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Türkiye'nin 2018-2022 Yılları Arasındaki Sağlık Performansının İncelenmesi

Evaluation of Türkiye's Health Performance from 2018 to 2022

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ÖZ

Amaç: Sağlık sistemlerinin temel hedeflerinden biri halk sağlığını iyileştirmek ve sürdürmektir. Sağlık sisteminin performansı, nüfusun sağlığı üzerinde güçlü bir etkiye sahiptir ve yüksek performansla daha iyi sağlık sonuçları elde edilebilir. Çalışmanın amacı Türkiye'nin son beş yıldaki sağlık performansını incelemektir.

Yöntem: Çalışmada 2018-2022 yılları arasındaki beş yıllık sağlık göstergeleri incelenmiştir. Mortalite, morbidite, hastalıkların önlenmesi ve sağlığın korunması, sağlık hizmeti verilen kurumlar ve alt yapıları, sağlık hizmeti kullanımı, sağlıkta insan kaynakları ile sağlık ekonomisi ve finansmanı başlıkları altında toplam 45 gösterge değerlendirilmiştir. Veriler T.C. Sağlık Bakanlığı Sağlık İstatistikleri Yıllıkları resmi sayfasından alınmıştır. Analizde TOPSIS yöntemi uygulanmıştır. Veriler, MS Office Excel Programı ile analiz edilmiştir.

Bulgular: Analiz sonucunda 2022 yılı en yüksek performans (0,884) ile birinci sıradadır. Daha sonra sırasıyla 2021 (0,836), 2018 (0,745) ve 2020 (0,686) yıllarının yüksek performans gösterdiği bulunmuştur. 2019 yılı ise en düşük performans (0,226) ile son sırada yer almaktadır.

Sonuç: Türkiye'de sağlık sisteminin performansında son yıllarda olumlu bir yükselme görülmektedir. Tüm dünyayı etkisine alan COVID-19 pandemisinde yapılan hızlı müdahalelerin de bu sonuca katkısı olduğu düşünülmektedir.

Anahtar Kelimeler: Sağlık sistemleri, Performans, Sağlık göstergeleri, TOPSIS, Türkiye.

ABSTRACT

Objective: One of the main goals of health systems is to improve and maintain public health. The performance of the health system has a strong impact on the health of the population, and better health outcomes can be achieved with high performance. The aim of the study is to examine Türkiye's health performance in the last five years.

Method: The five-year health indicators between 2018 and 2022 were examined in the study. A total of 45 indicators were evaluated under the headings of mortality, morbidity, disease prevention and health protection, institutions and infrastructures providing health services, health service use, human resources in health, and health economics and financing. The data were taken from the official page of the Health Statistics Yearbooks of the Ministry of Health of the Republic of Türkiye. The TOPSIS method was applied in the analysis. The data were analyzed with the MS Office Excel Program.

Results: As a result of the analysis, 2022 ranked first with the highest performance (0.884). Then, it was found that the years 2021 (0.836), 2018 (0.745) and 2020 (0.686) showed high performance, respectively. The year 2019 ranks last with the lowest performance (0.226).

Conclusion: There has been a positive increase in the performance of the health system in Türkiye in recent years. It is thought that the rapid interventions made during the COVID-19 pandemic, which has affected the whole world, also contributed to this result.

Key words: Health systems, Performance, Health indicators, TOPSIS, Türkiye.

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1. INTRODUCTION

Health services are one of the determinants of public health, and one of the main goals of health systems is to improve and maintain public health (1,2). The performance of a country's health system has a strong impact on the health of the population, and better health outcomes can be achieved with higher performance. When health services are of high quality and accessible to everyone, the health outcomes of society are better (3).

Studies evaluating the performance of health systems have occupied the agenda of health management since the 90s. Initiatives pioneered by the World Health Organization (WHO), the Organization for Economic Co-operation and Development (OECD), and the World Bank have aroused worldwide interest in measuring the performance of health systems across and within countries (1).

According to the WHO's approach, three goals should be considered for a health system to perform well: improving the health status of the society, meeting people's expectations, and distributing the financial burden of health services fairly (4,5). Yet evaluating performance has a complex multi-dimensional structure and it is very difficult to summarize the performance of health systems with a single measurement (6). For this reason, health systems are evaluated using many different indicators under various dimensions.

The scope of performance indicators is broad and can range from examining the state of a country's healthcare system to reflecting the experiences of individual patients. Moreover, performance can be defined as international, national, regional, local, or institutional (7). Healthcare performance indicators can vary in focus depending on the level of analysis and the purpose. They can concentrate on patient care (micro level), healthcare organizations (meso level), or be utilized for policy-making (macro level). At the macro level, these indicators influence policy decisions by assessing the healthcare system as a whole and monitoring its performance. They provide valuable insights into the effectiveness of the health system and are used for developing strategies, identifying priority areas, and monitoring trends over time (8). Countries may adopt very different indicators to measure the performance of their health systems (9) and the indicators adopted may focus on the evaluation of processes or health outcomes (7).

There are studies in literature comparing the performance of countries' health systems with each other (10,11) or comparing the health performance of different regions of a country (1,12,13). Comparing health systems across countries allows for performance evaluation and policy assessment (14). In addition to comparing health performance across countries or regions, the health performance of a specific country can also be evaluated against data from previous years. For instance, Ta and colleagues examined China's health performance from 2010 to 2016 to investigate the impact of health system reforms implemented during that period (15). Various methods are used in performance evaluation. Technique for Order Preference by Similarity (TOPSIS) is one of the analysis methods used to determine the decision unit that shows the best performance among different alternatives. The method is also used in the healthcare sector (16). Araujo et al. (12) used the TOPSIS method to evaluate the performance of services of hospitals in Brazil. Sielska (16) preferred this method to compare the health systems performance of thirty-two European countries, and Ardielli et al. (17) preferred this

method to evaluate and compare the health care performance in the Czech Republic and Poland based on a multi-criteria analysis.

