic Development and Cooperation (OECD) countries in light of certain health and socioeconomic indicators and to rank country performances using the Multi-Objective Optimization by Ratio Analysis plus Full Multiplicative Form (MULTIMOORA) method. This study is one of the rare studies that evaluates the health system performance of OECD countries using the MULTIMOORA method. Unlike the analyses generally conducted using methods such as TOPSIS and DEA in the literature, the holistic decision-making method used in this study provides more robust decision support by combining proportional, reference point and multiplier analyses.

Material and Methods

1.1. Design of the Study

This study was designed as a cross-sectional, quantitative and comparative research aiming to compare the health system performances of OECD countries in terms of certain indicators.

1.2. Data Collection

As a result of the literature review, life expectancy at birth, maternal mortality ratio, infant mortality rate, under-5 mortality rate, health expenditures to GDP ratio, out-of-pocket health expenditures ratio in total health expenditures, service coverage index and income inequality coefficient indicators were determined in order to compare the performance of country health systems. To ensure a balanced assessment, both outcome-based (e.g. mortality rates) and resource-based (e.g. healthcare expenditure) measures are included. Data on the indicators were obtained from reliable international databases such as OECD, World Health Organization (WHO) and World Bank (WB) for 38 OECD countries. The data collection phase was carried out by taking into account the latest available data of the countries for the relevant indicator. Details on the data are shown in Table 1.

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Table 1: Health and Socio-economic Indicators and Data Sources Used in the Study			
Indicator Name / Year	**Indicator Code**	**Desirable Value**	**Data Source**
Life Expectance at Birth (per year) (2023)	LEB	Max	OECD Data Explorer (12)
Maternal Mortality Ratio (per 100 000 live births) (2022)	MMR	Min	OECD Data Explorer (12)
Infant Mortality Rate (per 1000 live births) (2023)	IMR	Min	OECD Data Explorer (12)
Under-five mortality rate (per 1000 live births) (2022)	UFMR	Min	World Bank, Gender Data Portal (13)
Health expenditure (% of GDP) (2023)	HE	Max	OECD Data Explorer (12)
Out-of-pocket health expenditure (% of total expenditure on health) (2023)	OOP	Min	World Bank, DataBank (14)
Service Coverage Index (2023)	UHC	Max	WHO Data (15)
Income inequality (2022)	GINI	Min	OECD Data Explorer (12)

1.3.Analysis of Data

MULTIMOORA method, one of the multi-criteria decision-making methods, was used to evaluate the health system performance of OECD countries. MOORA (Multi-Objective Optimization by Ratio Analysis) method was developed by Brauers and Zavadskas in 2006 (16). MULTIMOORA method is an extension and improvement of MOORA method. It increases the consistency and accuracy in decision-making processes (17). In this study, the MULTIMOORA method was chosen to compare health system performances. This is because the method offers a more holistic and objective approach than common multi-criteria decision-making (MCDM) methods such as TOPSIS, VIKOR or AHP (17). Unlike methods that rely heavily on normalization sensitivity (e.g. TOPSIS) or subjective pairwise comparisons (e.g. AHP), MULTIMOORA combines ratio analysis, reference point assessment and full multiplicative form in a comprehensive framework (18). This hybrid approach reduces the influence of data scale and minimizes subjective bias, making it highly suitable for international comparisons based on objective health indicators. The stages of the method can be expressed as follows (19);

1. A "decision matrix" consisting of columns representing performance criteria and rows representing alternative decision units is prepared.

2. The "normalization" process is performed by dividing the criterion value of each alternative by the square root of the sum of the squares of each alternative value. This vector normalization method allows criteria measured at different scales to be integrated within a single framework. In fact, this guarantees comparability between different indicators such as mortality rates, financial ratios and index scores by converting all values into dimensionless units.

3. "Ratio analysis" is applied by subtracting the minimum objective values collected from the maximum objective values collected with the table values formed by the normalized values. Benefit criteria (e.g., life expectancy, UHC) are added, and cost criteria (e.g., mortality rates, OOP spending) are subtracted after normalization. Countries are ranked based on the resulting composite scores.

4. The maximum points for the objective to be maximized and the minimum points for the objectives to be minimized, which are the maximal objective reference points, are determined. The distances to these determined points are found and converted into a matrix. In this way, the "reference point approach" is applied. For each criterion, the best value is identified as a reference point. The Euclidean distance of each alternative to this ideal point is calculated, and countries with smaller distances are preferred.

5. The values and meanings of the objectives are expressed as products and the "full multiplication form approach" is applied. The product of the criteria to be maximized is divided by the product of the criteria to be minimized.

