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Technical Efficiency of Physicians on a Provincial Basis in Turkey: An Application in Ministry of Health Hospitals

Türkiye'de Hekimlerin İl Bazında Teknik Etkinliği: Sağlık Bakanlığı Hastanelerinde Bir Uygulama

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Abstract: This study aims to analyze the technical efficiency of the physicians working in the hospitals of the Turkish Ministry of Health of Turkey on a provincial basis. The other aim is to determine the idle inputs and under-produced outputs of the inefficient provinces. CCR and BCC models of Data Envelopment Analysis (DEA) technique were used as a method to determine the technical efficiency level of physicians. The Super-efficiency model was also used to rank the efficiency of the efficient provinces. The total number of surgical specialists, the total number of internal medicine specialists, and the total number of general practitioners were used as input variables, the total weighted number of surgeries, the total number of hospital admissions, and the total number of inpatients as output variables in this study. As a result of the analysis, 19 (23.5%) provinces were technically efficient according to the CCR model, while 28 (34.6%) provinces achieved to be technically efficient in the BCC model. The efficiency average of 81 provinces was calculated as 0.8647 in the CCR model and 0.9149 in the BCC model. As a consequence of the super-efficiency ranking of the 19 provinces that are efficient in the input-oriented CCR model, the three provinces with the highest efficiency scores were Istanbul, Ankara, and Kırıkkale, respectively. The super-efficiency score of the Istanbul Province was higher than the others, having a value above 1.7. It is a known fact that the number of physicians in Turkey is quite insufficient compared to developed countries. Therefore, instead of reducing the number of healthcare personnel in inefficient provinces, the number of healthcare personnel in efficient provinces should be increased.

Keywords: Technical Efficiency of Physicians, Ministry of Health Hospitals, Data Envelopment Analysis, Super-efficiency Analysis

Öz: Bu araştırmanın amacı, Türkiye Sağlık Bakanlığı Hastanelerinde görev yapan hekimlerin il bazında teknik etkinliğini analiz etmektir. Diğer amaç ise, etkin olmayan illerin atıl kullanılan girdilerini ve eksik üretilen çıktılarını tespit etmektir. Hekimlerin teknik etkinlik düzeyini belirleme yöntemi olarak Veri Zarflama Analizi (VZA) tekniğinin CCR ve BCC modelleri kullanılmıştır. Ayrıca etkin olan illerin etkinlik sıralamasını yapmak

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için Süper Etkinlik modeli kullanılmıştır. Araştırmada, toplam cerrahi uzman hekim sayısı, toplam dâhili uzman hekim sayısı, toplam pratisyen hekim sayısı girdi; toplam ağırlıklı ameliyat sayısı, toplam hastane başvuru sayısı ve toplam yatan hasta sayısı ise çıktı değişkeni olarak kullanılmıştır. Analiz sonucunda, CCR modeline göre, 19 (%23,5) il teknik etkin olurken, BCC modelinde 28 (%34,6) il teknik etkin olmayı başarmıştır. 81 ilin etkinlik ortalaması CCR modelinde 0,8647, BCC modelinde ise 0,9149 olarak hesaplanmıştır. Girdi yönelimli CCR modelinde etkin olan 19 ilin süper etkinlik sıralaması sonucunda, etkinlik skoru en yüksek üç il sırasıyla İstanbul, Ankara ve Kırıkkale olmuştur. İstanbul ili süper etkinlik skoru 1,7 üzerinde bir değer alarak diğer illere göre oldukça yüksek çıkmıştır. Gelişmiş ülkelere göre Türkiye'de hekim sayısı oldukça yetersiz olduğu açık bir gerçektir. Bu sebeple etkin olmayan illerde sağlık personelinin azaltılması yerine, etkin olan illere yönelik sağlık personeli sayısının arttırılması yoluna gidilmelidir.

Anahtara Kelimeler: Hekimlerin Teknik Etkinliği, Sağlık Bakanlığı Hastaneleri, Veri Zarflama Analizi, Süper Etkinlik Analizi

Introduction

Hospitals across the world constitute the basic cost element of healthcare systems (Kohl et al., 2019: 245). Almost half of the resources allocated to public healthcare services in developing countries are used by hospitals (Çalışkan, 2016: 3). The ineffective use of resources is considered the main reason for the hospital costs increase (Olesen and Petersen, 2002: 83; Torabipour et al., 2014: 1576). Hospitals that exclude the efficiency of resource utilization may put the financial sustainability of the health system at risk (Yeşilyurt ve Selamzade, 2021: 1000). Increasing pressure on the most effective use of scarce resources in healthcare services has increased the importance of efficiency analyses for the comparison of the relative performances of hospitals (Jacobs, 2001: 103). When considering the difficulties in financing healthcare services, especially in developing countries, ensuring efficiency and productivity in the production of healthcare services in hospitals become more of an issue (Çalışkan, 2016: 3-4). Although the productivity problem in healthcare organizations is one of the first identified problems, any standard prescription has not yet been provided for the performance and productivity problems (Yiğit, 2020: 28).