In this study, TOPSIS method is used as the performance evaluation method. The purpose of the study is to analyze Türkiye's health performance from 2018 to 2022. The changes in Türkiye's health performance over the years will be analyzed, and indicators reflecting low and high performance will be identified. These findings are expected to assist policymakers in shaping the country's health policies.

2. MATERIAL AND METHODS

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

Decision making is the process of choosing among many alternatives. Multi-criteria decision making problems are situations in which more than one criteria are evaluated and the best alternative is selected (18). In TOPSIS, criteria are often classified as benefit criteria (where higher values indicate better performance) and cost criteria (where lower values are preferable). Due to this classification, conflicts may arise when an alternative performs well in one criterion but poorly in another. For example, while increasing healthcare expenditures (a cost criterion) may enhance the quality and accessibility of healthcare services (benefit criteria), excessive spending does not always guarantee better health outcomes. Similarly, some indicators, such as mortality rates, are expected to be minimized, whereas others, like vaccination coverage or hospital capacity, should be maximized. This inherent contradiction among different criteria is a fundamental aspect of multi-criteria decision-making methods like TOPSIS, which aims to find the most balanced and optimal alternative based on these opposing factors (19).

When criteria normally contradict each other, it is quite difficult to compare all the criteria at the same time (20). If alternatives need to be ranked or compared according to more than one criterion, multidimensional methods or Multi-Criteria Decision Making (MCDM) methods are generally used. These methods rank alternatives according to the decision maker's preferences (16). The focus of the field of MCDM is the introduction of procedures, methods and tools to solve problems to support decision making. In MCDM problems, the overall performance of alternatives is evaluated according to various and conflicting criteria, and goals are combined according to the decision maker's preferences (21). Different methods are used to solve MCDM problems (20). The TOPSIS, developed by Hwang and Yoon, is one of the most widely used multi-criteria decision analysis methods (20-22). It has been highly accepted, implemented and adopted due to its simplicity (23). In this approach the chosen alternative should be closest to the positive ideal solution (PIS) and farthest from the negative ideal solution (NIS). PIS is a hypothetical alternative that maximizes the benefit criterion and at the same time minimizes the cost criterion. On the contrary, NIS maximizes cost criteria while simultaneously minimizing benefit criteria. As a result, a ranking is created among the best answers for each alternative. At the end of the ranking, the alternative with the least Euclidean distance to PIS and the farthest from NIS is determined as the best choice (20,22,24).

Today, this approach is used in different areas of life, such as energy medicine, engineering and production systems, security and environmental fields, chemical engineering and water resources studies (20). It is widely used in purchasing decisions and outsourcing provider selection, production decision-making, financial performance analysis, service quality

evaluation, selection practices training, technology selection, material selection, product selection, strategy evaluation and critical mission planning (22). It is also frequently used for performance evaluation (25).

The TOPSIS method is applied through a series of stages shown below (10,20,21,23).

Step 1: Creating the decision matrix

In the analysis, first a decision matrix (A) is created. Evaluation criteria and alternative decision points are placed in the columns and rows of this matrix.

Step 2: Creating the normalized decision matrix

In the second step, the values of these functions are standardized to compensate for the scale effect.

The normalization process in TOPSIS is not performed on the entire decision matrix as a whole but rather on a criterion-by-criterion basis. Specifically, for each criterion (e.g., criterion A), every individual value in the corresponding column is divided by the square root of the sum of the squared values of that column. This method, known as vector normalization, ensures that each criterion is scaled appropriately while preserving the relative differences between alternatives.

Step 3: Creating the weighted normalized decision matrix

To create the weighted normalized decision matrix, the weights of the criteria are first determined. There are two different approaches to weighting the criteria. Some researchers assume that the criteria used in the study have different weights, while others assume that all criteria have the same weight. It is seen that both approaches are applied in the literature (26).

Whether criteria are equally or differently weighed, the weighted normalized matrix at this stage is obtained by multiplying the weight values determined for each criterion.

Step 4: Obtaining positive and negative ideal solutions

In the fourth step of the sequence, two reference points are established from which the decision is made. The positive ideal solution (PIS), that is, the hypothetical best alternative, is defined using the values of the criteria for the considered alternatives. Similarly, the negative ideal solution (NIS) is interpreted as the hypothetical worst alternative. Both points are determined based on data. The best alternative must be as close to the ideal solution and/or as far from the negative ideal solution as possible. The PIS (I^+) and the NIS (I^-) are defined concerning the weighted decision matrix as follows:

NIS = $I^- = \{V_1^-, V_2^-, \ldots, V_q^-\}$, where:

$V_m^- = \{(\text{mini}(V_{lm}) \text{ if } m \in J; (\text{maxi}(V_{lm})) \text{ if } m \in J')\}$

Where J is associated with the non-beneficial attributes and J' is associated with beneficial attributes.

Step 5: Calculating the distances of the positive and negative ideal solution points of the alternatives

Applying the Euclidean distance theory, the distance of each alternative rating from both positive and negative ideal solutions is obtained.

$$S_l^+ = \sqrt{\sum_{m=1}^{p} (V_m^+ - V_{lm})^2} \; ; \; l = 1, 2, \dots, q$$

$$S_l^- = \sqrt{\sum_{m=1}^{p} (V_m^- - V_{lm})^2} \; ; \; l = 1, 2, \dots, q$$

Step 6: Calculating the relative priority to the ideal solution

In the last step, a closeness coefficient is calculated for each alternative and the alternatives are ranked in descending order using the obtained C_i^* value. C_i^* represents the relative closeness coefficient of alternative Ai to the ideal solution. It measures how close an alternative is to the ideal solution while being far from the negative-ideal solution. In this way, the relative ranking of the alternatives is done. C_i^* ranges from 0 to 1. The highest value of C_i^* indicates the best among the alternatives. The alternative with the lowest value of C_i^* is the last alternative in the ranking.

$$C^1 = \frac{\mathrm{S_i}^-}{(\mathrm{S_i}^+ + S_\mathrm{i}^-)} \; , 0 \leq C_\mathrm{i} \leq 1$$

Data Collection

This is a retrospective study using secondary data. The data used as performance evaluation criteria were taken from the Republic of Türkiye Ministry of Health Statistics Yearbook (HSY) 2018, 2019, 2020, 2021 and 2022 publications (27-31).