6. The rankings made as a result of the ratio analysis, reference point and full multiplication form of the MULTIMOORA method are evaluated collectively according to their dominance.

Results

Current data on health and socio-economic indicators are obtained from reliable international databases such as WHO, WB and OECD and are shown in Table 2. The weight of each indicator is assumed to be 12.5% and kept equal. The main reason for the equal weights of the indicators is that the health system performance is multidimensional and no weighting has been made between the indicators by national and international organizations. However, it is accepted that alternative weightings such as AHP and DEMATEL can be adopted in future studies by taking expert opinions for each indicator.

Country	LEB (2023)	MMR (2022)	IMR (2023)	UFMR (2022)	HE (2023)	OOP (2023)	UHC (2023)	GINI (2022)
Australia	83,2	2,00	3,20	3,80	9,74	15,3	87	0,32
Austria	81,6	3,60	2,40	3,20	10,9	15,9	85	0,29
Belgium	82,5	7,90	2,90	3,70	10,9	20,0	86	0,25
Canada	81,6	8,50	4,70	4,90	11,2	14,8	91	0,30
Chile	81,4	18,9	6,80	6,30	10,0	35,4	82	0,45
Colombia	76,9	83,2	16,5	12,4	7,69	14,3	80	0,55
Costa Rica	81,0	15,0	9,50	7,70	7,02	22,4	81	0,47
Czechia	80,0	4,00	2,30	2,60	8,54	14,2	84	0,25
Denmark	81,9	1,60	2,40	3,50	9,44	13,0	82	0,27
Estonia	78,8	0,01	2,30	1,90	7,55	23,1	79	0,32
Finland	81,7	8,90	2,00	2,30	10,1	16,1	86	0,27
France	83,1	7,60	3,90	4,10	11,5	8,92	85	0,30
Germany	80,7	4,10	3,20	3,60	11,7	10,7	88	0,30
Greece	81,6	5,90	3,10	3,90	8,37	33,5	77	0,31
Hungary	76,9	7,90	3,60	4,00	6,36	24,2	79	0,29
Iceland	82,6	3,30	3,30	2,60	8,99	13,6	89	0,25
Ireland	82,6	1,60	3,30	3,10	6,56	10,6	83	0,29
Israel	82,8	1,10	2,80	3,40	7,62	20,2	85	0,34
Italy	83,8	2,50	2,30	2,60	8,44	22,7	84	0,32
Japan	84,1	4,30	1,80	2,30	11,0	10,9	83	0,34
Korea	82,7	8,40	2,30	2,80	9,88	28,7	89	0,32
Latvia	75,9	31,6	2,40	3,20	7,77	30,7	75	0,34
Lithuania	77,3	0,01	3,00	3,50	7,30	31,8	75	0,36
Luxembourg	83,4	0,01	3,10	2,70	5,78	8,67	83	0,30
Mexico	75,3	38,2	13,3	12,8	5,72	39,0	75	0,40
Netherlands	82,0	3,0	3,10	3,90	10,1	10,0	85	0,28
New Zealand	82,0	13,2	4,60	4,60	10,9	11,6	85	0,32
Norway	82,6	1,90	1,90	2,20	9,25	14,0	87	0,26
Poland	78,6	2,00	3,80	4,40	6,98	18,8	82	0,27
Portugal	82,4	8,80	2,50	3,20	10,0	29,6	88	0,33
Slovak Republic	78,1	3,80	5,40	5,90	8,63	19,2	82	0,23
Slovenia	82,0	5,50	2,50	2,30	9,41	12,4	84	0,24
Spain	84,0	3,30	2,60	3,00	9,62	19,1	85	0,32
Sweden	83,4	4,80	1,80	2,50	10,9	12,8	85	0,29
Switzerland	84,2	1,20	3,20	4,00	11,9	21,5	86	0,31
Türkiye	77,3	12,6	9,10	9,60	4,20	19,4	76	0,43
United Kingdom	80,9	5,50	4,00	4,10	10,8	13,2	88	0,37
United States	76,4	32,9	5,40	6,30	16,6	11,1	86	0,40

Table 2. Raw Data for Health and Socio-economic Indicators across 38 OECD Countries

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The equation calculations related to the method were made via Microsoft Excel; ratio analysis, reference point, full multiplicative form and MULTIMOORA rankings were obtained as in Table 3. The board count method was applied to obtain the MULTIMOORA rankings.