The Health Transformation Program (HTP) was introduced in 2003 to organize, finance, and deliver healthcare services effectively, efficiently, and fairly in Turkey (Sağlık Bakanlığı, 2003: 24; Tengilimoğlu et al., 2014: 138). One of the most important developments of the HTP is the establishment of the Public Hospitals Administration of Turkey in 2011 to ensure professionalization in the management of healthcare institutions, increase quality, prevent waste of resources and evaluate the effectiveness and efficiency of service delivery (SASAM, 2015). Due to these developments in the healthcare system, it is aimed to find a solution to the efficient management of scarce resources, which is the major issue of healthcare organizations (Yiğit, 2016: 10).

Healthcare services in labor-intensive hospitals are provided by healthcare professionals who have a higher level of education and professionalism. On the other hand, physician fees constitute a significant part of healthcare spending. There is a significant impact on the number of doctors in Turkey on healthcare spending. Therefore, the effective and efficient management of human resources, which are scarce in health, has always been among the current field of interest of policymakers in health (Avcı and Ağaoğlu, 2014: 85; Sumer et al., 2019; Şener et al., 2019: 274; Çınaroğlu, 2021: 237).

Although the number of health professionals in Turkey has increased continuously over the years, it is below the OECD average with respect to the total number of physicians and nurses-midwives per 100.000 people. While the total number of physicians per 100.000 population is 193 in Turkey, the OECD average is 352, 284 in England, 261 in the USA, and 431 in Germany (Sağlık Bakanlığı, 2019; Zekioğlu and Tengilimoğlu, 2021: 561). The insufficient number of physicians in international comparisons causes the number of visits to physicians per capita to be high. While the number of visits to physicians per capita was 9.8 in Turkey in 2017, it was 6.6 in OECD countries on average (Sağlık Bakanlığı, 2019). Therefore, although physicians, who are the most important element of health human resources in Turkey, are few, they confront an intense workload in parallel with the goals to increase access and use to health with the HTP (Çınaroğlu, 2021: 240).

Data Envelopment Analysis (DEA) method is often used to evaluate the performance of several organizational forms in the health sector, including hospitals, nursing homes, doctors, and healthcare organizations (Sherman and Zhu, 2006: 203; Nayar and Ozcan, 2008: 193). Data Envelopment Analysis (DEA) is a non-parametric methodology based on mathematical programming for comparing the efficiency of Decision Making Units (DMUs) using multiple inputs to outputs (Applanaidu et al., 2014: 329; Cook et al., 2014). In DEA, defined as the ratio of weighted inputs and outputs, we calculate the efficiency score, which is then compared to that of the best performing DMUs (Applanaidu et al., 2014: 329). Inefficient hospitals need to increase their output or reduce their idle inputs in order to be efficient. Therefore, DEA is a very useful technique for hospital managers who want to identify performance improvement opportunities (Nayar and Ozcan, 2008: 195).

DEA can basically analyze by taking into account the situation of constant return to scale and variable return to scale, and every single model used can be either input-oriented or output-oriented, or non-oriented (Dinçer, 2011: 71). The most preferred methods in DEA are the input and output-oriented Charnes-Cooper-Rhodes (CCR) and Banker-Charnes-Cooper (BCC) models. The CCR model performs efficiency analysis at the optimal scales of all DMUs, being under the assumption of constant returns to the scale it operates. The BCC model also measures efficiency under the assumption of variable returns to scale, providing the efficiency to be divided into technical and scale efficiencies (Khezrimotlagh and Chen, 2018: 268). While the input-oriented DEA method reveals the optimal combination of input required to obtain the maximum output, the output-oriented model aims to produce the maximum output with the present combination of input (Ozcan et al., 2010; Ozcan, 2013: 222; Yiğit & Esen, 2017: 26).