The total number of criteria used is 45 (Appendix -1). The criteria consist of indicators under the headings of mortality (3), morbidity (4), prevention of diseases and protection of health (11), institutions and infrastructures providing health services (8), use of health services (11), human resources in health (4), and health economics and financing (4). International standards were used when calculating the values of these indicators by the Ministry of Health of the Republic of Türkiye (31).

TOPSIS method was applied in the analysis. Mathematical calculations of the research were carried out with MS Office Excel Program. In this study, all indicators were assigned equal importance, and the criteria were not weighted at different levels.

In this study, equal weighting was preferred for all indicators to ensure an objective and neutral evaluation of Türkiye's healthcare performance over the years. Assigning equal weights prevents subjective bias that could arise from expert opinions or arbitrary weight assignments. While methods such as the Analytical Hierarchy Process (AHP) could have been used to determine different weights based on expert input, this approach was not pursued to maintain

methodological simplicity and avoid potential inconsistencies in expert judgments. Moreover, since the study aims to provide a holistic assessment of healthcare performance, treating all indicators with equal importance allows for a balanced comparison without prioritizing any specific aspect of the healthcare system. Future research could explore alternative weighting methods to assess their impact on performance rankings.

3. RESULTS

In the study, five years were evaluated from best to worst performance using the TOPSIS method, based on some selected health indicators of Türkiye.

Table 1. Decision Matrix

Evaluation Criteria	Direction of Effect	Alternative Decision Points				
		2018	**2019**	**2020**	**2021**	**2022**
C1	Min	9.2	9.0	8.5	9.1	9.1
C2	Min	13.6	13.1	13.1	13.1	12.6
C3	Min	283.7	271.7	276.9	267.7	245.7
C4	Min	0.2	0.2	0.1	0.1	0.1
C5	Min	0.9	3.5	0.7	0.1	0.1
C6	Min	14.1	13.5	10.6	10.7	11.4
C7	Min	0.29	0.34	0.16	0.25	0.33
C8	Max	98	99	98	95	99.5
C9	Max	96	96	96	95	98.1
C10	Max	98	99	98	96	99.3
C11	Max	96	97	95	96	95.2
C12	Max	98.0	97.0	98.0	97.5	97.3
C13	Min	54.9	54.4	57.3	58.4	60.1
C14	Min	26.3	26.5	28.8	29.1	31.1
C15	Max	99.5	99.4	99.7	99.7	99.7
C16	Max	92.5	98.3	96.2	96.1	96.4
C17	Max	88.6	91.7	90.5	92.4	90.8
C18	Max	92.8	93.6	91	90.6	94
C19	Max	28.3	28.6	30	30.1	30.7
C20	Max	71.9	74.7	78.5	79.7	80.9
C21	Max	4.6	4.8	5.7	5.8	5.7
C22	Max	9.9	10.8	11.8	12.3	13.2
C23	Max	7931	8357	8248.0	8412	8209
C24	Min	3124	3141	3144	3145	3072
C25	Min	1998	1980	2428	2269	2071
C26	Min	16701	15451	14641	14598	14870
C27	Max	3.2	3.5	3	2,9	4
C28	Max	6.3	6.3	4.2	5.1	6
C29	Max	0.65	0.67	0.32	0.4	0.6
C30	Max	13651377	13806349	10620517	11785492	13280620
C31	Max	5201738	5223815	3722218	4704094	5773049
C32	Max	56642035	57501537	48168462	51742167	55609381
C33	Max	66.9	66.3	52.5	55.7	58.1
C34	Min	4	4	5	4.4	4.2
C35	Max	58.9	58.1	42.3	46.3	50.7
C36	Min	2.1	2.1	4.1	3.5	3
C37	Max	70.4	67.1	72.1	68.1	65.6
C38	Max	187	193	205.0	217	228
C39	Max	37	40	42	47	50
C40	Max	39.1	40.7	42.3	43.9	45.7
C41	Max	301	306	342	343	356

Table 1. Decision Matrix (continued)

Evaluation Criteria	Direction of Effect	Alternative Decision Points				
		2018	**2019**	**2020**	**2021**	**2022**
C42	Max	4.4	4.7	5	4.9	4
C43	Max	5409	5633	6177	7248	7141
C44	Min	938.00	942	991.0	1154	1318
C45	Min	17.3	16.7	16	15.9	18.5

Table 1 includes a 5x45 Matrix consisting of 45 healthcare indicators (evaluation criteria) for the years 2018, 2019, 2020, 2021, 2022 (alternative decision points). Criteria are shown in the rows of the decision matrix, and alternative decision points are shown in the columns. Some indicators represent negative conditions in the healthcare system and should be reduced to improve public health. In this study, indicators such as C1 (Infant Mortality Rate), C2 (Maternal Mortality Rate), and C3 (Age-Standardized Premature Death Rate due to Four Main Non-Communicable Diseases) are marked as "Min", meaning they should be minimized. On the other hand, some indicators reflect positive factors that enhance the effectiveness and accessibility of healthcare services. An increase in these indicators signifies progress in the healthcare system. Such variables include C8, C9, and C10 (Vaccination Rates), C15 (Antenatal Care Coverage), and C20 (Proportion of Qualified Beds in Total Beds), which are designated as "Max", indicating they should be maximized (Table 1).