Table 3: Country Rankings Based on Ratio Analysis, Reference Point, Full Multiplicative Form, and Final MULTIMOORA Aggregated Score						
Country	Ratio Analysis	Rank	Reference Point	Rank	Full Multiplicative Form	Rank	MULTI-MOORA
Australia	-0,0198	15	0,1185	12	38094,34	16	14
Austria	0,0350	9	0,0979	4	38592,66	15	6
Belgium	-0,0481	20	0,0986	6	11664,73	23	18
Canada	-0,1195	23	0,0980	5	6116,43	28	22
Chile	-0,6010	34	0,2133	32	333,71	34	32
Colombia	-1,6247	38	0,7550	38	22,60	37	38
Costa Rica	-0,6590	35	0,2426	33	253,78	35	35
Czechia	0,0389	8	0,1392	20	43153,33	14	12
Denmark	0,0442	5	0,1238	15	86460,40	5	4
Estonia	-0,0376	18	0,1560	23	9273852,05	2	15
Finland	0,0211	12	0,1124	11	25170,06	20	16
France	-0,0137	14	0,0870	2	16277,02	22	11
Germany	0,0436	6	0,0835	1	34889,77	18	5
Greece	-0,2454	31	0,1980	31	4455,21	30	31
Hungary	-0,2379	30	0,1764	28	3047,33	31	30
Iceland	0,0409	7	0,1315	18	43721,65	11	10
Ireland	-0,0064	13	0,1730	27	57871,92	8	17
Israel	-0,0793	22	0,1548	22	46964,41	10	21
Italy	-0,0431	19	0,1408	21	35090,00	17	23
Japan	0,0942	2	0,0956	3	75037,09	6	1
Korea	-0,1219	24	0,1602	24	9223,17	25	27
Latvia	-0,4491	33	0,2862	35	1116,88	33	34
Lithuania	-0,2154	29	0,1844	29	2251205,56	3	24
Luxembourg	0,0252	11	0,1863	30	1192726,79	1	13
Mexico	-1,2987	37	0,3623	37	20,335	38	37
Netherlands	0,0283	10	0,1120	10	43181,74	13	8
New Zealand	-0,1517	26	0,1190	13	4609,56	29	25
Norway	0,1023	1	0,1269	17	145348,15	4	3
Poland	-0,1288	25	0,1657	25	16936,245	21	26
Portugal	-0,1559	27	0,1670	26	6707,70	26	29
Slovak Republic	-0,1992	28	0,1376	19	6701,91	27	28
Slovenia	0,0652	4	0,1243	16	43340,46	12	7
Spain	-0,0206	16	0,1207	14	28180,85	19	19
Sweden	0,0911	3	0,0987	7	61404,36	7	2
Switzerland	-0,0282	17	0,1028	9	53477,39	9	9
Türkiye	-0,7062	36	0,2516	34	172,71	36	36
United Kingdom	-0,0767	21	0,0991	8	11333,79	24	20
United States	-0,3533	32	0,2980	36	1425,92	32	33

According to the analysis results, countries can be summarized in three groups in line with the study indicators for health system performance: best performance (ranks 1-13), medium performance (ranks 14-25) and low performance (ranks 26-38). Among the OECD countries, the countries with the highest health system performance were identified as Japan, Sweden, Norway, Denmark and Germany, respectively. On the other hand, the countries with the lowest performance were identified as Latvia, Costa Rica, Türkiye, Mexico and Colombia, respectively. In addition, Figure 1 provides a heatmap of countries according to their ratio analysis, reference point, full multiplicative form and MULTIMOORA rankings. Lower rankings (better performances) are shown in blue tones, and higher rankings (worse performances) are shown in red tones.