In DEA models, the efficiency score of all DMUs with optimum performance is calculated to be 1. In other words, DEA evaluates the relative efficiency of DMUs but does not allow any ranking of the efficient units themselves. Super-efficiency analysis was developed for ranking and comparing the DMUs (Andersen & Petersen, 1993; Ozcan, 2014: 121). Super-efficiency analysis is performed with the data of efficient DMUs, excluding DMUs that are inefficient in other DEA models.

This study aims to measure the technical efficiency of physicians in the hospitals of the Turkish Ministry of Health through the DEA method. For this purpose, the efficiency analyses related to the Ministry of Health hospitals in 81 provinces were determined by the DEA method. A super-efficiency analysis was also performed to determine the efficiency ranking for the efficient provinces. In the DEA method, efficiency aims to produce maximum outputs with minimum inputs. This study aimed to determine the inputs (physicians) used idle in the Ministry of Health hospitals on a provincial basis and the amount of under-produced output, as well as the inputs that need to be increased in the super-efficient provinces and the overproduced outputs.

Materials and Methods

The target population of the study consists of public hospitals of the Turkish Ministry of Health. The sample was not selected in the study, and the entire target population was reached. We included 81 provinces in the sample in this context. The data used in the study were derived from "Public Hospitals' Health Statistical Yearbook 2017". After the data obtained for the study were made suitable for analysis in Microsoft Excel, the efficiency analyzes were performed through the DEA-Solver-Pro 15 package program. The total number of surgical specialists, the total number of internal medicine specialists, and the total number of general practitioners were used as input variables, the total weighted number of surgeries, the total number of hospital admissions, and the total number of inpatients as output variables in the study. The weighted number of surgeries used as the output variable was formed by the weighted average of the total number of A, B, and C surgeries. In calculating the weighted average of the surgery, the coefficients in the surgery indicator per operating table included in the "productivity application scorecard indicators card RV-05-2" guide were used (TKHK, 2016; Esen, 2019: 118). The weighted number of surgeries is calculated with the formula given below.

$$\text{Weighted Number of Surgeries} = (\text{A} \times 5) + (\text{B} \times 3) + (\text{C} \times 2)$$

In the study, the efficiency analyzes of the Ministry of Health hospitals on a provincial basis were evaluated with the input-oriented CCR and input-oriented BCC models, which aim at the optimal combination of input required to achieve the highest output. The efficiency ranking of the efficient provinces was measured with the non-oriented super SBM (slack based model).

Results

Descriptive statistics related to the input and output variables used in the technical efficiency analysis of physicians in the hospitals of the Ministry of Health are given in Table 1. Ministry of Health hospitals have an average of 176,1 surgical specialists, 175,7 internal medicine specialists, and 118,8 general practitioners on a provincial basis. An average of 28.037,8 weighted A, B, and C surgeries, 4.416.644 hospital admissions, and 95.328,2 inpatient treatments occurred in the hospitals of the Turkish Ministry of Health hospitals.

Table 1. Descriptive Statistics on Input and Output Variables Used in Physicians' Efficiency Analysis in Turkish Ministry of Health Hospitals

Variables	Max	Min	Average	Standard Deviation
X1: Total Number of Surgical Specialists	2690	19	176,1	350,2
X2: Total Number of Internal Medicine Specialists	306	86	175,7	44,3
X3: Total Number of General Practitioners	860	14	118,8	110,9
Y1: Total Weighted Number of Surgery	401205,3	1347,7	28037,8	51268,8
Y2: Total Number of Admissions	57536449	330428	4416644	7149981,6
Y3: Total Number of Inpatients	923853	6624	95328,2	123027

In Table 2, the summary results of technical efficiency for the input-oriented CCR and the input-oriented BCC model are given. According to the CCR model, 19 (23.5%) provinces were technically efficient, while 28 (34.6%) provinces were technically efficient in the BCC model. The efficiency average of 81 provinces was calculated as 0.8647 in the CCR model and 0.9149 in the BCC model. While Ağrı, Antalya, Ardahan, Bartin, Bayburt, Düzce, Kilis, Tunceli, and Yalova provinces were inefficient in the input-oriented CCR model, they achieved to be efficient in the input-oriented BCC model (Table 3).