Table 2. Normalized Decision Matrix

Evaluation Criteria	Alternative Decision Points				
	2018	**2019**	**2020**	**2021**	**2022**
C1	0.45799	0.44804	0.42315	0.45302	0.45302
C2	0.46415	0.44708	0.44708	0.44708	0.43002
C3	0.47087	0.45095	0.45958	0.44431	0.40780
C4	0.54245	0.57635	0.30513	0.40684	0.33903
C5	0.23676	0.94977	0.20138	0.01633	0.03266
C6	0.51907	0.49699	0.39023	0,39391	0.41968
C7	0.46043	0.53982	0.25403	0.39693	0.52394
C8	0.44761	0.45218	0.44761	0.43391	0.45446
C9	0.44617	0.44617	0.44617	0.44152	0.45593
C10	0.44691	0.45147	0.44691	0.43779	0.45284
C11	0.44795	0.45261	0.44328	0.44795	0.44422
C12	0.44923	0.44464	0.44923	0.44693	0.44602
C13	0.43028	0.42637	0.44909	0.45772	0.47104
C14	0.41391	0.41706	0.45325	0.45798	0.48945
C15	0.44676	0.44632	0.44766	0.44766	0.44766
C16	0.43128	0.45832	0.44853	0.44806	0.44946
C17	0.43633	0.45160	0.44569	0.45505	0.44717
C18	0.44910	0.45297	0.44039	0.43845	0.45491
C19	0.42823	0.43277	0.45395	0.45547	0.46455
C20	0.41644	0.43266	0.45467	0.46162	0.46857
C21	0.38491	0.40165	0.47696	0.48533	0.47696
C22	0.37981	0.41434	0.45270	0.47188	0.50641
C23	0.43080	0.45394	0.44802	0.45693	0.44590
C24	0.44702	0.44946	0.44989	0.45003	0.43958
C25	0.41441	0.41068	0.50360	0.47062	0.42955
C26	0.48905	0.45244	0.42872	0.42746	0.43543
C27	0.42800	0.46813	0.40125	0.38788	0.53500
C28	0.49958	0.49958	0.33305	0.40442	0.47579

Table 2. Normalized Decision Matrix (continued)

Evaluation Criteria	Alternative Decision Points				
	2018	2019	**2020**		**2021**
C29	0.52613	0.54232	0.25902	0.33187	0.50185
C30	0.48113	0.48660	0.37431	0.41537	0.46807
C31	0.46778	0.46976	0.33473	0.42302	0.51915
C32	0.46870	0.47581	0.39858	0.42815	0.46015
C33	0.49719	0.49273	0.39017	0.41395	0.43179
C34	0.42815	0.43860	0.46992	0.45948	0.43860
C35	0.50980	0.50288	0.36612	0.40075	0.43883
C36	0.30671	0.30671	0.59881	0.51118	0.43815
C37	0.45828	0.43680	0.46935	0.44331	0.42704
C38	0.40488	0.41787	0.44386	0.46984	0.49365
C39	0.38078	0.41165	0.43223	0.48369	0.51456
C40	0.41237	0.42925	0.44612	0.46300	0.48198
C41	0.40751	0.41428	0.46301	0.46437	0.48197
C42	0.42644	0.45552	0.48459	0.47490	0.38767
C43	0.37995	0.39568	0.43389	0.50912	0.50161
C44	0.38888	0.39053	0.41085	0.47843	0.54642
C45	0.45761	0.44174	0.42322	0.42058	0.48935

Normalization is essential in multi-criteria decision-making (MCDM) analysis because it standardizes the data, ensuring that indicators with different measurement scales can be fairly compared. After the decision matrix was created, the sum of the squares of each value in the row was calculated, and then the square root of the sum of the squares was calculated. Normalization was performed by dividing the sum of the squares of the values in the decision matrix by the square root. In this way, the normalized decision matrix given in Table 2 was obtained (Table 2).

Table 3. Weighted Normalized Decision Matrix

Evaluation Criteria	Alternative Decision Points				
	2018	**2019**	**2020**	**2021**	**2022**
C1	0.01018	0.00996	0.00940	0.01007	0.01007
C2	0.01031	0.00994	0.00994	0.00994	0.00956
C3	0.01046	0.01002	0.01021	0.00987	0.00906
C4	0.01205	0.01281	0.00678	0.00904	0.00753
C5	0.00526	0.02111	0.00448	0.00036	0.00073
C6	0.01153	0.01104	0.00867	0.00875	0.00933
C7	0.01023	0.01200	0.00565	0.00882	0.01164
C8	0.00995	0.01005	0.00995	0.00964	0.01010
C9	0.00991	0.00991	0.00991	0.00981	0.01013
C10	0.00993	0.01003	0.00993	0.00973	0.01006
C11	0.00995	0.01006	0.00985	0.00995	0.00987
C12	0.00998	0.00988	0.00998	0.00993	0.00991
C13	0.00956	0.00947	0.00998	0.01017	0.01047
C14	0.00920	0.00927	0.01007	0.01018	0.01088
C15	0.00993	0.00992	0.00995	0.00995	0.00995
C16	0.00958	0.01018	0.00997	0.00996	0.00999
C17	0.00970	0.01004	0.00990	0.01011	0.00994
C18	0.00998	0.01007	0.00979	0.00974	0.01011
C19	0.00952	0.00962	0.01009	0.01012	0.01032
C20	0.00925	0.00961	0.01010	0.01026	0.01041
C21	0.00855	0.00893	0.01060	0.01079	0.01060
C22	0.00844	0.00921	0.01006	0.01049	0.01125

Table 3. Weighted Normalized Decision Matrix (continued)