Figure 1: Heatmap of Countries by Ratio Analysis, Reference Point, Full Multiplicative Form and MULTIMOORA Rankings
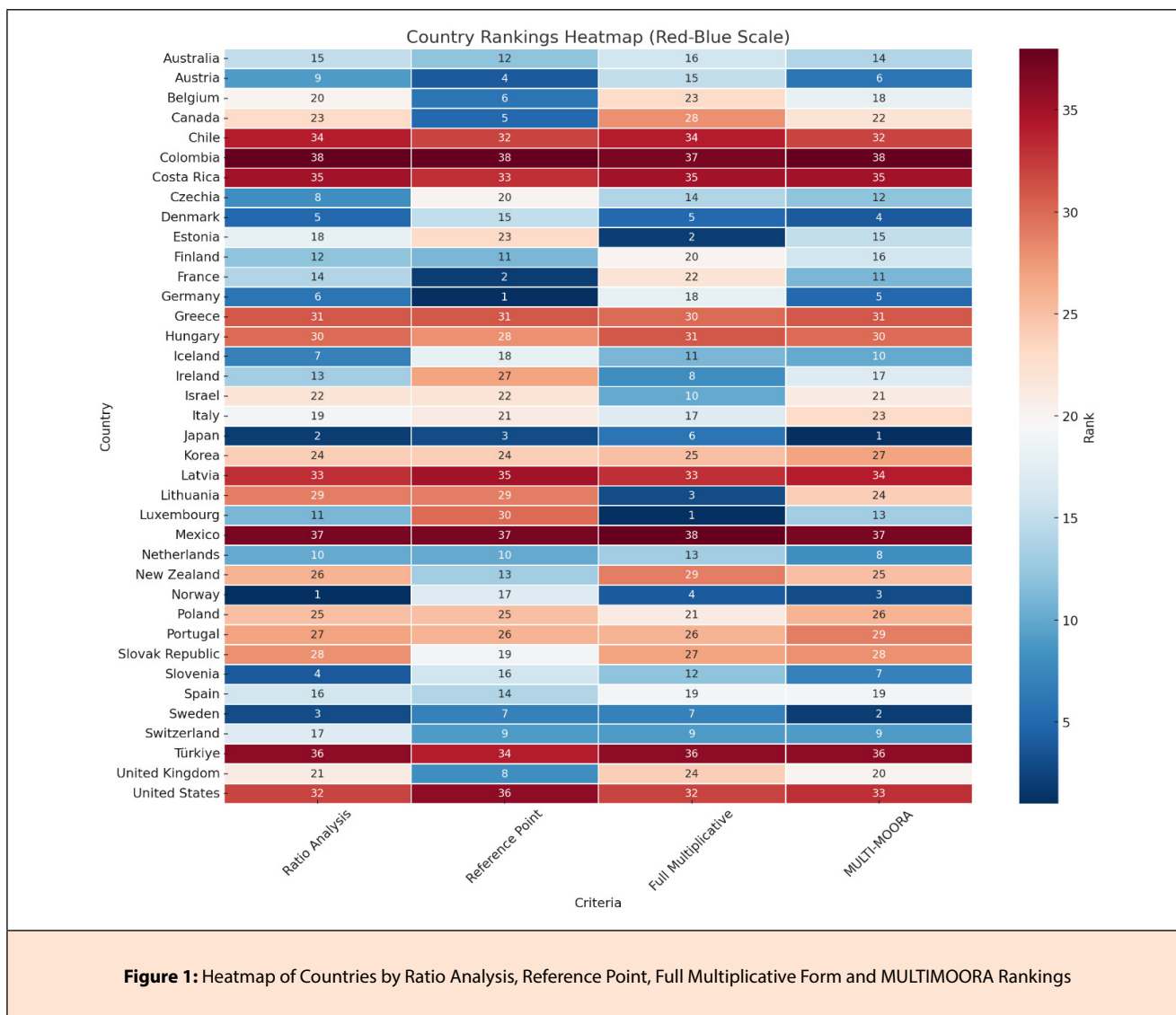
Conclusion

This study examined the health system performance of OECD countries. Member countries were compared in terms of a number of variables related to health and socio-economic indicators. The countries with the highest health system performance were identified as Japan, Sweden, Norway, Denmark and Germany, respectively. In fact, access to health services, quality and comprehensiveness were provided in these countries. The high ratio of health expenditures to GDP supports the effectiveness and comprehensiveness of health services in these countries. As a result of the data analysis, it was observed that some countries exhibited relatively low performance despite high health expenditures or, on the contrary, achieved better results with low health expenditures. Although this study uses the health expenditure-to-GDP ratio as a useful measure, it is important to recognize that higher

expenditures alone do not automatically translate into better health system performance. For example, the United States, despite being at the top of the list in health expenditures per capita, fell behind in overall system performance. This situation shows that not only the amount of expenditure, but also how the expenditures are directed and the efficiency in the system are important. Similarly, it is remarkable in terms of system efficiency that some countries perform better with relatively limited budgets. It is also acknowledged that the three indicators used in the study (maternal mortality ratio (MMR), infant mortality ratio (IMR) and under-5 mortality ratio (UFMR) are thematically linked to components in the service coverage index (UHC), particularly in the area of reproductive, maternal, newborn and child health. This conceptual overlap may raise concerns about potential multicollinearity or indicator redundancy. However, each of these mortality indicators was intentionally retained to capture nuanced differences in outcomes across countries that are not fully reflected in the composite UHC score. Furthermore, the MULTIMOORA method is robust to such overlaps because it does not rely on regression-based assumptions.