Table 2. The Summary Results of Technical Efficiency for the Input-Oriented CCR and the Input-Oriented BCC Model for Provinces

Variables	Input-oriented CCR	Input-oriented BCC
Total Number of Provinces	81	81
Number and percentage of efficient provinces	19 (%23,5)	28 (%34,6)
Number and percentage of inefficient provinces	62 (%76,5)	53 (%65,4)
Average Efficiency of all provinces	0,8647	0,9149
The maximum efficiency value of all provinces	1	1
The minimum efficiency value of all provinces	0,5168	0,6624
The efficiency the of the standard deviation of all provinces	0,1251	0,0958

Reaching the efficiency score by inefficient provinces is possible by improving the idle inputs and under-produced outputs. Table 3 shows the potential improvement percentages of inefficient provinces in terms of idle inputs and under-produced outputs according to the input-oriented CCR model. Accordingly, Tunceli, which is in the last place in the CCR model efficiency score, used the total number of surgical specialists, the total number of internal medicine specialists, and the total number of

general practitioners as idle at a rate of 48.3%, 87.5%, and 48.3%, respectively. 40.3% of the total number of surgeries and 20.3% of the total number of inpatients were also under-produced. In the province of Muş, the total number of surgical specialists and the total number of internal medicine specialists were used idle at the rate of 19.7%, and the total number of general practitioners at the rate of 26.9%. While Muş was efficient in terms of the total number of hospital admissions, like in Tunceli, the total number of surgeries and the total number of inpatients under-produced the output by 20% and 22.8%, respectively. Similar evaluations can be made for other provinces in Table 3.

Table 3. Efficiency Scores of Inefficient Provinces according to Input Oriented CCR Model and Idle Used Inputs and Under-produced Outputs (%)

No.	DMU	CCR-I	BCC-I	Idle Used Inputs (%)			Under-produced Outputs (%)		
				X1	X2	X3	Y1	Y2	Y3
1	Adana	0,930	0,958	-7,0	-7,0	-13,6	0	5,4	3,8
2	Ağrı	0,903	1	-9,7	-9,7	-9,7	32,1	0	5,3
3	Amasya	0,786	0,790	-21,3	-47,7	-21,3	0	0	17,3
4	Antalya	0,981	1	-1,8	-1,8	-1,8	0	3,4	1,5
5	Ardahan	0,565	1	-43,4	-82,3	-43,4	0	0	27,8
6	Artvin	0,693	0,728	-30,7	-30,9	-59,6	4,4	0	3,1
7	Aydin	0,871	0,871	-12,9	-12,9	-12,9	8,1	0	0
8	Balıkesir	0,929	0,958	-7,1	-7,1	-7,1	0	0	14,9
9	Bartın	0,886	1	-11,4	-52,9	-11,4	8,1	0	0
10	Batman	0,898	0,994	-10,2	-10,2	-10,2	0	0	0
11	Bayburt	0,700	1	-29,9	-85,9	-29,9	0	0	0
12	Bilecik	0,755	0,829	-24,5	-59,2	-24,5	0	0	64,2
13	Bingöl	0,670	0,766	-30,0	-56,4	-30,1	14	0,3	0
14	Bitlis	0,868	0,884	-13,1	-39,8	-36,4	0	0	0
15	Bolu	0,851	0,919	-14,8	-60,1	-14,8	11,3	0	0
16	Burdur	0,865	0,866	-13,4	-67,1	-13,4	0	0	0
17	Çanakkale	0,723	0,731	-27,6	-47,4	-27,6	0	0	39,6
18	Çankırı	0,825	0,949	-17,4	-66,9	-17,4	0	0	25,7
19	Çorum	0,694	0,709	-30,5	-30,5	-30,5	10,6	0	4,2
20	Düzce	0,725	1	-27,5	-51,6	-27,5	0	0	17,8
21	Edirne	0,846	0,860	-15,3	-15,3	-15,3	3,3	0	4,9
22	Elazığ	0,680	0,723	-31,9	-31,9	-31,9	11	0	0
23	Erzincan	0,608	0,708	-39,1	-59,3	-39,1	0	0	11,7
24	Erzurum	0,900	0,901	-9,9	-9,9	-17,2	0	2,5	15,6
25	Giresun	0,946	0,954	-5,39	-44,2	-22,1	0	0	4,4
26	Gümüshane	0,641	0,878	-35,8	-74,6	-35,8	0	0	3,5
27	Hakkari	0,780	0,896	-22,1	-22,1	-22,1	23,7	0	0
28	Hatay	0,927	0,939	-7,2	-7,2	-8,8	0	0	0,3
29	Isparta	0,852	0,858	-14,7	-14,7	-14,7	0	2,1	0
30	Izmir	0,894	0,896	-10,5	-10,5	-10,5	6,5	0	16,2
31	Karabuk	0,658	0,662	-34,1	-72,6	-34,1	0	0	10,4
32	Kars	0,719	0,816	-28,1	-49,5	-31,6	0	0	35,4
33	Kastamonu	0,859	0,864	-14,1	-39,1	-31,9	0	0	43,4
34	Kayseri	0,931	0,983	-6,9	-6,9	-6,9	67,6	0	2,3
35	Kırklareli	0,746	0,849	-25,3	-25,3	-25,3	1,5	0	0
36	Kırşehır	0,703	0,777	-29,7	-44,1	-29,7	96,9	0	0
37	Kilis	0,959	1	-4,1	-47,5	-41,1	0	0	0,5
38	Kocaeli	0,956	0,982	-4,3	-4,3	-4,3	22,4	0	55,1
39	Konya	0,955	0,960	-4,4	-4,4	-4,4	1,4	0	0
40	Kütahya	0,957	0,968	-4,2	-4,5	-4,2	0	0	0,2
41	Malatya	0,798	0,811	-20,1	-20,1	-20,1	6,1	0	8,8