Evaluation Criteria	Alternative Decision Points				
	2018	2019	**2020**		**2021**
C23	0.00957	0.01009	0.00996	0.01015	0.00991
C24	0.00993	0.00999	0.01000	0.01000	0.00977
C25	0.00921	0.00913	0.01119	0.01046	0.00955
C26	0.01087	0.01005	0.00953	0.00950	0.00968
C27	0.00951	0.01040	0.00892	0.00862	0.01189
C28	0.01110	0.01110	0.00740	0.00899	0.01057
C29	0.01169	0.01205	0.00576	0.00737	0.01115
C30	0.01069	0.01081	0.00832	0.00923	0.01040
C31	0.01040	0.01044	0.00744	0.00940	0.01154
C32	0.01042	0.01057	0.00886	0.00951	0.01023
C33	0.01105	0.01095	0.00867	0.00920	0.00960
C34	0.00951	0.00975	0.01044	0.01021	0.00975
C35	0.01133	0.01118	0.00814	0.00891	0.00975
C36	0.00682	0.00682	0.01331	0.01136	0.00974
C37	0.01018	0.00971	0.01043	0.00985	0.00949
C38	0.00900	0.00929	0.00986	0.01044	0.01097
C39	0.00846	0.00915	0.00961	0.01075	0.01143
C40	0.00916	0.00954	0.00991	0.01029	0.01071
C41	0.00906	0.00921	0.01029	0.01032	0.01071
C42	0.00948	0.01012	0.01077	0.01055	0.00861
C43	0.00844	0.00879	0.00964	0.01131	0.01115
C44	0.00864	0.00868	0.00913	0.01063	0.01214
C45	0.01017	0.00982	0.00940	0.00935	0.01087

The weighted normalized decision matrix was created by applying equal weighting to all criteria in the normalized decision matrix. It was assumed that the criteria had the same weight. This step ensures that each criterion contributes equally to the final evaluation, eliminating any bias that may arise due to differences in measurement scales (Table 3).

Table 4. Positive and Negative Ideal Solution Values

Evaluation Criteria	Positive ideal solution values	Negative ideal solution values
C1	0.00940	0.01018
C2	0.00956	0.01031
C3	0.00906	0.01046
C4	0.00678	0.01281
C5	0.00036	0.02111
C6	0.00867	0.01153
C7	0.00565	0.01200
C8	0.01010	0.00964
C9	0.01013	0.00981
C10	0.01006	0.00973
C11	0.01006	0.00985
C12	0.00998	0.00988
C13	0.00947	0.01047
C14	0.00920	0.01088
C15	0.00995	0.00992
C16	0.01018	0.00958
C17	0.01011	0.00970
C18	0.01011	0.00974
C19	0.01032	0.00952
C20	0.01041	0.00925
C21	0.01079	0.00855

Table 4. Positive and Negative Ideal Solution Values (continued)

Evaluation Criteria	Positive ideal solution values	Negative ideal solution values
C22	0.01125	0.00844
C23	0.01015	0.00957
C24	0.00977	0.01000
C25	0.00913	0.01119
C26	0.00950	0.01087
C27	0.01189	0.00862
C28	0.01110	0.00740
C29	0.01205	0.00576
C30	0.01081	0.00832
C31	0.01154	0.00744
C32	0.01057	0.00886
C33	0.01105	0.00867
C34	0.00951	0.01044
C35	0.01133	0.00814
C36	0.00682	0.01331
C37	0.01043	0.00949
C38	0.01097	0.00900
C39	0.01143	0.00846
C40	0.01071	0.00916
C41	0.01071	0.00906
C42	0.01077	0.00861
C43	0.01131	0.00844
C44	0.00864	0.01214
C45	0.00935	0.01087

The positive ideal solution (A^+) and negative ideal solution (A^-) values are fundamental components of multi-criteria decision-making (MCDM) methods, such as. These values help determine how close or far each alternative (year) is from the best and worst possible scenarios. Positive ideal solution value (A^+) and negative ideal solution value (A^-) are given in Table 4.

For indicators that should be minimized (e.g., mortality rates, disease incidence, out-of-pocket expenses), A^+ represents the lowest value, while A^- represents the highest value. For instance, for indicator C1 (Infant Mortality Rate), $A^+ = 0.00940$ represents the year with the lowest infant mortality rate, while $A^- = 0.01018$ indicates the year with the highest infant mortality rate. For indicator C8 (Vaccination Rate - DTP), $A^+ = 0.01010$, meaning the highest recorded vaccination rate while $A^- = 0.00964$, meaning the lowest recorded vaccination rate (Table 4).

Table 5. S_i^+ and S_i^- Values

	Alternative Decision Points				
	2018	**2019**	**2020**	**2021**	**2022**
$\boldsymbol{S_i^+}$	0.000138	0.000546	0.000181	0.000102	0.000076
$\boldsymbol{S_i^-}$	0.000402	0.000159	0.000396	0.000519	0.000585

After calculating the positive ideal solution value (A^+) and negative ideal solution value (A^-), the distance between the ith alternative and the positive ideal solution value (S_i^+) and the distance between the negative ideal solution value (S_i^-) were calculated. S_i^+ and S_i^- values are shown in Table 5. This indicates that 2022 was closest to the ideal solution and farthest from the worst-case scenario, suggesting significant improvements in healthcare service efficiency and accessibility. 2019 exhibited the weakest performance, having the highest S^+ value

(0.000546) and the lowest S^- value (0.000159). This implies that 2019 was the farthest from the ideal solution and closest to the worst-case scenario, indicating a year of relative inefficiency or systemic healthcare challenges. 2020 and 2021 demonstrated progressive improvement, with their S^+ values decreasing and S^- values increasing, indicating a gradual movement toward an optimal healthcare system. 2018 positioned itself between the worst (2019) and the best (2022), with moderate S^+ and S^- values (Table 5).

