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ANALYSIS OF THE CHANGE IN THE DISTRIBUTION OF HEALTH HUMAN RESOURCES AT THE PROVINCIAL LEVEL IN TURKEY IN 2014-2019

2014-2019 YILLARINDA TÜRKİYE'DE SAĞLIK İNSAN KAYNAKLARI DAĞILIMININ İLLER DÜZEYİNDEKİ DEĞİŞİMİNİN ANALİZİ

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Abstract

The analysis of policies in the public sector is monitored with various indicators and new policies are determined according to the changes. The official reports highlighted that the distribution of health human resources, which should be benefited equally by all individuals in public health services in Turkey, is not equal on a provincial basis and that policies tolerating this are implemented. In this study, the change in the distribution of health human resources in 81 provinces of Turkey between the years 2014 and 2019 was analyzed using multi-criteria decision-making techniques. The study differs from its counterparts in the literature with its macro and micro suggestions, focusing only on the distribution of human resources at the provincial level. The findings obtained as the result of the analysis can be listed as follows. i) To eliminate the inequities between provinces, the priorities of health human resources have been determined. ii) In different periods, the rank of the provinces expressing the relative status of the health human resources compared to the country has been determined. iii) Interpretations of the obtained rankings from different perspectives are presented.

Keywords: health human resources, multi-criteria decision making, human resource management

Öz

Kamu sektöründe politikaların analizi çeşitli göstergelerle izlenmekte ve göstergelerdeki değişimlere göre yeni politikalar belirlenmektedir. Türkiye'de kamu ağırlıklı olarak sunulan sağlık hizmetlerinde tüm bireylerin eşit olarak yararlanması gereken sağlık insan kaynağının il bazındaki dağılımının eşit olmadığı ve bunu tolere edici politikaların uygulandığı resmi raporlarda vurgulanmaktadır. Bu çalışmada 2014-2019 yılları arasında Türkiye'nin 81 ilindeki sağlık insan kaynağı dağılımındaki değişim çok kriterli karar verme teknikleriyle analiz edilmiştir. Çalışma sadece insan kaynağının il düzeyindeki dağılımına odaklanarak sunduğu makro ve mikro

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önerilerle literatürdeki benzerlerinden ayrışmaktadır. Analiz neticesinde ulaşılan bulgular şöyle listelenebilir. i) İller arasındaki farklılığın giderilmesi için sağlık insan kaynaklarının öncelikleri belirlenmiştir. ii)Farklı dönemlerde illerin ülkenin geneline göre sahip olduğu sağlık insan kaynağının göreli durumunu ifade eden sırası belirlenmiştir. iii) Elde edilen sıralamaların farklı perspektiflerden yorumları sunulmuştur.

Anahtar Kelimeler: sağlık insan kaynağı, çok kriterli karar verme, insan kaynakları yönetimi

INTRODUCTION

In the service sector, quality is directly related to the service provider (Wisniewski & Donnelly, 2010). In public-dominated sectors such as education and healthcare, supplying sufficient and competent professionals to satisfy the demand requires comprehensive planning and management. In other words, effective human resources management is needed in the public service sector (Brown, 2007). Unlike the private sector, all processes from recruitment to promotion, from punishment to retirement of public personnel are regulated by the law (Pynes, 2008). The term personnel management may be more appropriate as all personnel operations are restricted by legal regulations (Kaya & Taş, 2015). However, the opposite is claimed due to the key role of human resources management in achieving the missions of the organization (Hassani et al., 2013). Despite the differences of opinion, the undisputed main focus of health personnel planning is ensuring the right number of health care providers with the right qualifications, in the right place, and at the right time. (Spinks & Moore, 2007).

Human resources planning in healthcare is based on the development of strategies that will keep the balance between personnel supply and demand (Avcı & Ağaoğlu, 2014). The volatility of supply/demand is observed by policymakers with indicators such as patient waiting time and population per health professional. High volatility signals the necessity of controlling existing policies and making new strategic decisions. Monitoring every policy or decision regarding health human resources is vital for the efficient use of scarce health professionals. As a basic health policy, all individuals in a health system should have equal access to health services (Gulzar, 1999; Khan & Bhardwaj, 1994). Health human resources indicators play a key role in checking this policy on a regional basis and trying to identify and reduce the inequity between regions (Gupta et al., 2003). The health literature considers population-adjusted indicators, such as population per health professional or the number of health professionals per 10000 people, to reflect workloads. It is common to examine the distribution of health human resources on a regional basis, taking into account similar indicators (Al-Hanawi et al., 2019; Anand et al., 2008; Çınaroğlu, 2021; Nawaz et al., 2021; Shan et al., 2013).