42	Manisa	0,897	0,899	-10,2	-10,2	-10,2	19,3	0	24,8
43	Mardin	0,850	0,944	-14,9	-14,9	-19,5	0	0	0
44	Mersin	0,907	0,907	-9,2	-9,2	-9,2	2,1	0	0
45	Muğla	0,719	0,751	-28,1	-28,1	-28,1	0	0	10,1
46	Muş	0,803	0,855	-19,6	-19,6	-26,8	20,1	0	22,8
47	Nevşehir	0,880	0,958	-11,9	-16,3	-11,9	0	0	0
48	Rize	0,823	0,825	-17,7	-20,3	-17,7	0	0	0
49	Sakarya	0,936	0,957	-6,4	-6,4	-6,4	0	0	12,1
50	Samsun	0,971	0,977	-2,9	-2,9	-2,9	0	0	28,8
51	Siirt	0,790	0,900	-21,1	-42,9	-25,50	0	0	0,1
52	Sinop	0,770	0,802	-23,1	-76,4	-23,1	0	0	7,9
53	Sivas	0,891	0,892	-10,8	-10,8	-10,8	50,4	0	59,4
54	Şırnak	0,750	0,931	-25,0	-25,0	-25,0	0	0	12,1
55	Tekirdağ	0,910	0,968	-9,0	-9,0	-9,0	14,3	0	36,8
56	Tokat	0,991	0,993	-0,9	-0,9	-5,7	0	0	8,1
57	Trabzon	0,780	0,781	-21,9	-41,9	-21,9	0	0	17,2
58	Tunceli	0,517	1	-48,3	-87,5	-48,3	40,3	0	20,3
59	Usak	0,867	0,867	-13,3	-17,4	-13,3	0	0	0
60	Van	0,965	0,969	-3,4	-3,4	-3,4	43,8	0	0
61	Yalova	0,943	1	-5,7	-5,7	-5,7	7,1	0	0
62	Yozgat	0,614	0,688	-38,5	-38,5	-47,3	27,1	0	13,9
	Average	0,864	0,915	-13,5	-23,8	-15,7	6,8	0,2	8,8
	Max	1	1	0	0	0	96,9	5,4	64,2
	Min	0,517	0,662	-48,3	-87,5	-59,6	0	0	0
	St Dev	0,125	0,096	12,5	25,4	14,3	16,1	0,8	14,6

The distribution of the idle used input and under-produced output averages of the provinces according to the variables is given in Figure 1. Accordingly, the total number of internal specialist physicians among the input variables was the most idle-used variable (-23.8%). 15.7% of the total number of general practitioners and 13.5% of the total number of surgical specialists were used as idle. Among the output variables, 8.8% of the total number of inpatients and 6.8% of the total number of surgeries were under-produced. Nevertheless, the total number of hospital admissions is very close to the efficiency (0,17%).