Table 6. Calculation of Relative Priority to Ideal Solution

	Alternative Decision Points				
	2018	**2019**	**2020**	**2021**	**2022**
C_i^*	0.745	0.226	0.686	0.836	0.884
Ranking	3	5	4	2	1

After calculating the S^+ (distance from the positive ideal solution) and S^- (distance from the negative ideal solution) values, the relative closeness to the ideal solution (C_i^+) was determined. Proximity values (C_i^*) were calculated using the formula provided in the sixth step. The results showed that 2022 was identified as the best-performing year, with a value of C_i^+ = 0.884. This indicates that the healthcare system achieved its highest efficiency and effectiveness during this period. Following 2022, 2021 ranked second with a value of C_i^+= 0.836, demonstrating sustained progress and recovery from earlier challenges, particularly those faced in 2020. In third place was 2018, with a value of C_i^+= 0.745, reflecting moderate performance compared to the later years. Fourth place went to 2020, which had a C_i^+value of 0.686, indicating a decline in performance likely due to disruptions caused by the COVID-19 pandemic. Lastly, the analysis showed that 2019 was the worst-performing year, with a C_i^+value of 0.226 (Table 6).

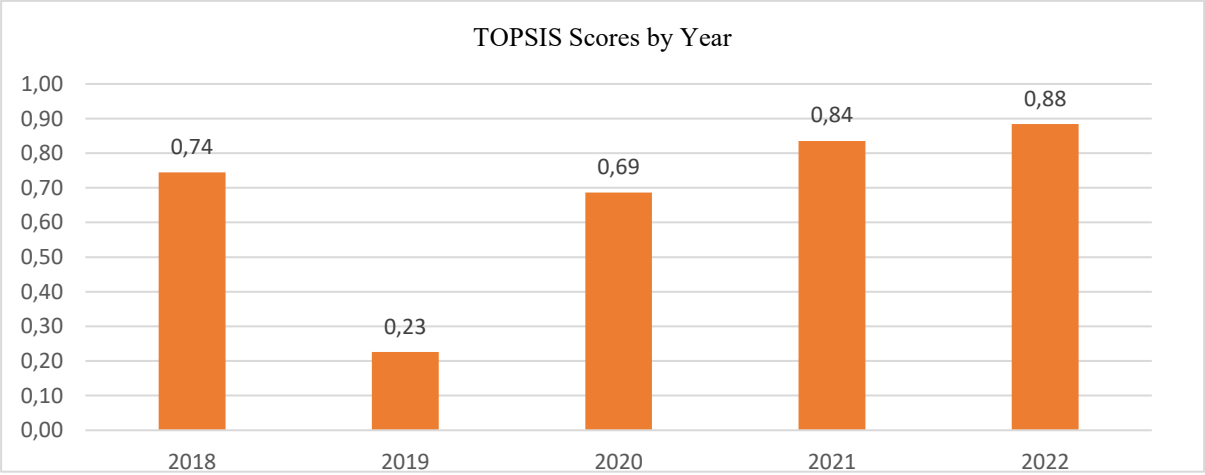

Figure 1. TOPSIS Scores by Year

According to the TOPSIS analysis, the years with the highest performance were 2022, 2021, 2018, 2020, and 2019, respectively. In 2019, there was a significant decline in performance, followed by a slight recovery in 2020. Performance then gradually increased in 2021 and 2022 (Figure 1).

4. DISCUSSION

Better health is undoubtedly the main goal of every health system, and in line with this goal, governments make the necessary arrangements for the best functioning of health systems (32). In this study, the performance of Türkiye's health system in the five-year period covering the years 2018, 2019, 2020, 2021 and 2022 was examined. According to the indicators included in the analysis in this five-year period, the best performance belongs to 2022 and then 2021. The worst performance belongs to 2019.

In Türkiye, a reform was initiated with the Health Transformation Program (HTP), which was announced in 2003 (33,34). Since the 1990s, the deficiencies in the country's health system and poor health indicators had been a growing concern. Notably, high infant mortality rates, regional inequalities, the proportion of individuals without health insurance, low satisfaction with health services, and inefficient management of healthcare were identified as the most significant issues (35). The main objectives of the HTP were as follows: administrative and functional restructuring of the Ministry of Health; including all citizens in health insurance; centralized management of public health institutions affiliated with different organizations; providing administrative and financial autonomy to hospitals; developing the family doctor system; improving maternal and child health; placing importance on preventive medicine; encouraging the private sector; delegating authority in the management of public health institutions; eliminating personnel shortages in regions where service delivery is inadequate; and accelerating healthcare digitalization (34). HTP was implemented in two stages. The first stage, which took place from 2003 to 2008, focused on capacity building, reorganizing service delivery, and developing health information systems. The second stage, from 2009 to 2013, primarily addressed health financing (36).

Following the Health Transformation Program, many positive developments have occurred. For example, there has been a decrease in maternal and infant mortality rates. Out-of-pocket payments and catastrophic expenditures for health services have decreased. In addition, satisfaction with health services has increased significantly (37). Access to health services has spread rapidly and immunization rates have improved impressively since early 2000s (38). When the period between 2018 and 2022 is examined, the infant mortality rate reached its lowest level in 2020 during this five-year period, it is lower in 2022 compared to 2018. Moreover, vaccination rates for all three childhood vaccines (DaBT 3, BCG, HBV 3) show a positive trend.