In the report titled *"Human Resources in Health 2023 Vision"* published by the Republic of Turkey Ministry of Health (Akdağ et al., 2011), the issues related to human resources in the health system were examined in detail and the policy changes and reforms were discussed by making projections from the past to the future. Our deductions from the report regarding our study are as follows: i) Lack of health human resources and inequity of regional distribution are one of the chronic problems of the Turkish health system. Although this problem has been on the agenda since the establishment of the country and tried to be solved with various practices, no permanent solution has been found. ii) While the education of a health professional takes a long time, the limited quotas of medical faculties restrict the supply of personnel, and the rapidly increasing population and immigration explode the demand. In addition, the socio-economic homogeneity of the cities strengthens the tendency of the limited human resources to gather in relatively more developed cities. iii) A sustainable information system is needed for the effective management of health human resources, especially for the monitoring of personnel mobility. New methods are needed to make consistent assessments across the country.

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Consequently, the necessity for all individuals to utilize equally the already scarce health human resource, which is increasing slowly according to demand and concentrated in relatively developed regions, motivates the consistent measurement of regional imbalance.

In this study, the change in the distribution of health human resources at the provincial level in Turkey between 2014 and 2019 was analyzed. Population per Specialist, General Practitioner, Dentist, Pharmacist, Nurse, Midwife were used as evaluation indicators. In the analysis, the combined consensus solution (CoCoSo) method, which stands out with its consistency and accuracy in the results, was used. The criteria weights were determined by taking the average of the weights obtained by the CRITIC and ENTROPY methods, which are objective weight determination techniques, to prevent decision-maker bias.

The contribution of the study to researchers and practitioners interested in health human resource management can be listed as follows. i) It ensures the prioritization of human resource types in improving the distribution of human resources. ii) It makes it possible to monitor the change in health resources at the provincial level from a micro point of view.

The paper is organized as follows. Section 2 covers the presentation of related studies. Section 3 introduces the methods used in the assessment. Section 4 contains interpretations of practice and findings. Conclusions and recommendations are given in Section 5.

RELATED STUDIES

The evaluation of the performance of the units with MCDA techniques to provide managerial insight into health policies is of interest to researchers (Otay et al., 2017; Torkayesh, Pamucar, et al., 2021). Many focus on health human resources and evaluate the performance of units such as cities and countries with health human resource indicators. In this section, similar studies focused on Turkey are examined in terms of approach and method.

Clustering-oriented studies investigating the differences between clusters formed by similar units are discussed below. Çınaroğlu (2021) examined the distribution of health personnel at the provincial level in Turkey and made policy recommendations. In the study, how 81 provinces were grouped based on the number of physicians, nurses, midwives, dentists, pharmacists, and other health workers in 2017 investigated. Provinces were divided into three clusters using the K-means algorithm, which is based on the evaluation units being included in the closest cluster. Descriptive statistical comparison of the clusters pointed to inequity in terms of human resource distribution among the clusters. It was emphasized that personnel management policies should be reviewed for a strong health system, taking into account the inadequacy of human resources in health and regional inequalities. Çelik (2013) classified the provinces in Turkey according to health indicators with cluster analysis. 8 out of 10 indicators were related to health human resources. In the study, hierarchical and non-hierarchical clustering techniques are used to compare the consistency of the clusters. As a result of the comparison, regional differences were emphasized and it was stated that small and underdeveloped provinces should be supported in terms of health personnel. Tekin (2015) grouped the provinces in Turkey with the hierarchical clustering method in terms of basic health indicators. 7 out of 16 indicators were related to health human resources. The clusters were compared with the socio-economic development rankings and health development levels of the provinces. As a result of the study, the inequity between the east and west of the country was emphasized.