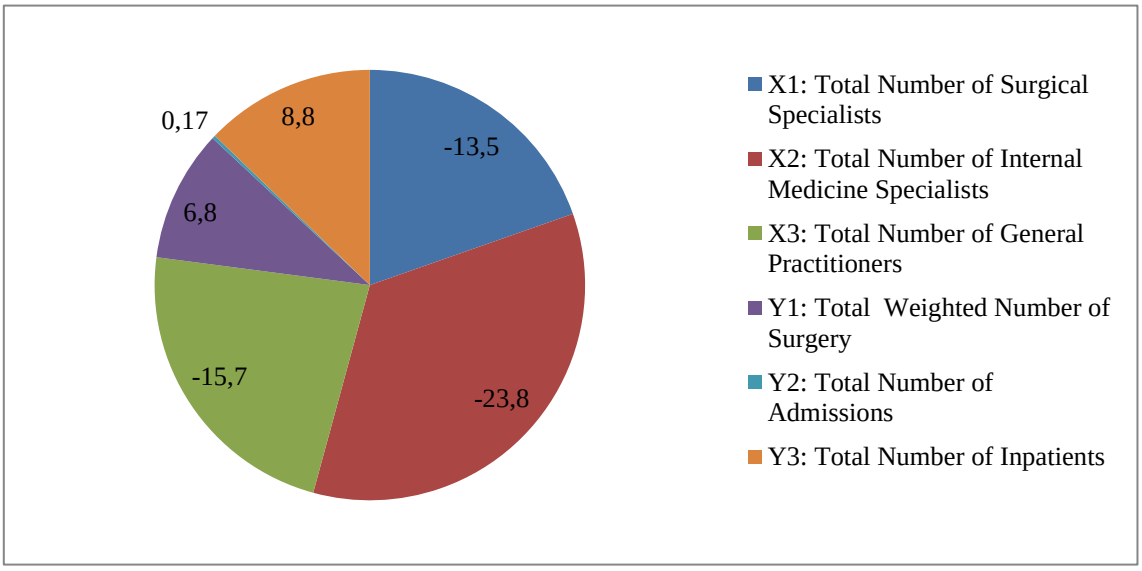

Figure 1. Average Percentage of Idle Used Input and Under-produced Output of Provinces according to Input Oriented CCR Model

It is not possible to rank the DMUs that are efficient in the efficiency measurements made with DEA, since the efficiency score is calculated as 1,000. To make the efficiency ranking for the efficient provinces, the inefficient provinces were excluded from the analysis, and the super-efficiency model was applied with the data of the efficient provinces. In Figure 2, the super-efficiency ranking for the 19 provinces that are efficient in the input-oriented CCR model is given. Accordingly, the three provinces with the highest efficiency scores were Istanbul, Ankara, and Kırıkkale, respectively. The super-efficiency score of the Istanbul Province achieved to be higher than the others, having a value above 1.7.

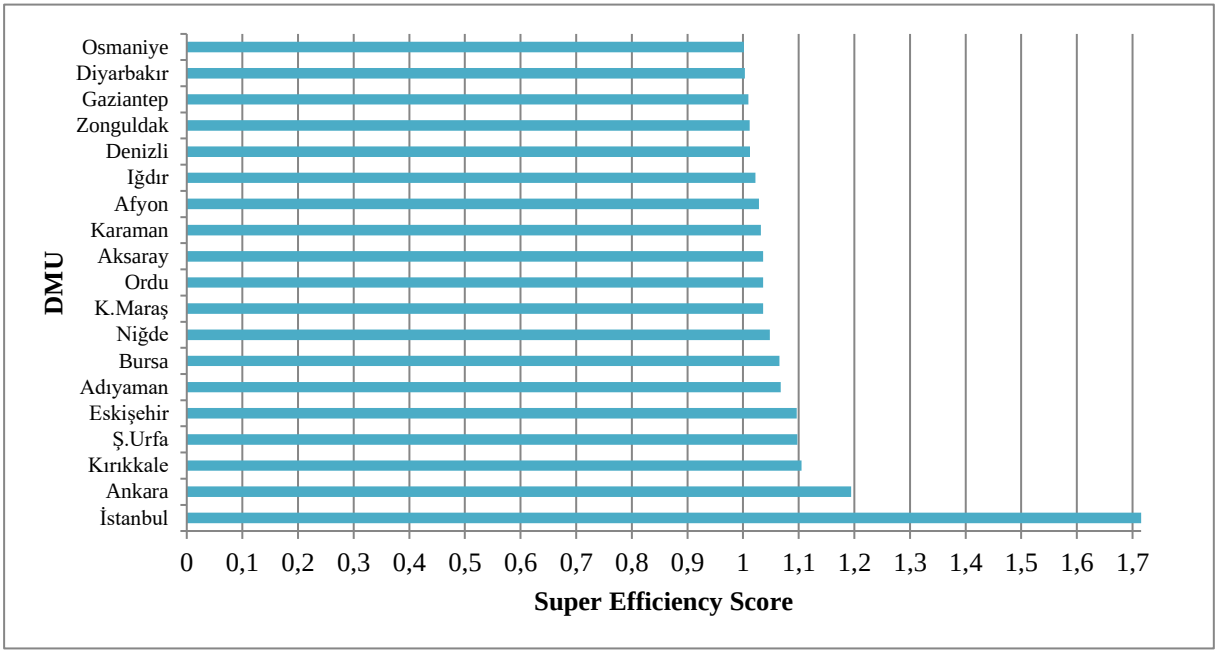

Figure 2. Super-Efficiency Ranking of the Efficient Provinces in the Input-Oriented CCR Model (Non-Oriented Super-CCR)