Due to its widespread impact and severity, the COVID-19 pandemic has created great pressure on countries' health systems. The WHO declared COVID-19 as a "pandemic" on March 11, 2020, and announced that it ended on May 5, 2023 (39,40). The first COVID-19 case in Türkiye was reported on March 11, 2020 (39), and the Ministry of Health stopped publishing disease statistics as of March 2023 (41). Therefore, it would be appropriate to evaluate the three years between 2020 and 2022 with the effects of the pandemic. Therefore, this study is also important in showing the effects of COVID-19 on the performance of the Turkish healthcare system. The COVID-19 pandemic has shown that health systems are generally not designed to meet the demands of large-scale disasters, and even health systems in high-income countries remain under capacity in the face of this crisis (11,42,43). The pandemic has caused significant human, social and economic costs, revealing the fundamental vulnerability of many health systems to stand shocks (3). Nowadays, as the effects of the pandemic have diminished,

researchers are examining the performance of countries in the pandemic using retrospective data. Based on these studies, ways to be stronger and prepared against possible pandemics that may be encountered in the future are being sought.

Studies comparing the health performance of different countries in the COVID-19 pandemic state that Türkiye performs lower than other countries in the fight against the pandemic (2,44,45). However, in the analysis conducted in this study, it was seen that the highest performing years were 2022 and 2021, and the worst performing year was 2019. These findings surprisingly show that the COVID-19 pandemic does not reduce the performance of the Turkish healthcare system but rather has a more positive effect. It is thought that there may be different reasons for the contradictory results with previous studies. Studies conducted using pre-pandemic data show that Türkiye's health performance is ranked low compared to other countries, and it is likely that this situation may have continued during the pandemic (26,46). Yet this study examines Türkiye's performance in terms of health results obtained in certain years making no relative comparison with other countries. It should not be forgotten that the use of different indicators may change the performance ranking of health systems (7). The differences in the indicators, methods used and the years in which the data were obtained may affect the results of the studies.

It is possible to talk about government regulations and activities affecting the health system in Türkiye in 2021. Türkiye was among the countries that responded fastest to the pandemic worldwide. Studies on COVID-19 in Türkiye started on January 10, and the first meeting of the Scientific Advisory Board of the Ministry of Health of the Republic of Türkiye was held on January 22 generating the "COVID-19 Risk Assessment" and the "COVID-19 Guide and Case Report Form" (39). Information about the disease was disseminated throughout the country with the "COVID-19 Disease Guide" containing general information about the infection, case definitions and information on case management, infection control and isolation, patient care and treatment. During the pandemic, all developments were tracked, and new updates published on the official website of the Ministry of Health (47). This rapid and standard information flow may have positively affected the country's health system.

Another important regulation is the interventions aimed at increasing capacity in health. A critical aspect of a country's response to rapidly increasing demand is the ability of its healthcare system to expand rapidly to meet the increasing demand for medical care. This is known as capacity expansion (42). As in the rest of the world, the rapidly rising number of cases in Türkiye due to COVID-19 has increased hospital admissions and occupancy rates. In response to this situation, the Ministry of Health postponed non-urgent surgeries and non-urgent dentistry practices for a certain period (47). Thus, the available beds were used mainly for COVID-19 patients. In addition, the bed capacity in the country has been significantly increased with the newly opened hospitals during the pandemic period (48). The construction period of Sancaktepe Prof. Dr. Feriha Öz Emergency Hospital and Prof. Dr. Murat Dilmener Emergency Hospital, which were built to meet the increasing need especially during the pandemic period and each have more than 1000 beds, was completed very quickly (49). In fact, this situation increased the number of hospital beds per 10,000 people in the country from 28.3 in 2018 to 30.7 in 2022.

Apart from the positive contribution of the number of hospital beds to the fight against the COVID-19 pandemic, past studies show that the number of hospital beds in a country has

an impact on health outcomes. A study points to a high and negative relationship between hospital bed capacity and mortality rate, reporting that one less death for every three beds retained (50). Another study found a negative relationship between bed density and maternal death (51). Based on this information, it would not be wrong to say that the increase in the number of beds impacts performance.

Health workers are essential to health systems and to achieving, sustaining, and accelerating progress toward Universal Health Coverage (UHC) (52). Moreover, previous studies reveal significant relationships between manpower in health and the health outcomes of the society. Liu and Eggleston (53) state that the density of skilled health workers, nurses and midwives is significantly associated with maternal mortality rate, under-five mortality rate, infant mortality rate and neonatal mortality rate. Another study found that countries' nurse employment positively affects life expectancy at birth and at age 65 (54). Basu et al. state that every 10 additional primary care physicians per 100,000 population leads to a 51.5-day increase in life expectancy, and an additional 10 specialist physicians leads to a 19.2-day increase. Moreover, as the number of physicians increases, deaths from cardiovascular, cancer and respiratory diseases decrease significantly (55). Considering the years evaluated in this study, it is seen that the total number of physicians, dentists, pharmacists, nurses and midwives per 100,000 people has increased gradually since 2018. An increase of 121.9% and 118.1% was recorded in the number of physicians and nurses-midwives between 2018 and 2022. It is thought that this increase has a positive reflection on the health outcomes in the country.

Another consideration when evaluating the performance of health systems is health expenditures. The ratio of total health expenditure to Gross Domestic Product (GDP) (%) in Türkiye increased from 4.4 in 2018 to 4.9 in 2021. In general, countries with higher health expenditures are known to have better health outcomes (3). The literature provides evidence that increased spending on public health is associated with increased life expectancy in the country, reduced infant mortality, and reductions in mortality rates and years of life lost (3,56,57). Although Türkiye's health expenditure is among the lowest among OECD countries (10), there is an increase in the 4 years examined. It is thought that this situation may have a positive impact on the health system performance.

Since the announcement of the Health Transformation Program in 2003, Türkiye has made significant advancements in the health sector, leading to notable improvements in various health indicators. Analyzing the five-year period from 2018 to 2022 reveals some impacts of the COVID-19 pandemic; however, the health system responded quickly to the crisis, and many indicators showed improvement. In fact, the performance results for the years 2021 and 2022 were better than those of the preceding years. As Khambhati et al. (22) note, health services must be sustainable in the face of rising demand, as limited resources can lead to dire consequences, including loss of life, poverty, decreased productivity, and economic losses due to an inadequate health system. From this perspective, it can be concluded that the Turkish health system has become more robust as a result of the reforms implemented following the HTP.