A successful health system has been built thanks to stable health policies spanning many years. In countries such as Sweden and Norway, health services are financed by public resources and provided to all citizens equally. While healthy living is encouraged in Japan, early diagnosis is widespread thanks to screening programs and public health policies in countries such as Denmark. The COVID-19 pandemic significantly challenged the resilience and responsiveness of health systems across the globe. While this study does not specifically focus on pandemic-related dynamics, the performance rankings may partially reflect the post-pandemic health system responses, as some of the most recent data used (e.g., from 2022 and 2023) capture recovery trends. Countries such as Japan, Sweden, and Norway ranked among the top performers were noted for their effective crisis management and continuity of care during the pandemic, which may have contributed to their sustained performance levels. Conversely, countries struggling with fragmented service delivery or inequitable access may have experienced amplified vulnerabilities. When the literature is examined, there are various studies supporting these views.

Klummp et al. (20) stated in their study that countries such as Japan and Germany, which allocate a large share to health expenditures, showed superior performance during the pandemic and that this was due to their high general health system performance. Yüksel (21) also emphasized in his study comparing health system performances in OECD countries that higher performance was achieved in countries such as Sweden and Norway, where the public share allocated to health was higher. Tchouaket et al. (22) emphasized in their studies that countries such as Denmark and Germany have high health system performance by emphasizing that resource use efficiency is also effective in addition to health outcomes. Blümel et al. (23) emphasized in their study that the performance of the Norwegian health system is high compared to other countries as a result of health infrastructure investments, patient satisfaction and good health outcomes. Nilbert et al. (24) emphasized that Denmark focused on primary health care and preventive services, resulting in lower hospitalization rates and better management of chronic diseases, emphasizing the high health system performance. Johansson et al. (25) stated that Scandinavian countries, especially Sweden and Norway, have high health system performance in line with the implementation of evidence-based interventions that improve health outcomes by determining best practices.

On the other hand, the countries with the lowest performance were found to be Colombia, Mexico, Türkiye, Costa Rica and Latvia. The limited resources allocated to the health system in these countries cause the service coverage index to remain low. High out-of-pocket expenditures alienate especially low-income groups from health services. In addition, with a high income inequality coefficient, the problem of equity in access to health services arises in countries. When the literature is examined, Gavurová et al. (26) emphasized in their study that despite the increase in health expenditures, Latvia continues to have difficulties in terms of health system efficiency and ranks low among OECD countries. Rotar et al. (27) stated in their study that Colombia's health system performance is low due to problems such as administrative inefficiencies and the lack of comprehensive health policies that address the needs of vulnerable populations. Scheffler and Arnold (28) also stated in their study that there are significant barriers that limit the effectiveness and efficiency of Colombia's health system, indicating that its performance lags behind other OECD countries. Anwar et al. (29) reported that Mexico's health expenditures are low relative to its GDP and lag behind the performance of other OECD countries. Bilsel and Davutyan (30) also stated that Türkiye is among the lowest performing countries in the OECD in terms of indicators such as life expectancy at birth, infant mortality rate and the share of health expenditures in GDP.

As a result, in this study, health system performances were evaluated with health and socio-economic indicators. In this context, low-performing countries need to improve their health systems by making comparisons with high-performing countries' health systems and developing strategies to eliminate their current deficiencies. The indicators used in the study provide a snapshot of the current situation. In fact, the development speed and trends of health systems over time have not been taken into account. Therefore, it should be taken into account that some countries classified as low-performing may be in a faster recovery process compared to other countries with rapid structural reforms. This situation reveals that contextual and temporal dimensions should be taken into account as much as absolute values when classifying and evaluating. There are also some limitations to the indicators chosen. For example, more abstract aspects of service provision, such as geographic availability, health literacy, or cultural norms, could not be taken into account. Furthermore, equal weighting of indicators may limit the analysis in cases where some aspects of the system (such as maternal and child health) are more important than others. These limitations provide a compelling basis for further research. The MULTIMOORA method, which is applied to shed light on future studies, is a method that can be applied not only in measuring health system performances but also in other group decision-making problems involving personal judgments. This applied method can be improved by integrating with other MCDM methods (such as AHP, DEMATEL, ANP, SWARA, BWM).

Declarations

Funding

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Conflict of Interest

None declared.

Ethics approval

The ethical and scientific suitability of the research was approved by the Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee with the decision numbered E-10840098-202.3.02-5390, dated 05/09/2024.

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.

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