Table 4 includes the super-efficiency scores of the efficient provinces, the inputs required to be increased, and the percentages of the over-produced outputs. In Istanbul, which has the highest super-efficiency score, the number of internal medicine specialists should be increased by 108.6% and the number of surgical specialists by 5.1%. In Ankara, the number of general practitioners should be increased by 47.7%. In addition, the total number of hospital admissions in Ankara occurred 13.3% higher. While the number of internal medicine specialists was severely deficient in Istanbul, it was included at full capacity in other super-efficient provinces. Except for Aksaray, Ankara, Diyarbakır, Iğdır, and Zonguldak, the number of surgical specialists should be increased in other provinces. The number of general practitioners should also be increased in Ankara, Aksaray, Bursa, and Eskişehir provinces.

Table 4. Super-Efficiency Scores of Efficient Provinces and Inputs to be Increased and Over-Produced Outputs (%)

No.	DMU	Super-efficiency Score	Inputs to be increased (%)			Over-Produced Outputs (%)		
			X1	X2	X3	Y1	Y2	Y3
1	Adıyaman	1,067	7,2	0	0	0	0	0
2	Afyon	1,028	8,3	0	0	0	0	-18,3
3	Aksaray	1,035	0	0	8,3	-3,9	0	0
4	Ankara	1,194	0	0	47,7	0	-13,3	0
5	Bursa	1,065	9,3	0	3,3	0	0	0

6	Denizli	1,012	3,6	0	0	0	-1,2	0
7	Diyarbakır	1,003	0	0	0	-10	-8,2	0
8	Eskisehir	1,096	21,5	0	4,8	0	0	0
9	Gaziantep	1,009	1,4	0	0	0	-3,4	0
10	Iğdır	1,022	0	0	0	-31,5	0	-23
11	Istanbul	1,715	5,1	108,6	0	0	0	0
12	K.Maraş	1,036	9,1	0	0	0	0	-3,7
13	Karaman	1,031	9,2	0	0	0	0	-31,1
14	Kırıkkale	1,105	18,1	0	0	0	-43,1	0
15	Niğde	1,048	7,3	0	0	-25,0	0	0
16	Ordu	1,036	0,5	0	0	0	-10,2	0
17	Osmaniye	1,001	0,4	0	0	0	0	0
18	Ş.Urfa	1,097	7,2	0	0	-19,2	0	0
19	Zonguldak	1,011	0	0	0	0	0	-4,5
Average		1,085	5,7	5,7	3,3	-4,7	-4,2	-4,2
Max		1,715	21,5	108,6	47,7	0	0	0
Min		1,001	0	0	0	-31,5	-43,1	-31,1
Standard Deviation		0,159	6,2	24,9	10,9	9,6	10,2	9,2

Discussion and Conclusion

In this study, the technical efficiency of physicians in public hospitals of the Turkish Ministry of Health was measured by the DEA method. As a result of the study, 19 (23.5%) provinces were technically efficient according to the CCR model, while 28 (34.6%) provinces were technically efficient in the BCC model. The efficiency average of 81 provinces was calculated as 0.8647 in the CCR model and 0.9149 in the BCC model. While Ağrı, Antalya, Ardahan, Bartın, Bayburt, Düzce, Kilis, Tunceli, and Yalova provinces were inefficient in the input-oriented CCR model, they achieved to be efficient in the input-oriented BCC model. As a consequence of the super-efficiency ranking of the 19 provinces that are efficient in the input-oriented CCR model, the three provinces with the highest efficiency scores were Istanbul, Ankara, and Kırıkkale, respectively. The super-efficiency score of the Istanbul Province was higher than the others, having a value above 1.7. The most significant reasons for the high efficiency of physicians in Istanbul and Ankara are the high health outcomes because of the population density of these provinces and the high level of preference for physicians due to socio-economic and political factors. Inequalities in the distribution of physicians may lead to inequalities in the delivery of healthcare services.