Limitations of Study

The data used in the study is limited to the data from the HSY of the Ministry of Health of the Republic of Türkiye. This study analyses a five-year period. Longitudinal studies are

recommended to assess the long-term performance. Additionally, further research can identify regional differences.

5. CONCLUSION

Countries strive to provide their health systems with the highest performance to achieve better health outcomes. In this regard, health systems' performance is constantly evaluated and monitored. Sudden and large-scale changes in the country put intense pressure on the healthcare system and require the system to quickly adapt to this extraordinary situation. The COVID-19 pandemic has created an additional burden on the healthcare system in Türkiye, as well as all over the world. In this context, it is not possible for the performance of the health system not to be affected.

In the study, various indicators were evaluated within the five-year period determined to examine the Türkiye's health performance. As a result, it can be said that Türkiye has a health system performance that is gradually increasing in a positive direction.

Author Contribution Statement

The first authors' contribution rates is 40%, the second in authors' contribution rates is 30% and the third authors' contribution rates is 30%.

Conflict of Interest Statement

There is no conflict of interest with any institution or person within the scope of the study.

Ethical Considerations

Open-access data was used in the study; therefore, it does not require ethics committee permission.

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Appendix 1

Criterion Code	Criterion Name	Source
C1	Infant Mortality Rate (per 1.000 Live Births) (All weeks)	HSY, 2018,2019,2020,2021,2022
C2	Maternal Mortality Ratio (per 100.000 Live Births)	HSY, 2018,2019,2020,2021,2022
C3	Age-Standardized Premature Death Rate of Four Main Non-Communicable Disease Groups (per 100,000 Population, European Standard Population)	HSY, 2022
C4	AIDS Incidence (per 100,000 Population)	HSY, 2022
C5	Measles Incidence, (per 100,000 Population)	HSY, 2022
C6	Tuberculosis Incidence, (per 100,000 Population)	HSY, 2022
C7	Malaria Incidence, (per 100,000 Population)	HSY, 2022
C8	Vaccination Rate, (%) DaBT 3	HSY, 2022
C9	Vaccination Rate, (%) BCG	HSY, 2022
C10	Vaccination Rate, (%) HBV 3	HSY, 2022
C11	Vaccination Rate, (%) KKK	HSY, 2022
C12	Birth Rate in Hospitals (%)	HSY, 2018,2019,2021,2022
C13	Ratio of Caesarean Section in Live Births (%)	HSY, 2018,2019,2021,2022
C14	Ratio of Primary Caesarean Section in Live Births (%)	HSY, 2018,2019,2021,2022
C15	Antenatal Care Scope (At least One Visit), (%)	HSY, 2022
C16	Fully Monitored Pregnancy Rate, (%)	HSY, 2018,2019,2021,2022
C17	Fully Monitored Baby Rate, (%)	HSY, 2018,2019,2021,2022
C18	Fully Monitored Child Rate, (%)	HSY, 2018,2019,2021,2022
C19	Number of Hospital Beds Per 10,000 People, All Sectors	HSY, 2022
C20	Ratio of Qualified Beds in Total Beds, All Sectors, (%)	HSY, 2022
C21	Number of Intensive Care Beds per 10,000 People	HSY, 2018,2019,2020,2021,2022
C22	Number of Neonatal Intensive Care Beds per 1,000 Live Births	HSY, 2018,2019,2020,2021,2022
C23	Number of Hemodialysis Devices per 1,000,000 People	HSY, 2018,2019,2020,2021,2022
C24	Population per Dental Unit, All Sectors	HSY, 2018,2019,2020,2021,2022
C25	Population per Family Medicine Unit	HSY, 2018,2019,2020,2021,2022
C26	Number of cases per 112 emergency ambulances	HSY, 2018,2019,2020,2021,2022
C27	Number of Visits to Primary Care Physician per Person	HSY, 2018,2019,2020,2021,2022
C28	Number of Applications to Physician per Person in 2nd and 3rd Levels	HSY, 2018,2019,2020,2021,2022
C29	Number of Visits to the Dentist Per Person	HSY, 2018,2019,2020,2021,2022
C30	Number of Inpatients (All Sectors)	HSY, 2022
C31	Total Number of Surgeries (All Sectors)	HSY, 2022
C32	Number of Days Stayed in Hospitals (All Sectors)	HSY, 2022
C33	Bed Occupancy Rate in Hospitals, (%) All Sectors, (%)	HSY, 2018,2019,2020,2021,2022
C34	Average Length of Stay for Inpatients in Hospitals, All Sectors, (Days)	HSY, 2018,2019,2020,2021,2022
C35	Bed Turnover Rate in Hospitals, All Sectors, (Patient)	HSY, 2018,2019,2020,2021,2022
C36	Bed Turnover Range in Hospitals, All Sectors, (Day)	HSY, 2018,2019,2020,2021,2022
C37	Rate of Those Satisfied with Health Services, (%)	HSY, 2022
C38	Total Number of Physicians Per 100,000 People	HSY, 2022
C39	Total Number of Dentists per 100,000 People	HSY, 2022
C40	Number of Pharmacists per 100,000 People	HSY, 2022
C41	Number of Nurses and Midwives per 100,000 People	HSY, 2022
C42	Ratio of Total Health Expenditure to GDP (%)	HSY, 2022
C43	Public and Private Health Expenditure per Capita, Real, ₺	HSY, 2022
C44	Out-of-Pocket Health Expenditure per Person, Real, ₺	HSY, 2022
C45	Ratio of Out-of-Pocket Health Expenditures in Total Health Expenditures, (%)	HSY, 2022