Measuring physician productivity is one of the tools for determining how to use manpower resources. According to Chilingerian and Sherman (1990), physicians control more than 80 percent of the decisions that affect health costs. It has a considerable influence on the efficiency of hospitals. However, there exist very few studies investigating the technical efficiency of physicians in Turkey. In a study performed by Yiğit (2017), which analyzed the technical efficiency of physicians working in a university hospital in the performance-based supplementary payment system, we found that physician productivity was 67% on average according to the BBC model and 57% according to the CCR model.

In a study performed in the random-effects meta-analysis model to evaluate the technical efficiency of healthcare organizations in Turkey in 2020, the productivity score of hospitals was 0.82 (G.A; 0.78-0.86; $p<0.05$). It was also found that the Ministry of Health, Private, University, and Mixed ownership status ($Qb = 9.67$; $p>0.05$) and publication type ($Qb = 3.88$; $p>0.05$) did not have a moderator role in the studies included in the meta-analysis (Yiğit, 2020: 24).

Esen and Yiğit (2019) found that approximately 63.3% of the hospitals (CCR) were inefficient in the efficiency analysis study of Ministry of Health hospitals in the Mediterranean Region. The average productivity of hospitals was found to be 0.91 (CCR), 0.95 (BCC), and scale efficiency to be 0.96. Çalışkan (2020) found that 29 (33%) associations of public hospitals provide efficient service, while 59 (67%) associations of public hospitals provide inefficient service. Çakmak et al. (2009) found that approximately 1/3 of the public hospitals within the scope of the study operate efficiently, and 2/3 of

them inefficiently. Yazıcı and Çiçen (2021) found that 72 hospitals out of 124 public hospitals in the Black Sea region were efficient, and 52 hospitals were inefficient.

Keskin (2018) calculated the technical efficiency of 301 Ministry of Health Hospitals by using DEA method. As a result of DEA efficiency, 71.79% of hospitals in role A1 (training and research), 57.89% of hospitals in role A2, 33.17% of hospitals in role B and 30.03% of hospitals in role C are technically found to be efficient. As a result of the study, we found that the number of hospitals providing efficient service in the A1 group training and research hospitals is generally higher than the other group hospitals.

In his study, Yiğit (2016) found that about 31% of the Public Hospital Associations operate efficiently and 69% inefficiently. In consequence of the study, he emphasized that policies that will cause inefficient results related to resource allocation in healthcare services are implemented due to problems in healthcare service delivery plan, depending on the injustice in terms of the number of patient beds and physicians per capita in Turkish Public Hospitals. In the study, it is stated that group A surgeries should be increased by 886% in the province of Tunceli, but only if a qualified physician and the required infrastructure is provided to perform this surgery. In this study, the total number of surgeries should increase by 40.3% and the total number of inpatients by 20.3% in Tunceli. However, the required physical and technological health infrastructure must be provided for the occurrence of this increase.

In Turkey, regional agglomerations occur in health service purchases due to unbalanced distribution on the basis of provinces in terms of the number of beds, medical devices, and tools constituting healthcare services, healthcare organizations, health workforce, and other physical resources. (Demir, 2019: 84-85). To prevent this, the Ministry of Health should also consider the technical efficiency of hospitals in determining health policy and allocating resources.

Both the number and distribution of physicians in a country are essential to ensure equal access to health care (Sousa et al. 2012). The lack of healthcare professionals continues to be a problem even in many developed countries (Barber and López-Valcárcel 2010; Avcı and Ağaoğlu, 2014: 85). The number of physicians in Turkey is insufficient in international comparisons, and they face an excessive workload against increasing demand for healthcare services and unpredictable health crises (Çınaroğlu, 2021: 248).

Due to the lack of healthcare personnel in Turkey, the supply of personnel falls short of the demand for healthcare services (Sağlık Bakanlığı, 2017: 165). Because the number of doctors per capita is very low, examination times are also very short. They provide quantitatively more intensive health care services in provinces where the technical efficiency of physicians is above 1,000, especially in İstanbul, Ankara, Kırıkkale, Şanlıurfa, Eskişehir, and Adıyaman, which have the highest efficiency and compared to provinces with technical efficiency below 1,000. Therefore, instead of reducing the number of health personnel in inefficient provinces, the number of physicians in efficient provinces should be increased. Therefore, considering the demand for healthcare services in the employment policy of professional healthcare personnel in healthcare organizations, it is recommended to attach priority to provinces with high efficiency.

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