Although the cluster-focused studies examined can provide macro-level information about the health human resource distribution imbalance between regions, they are insufficient from an individual

perspective. Handling the units in clusters prevents comments on their performances and the effectiveness of policies.

In the literature, in addition to cluster-focused studies, some studies make evaluations based on the Nomenclature of Regional Statistical Units (NUTS) with a similar approach. Öksüzkaya (2017) evaluated the efficiency of hospitals affiliated with the Ministry of Health in 12 NUTS regions in Turkey. Data envelopment analysis, which is a non-parametric efficiency measurement tool, was preferred in the study. 4 out of 5 inputs are health human resources indicators. Targets have been set for inefficient regions. While interpreting the target values for the input indicators, it was stated that the health human resources should be shifted to the regions where they are needed more, emphasizing the regional inequality. Aydın (2021) evaluated the health services of 12 NUTS regions in Turkey using multi-criteria decision-making techniques. 5 out of 32 inputs are health human resources indicators. In the study, the TOPSIS method, which is one of the multi-criteria decision-making techniques that allows the evaluation of many alternatives with many criteria, was preferred. MCDM techniques are sensitive to criterion weights. In the study, criteria weights were determined by using the CRITIC method, one of the objective weighting techniques. In line with the findings, it has been suggested to increase the resources allocated to the underdeveloped regions in health services. Although different techniques and indicators have been used in NUTS-based studies, it is seen that similar results have been achieved in cluster-focused studies.

It is seen that different approaches are adopted in the provincial-based evaluations at the micro-level. Çağlar and Keten (2019) proposed an index that will allow a relative comparison of 81 provinces in Turkey according to their health indicators. The proposed index is formed from the average of 4 sub-indices, 1 of which is health human resources, and the health human resources index is formed from 7 health human resources indicators. One of the DEA-Like models based on linear programming was used to calculate the index. The health human resources index has shown that there are serious differences between the east and west of the country, and the provincial indices especially in the east and southeast regions are low. Karaer & Tatlıdil (2019) evaluated 81 provinces in Turkey with the help of some health indicators, principal component analysis, and gray relational analysis, and compared the consistency of the results of both analyzes. Health human resources are also included in the evaluation criteria. It has been emphasized that the results obtained may be guided in terms of providing the necessary information to the decision-makers in the policies to be formed in the future in health services. Studies conducted at the provincial level are more promising than cluster-based studies in the monitor and adjustment of policies by enabling the change in health human resources to be followed at the micro level.

Apart from the cluster and individual-based assessments, the distribution of health human resources has also been examined from a spatial perspective. Genel and Kaçmaz (2016) evaluated the spatial distribution and change in the number of health personnel between the years 2000 and 2013 in Turkey through geographic information systems. In the study, the geographical characteristics of the regions and the health human resources data were synthesized together, and the health geography, which allows the spatial association of health services and problems and the development of policies, was emphasized. It has been shown that thematic maps produced regarding the distribution and mobility of health human resources are an effective tool that can be used in personnel management.

The evaluation made based on countries can provide information about the general condition of Turkey. Demir Uslu (2021) compared OECD countries with TOPSIS and VIKOR methods using health resource indicators. 2 out of 8 criteria are health human resources indicators. In the study, the criteria weights were accepted as equal and the consistency of the results obtained by both methods

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was examined. It was emphasized that Turkey, which is in the last place, needs additional resources and that the existing resources should be directed to the field of medical technology.

If the mentioned studies are evaluated together, it is clear that researchers are interested in examining countries and regions with health resource indicators. Multi-period analyzes allow monitoring and interpretation of the impact of policies over time. Health human resources constitute some of the indicators taken into account in studies. However, evaluating the distribution between regions with only human resource indicators, which is a scarce and difficult to supply resource, can provide more specific findings.

METHODOLOGY

In this study, the change in the distribution of health human resources in 81 provinces of Turkey between 2014 and 2019 were analyzed with 6 indicators: population per health human resource (specialist, general practitioner, dentist, pharmacist, nurse, midwife). For this purpose, firstly, the health human resource numbers and populations of the provinces for the relevant years were obtained from the health statistics yearbooks published by the Ministry of Health of the Republic of Turkey. (Secondary data was used in the study. Ethics committee approval is not required.) Then, the health human resource indicators used in the analysis as data were calculated by dividing the population by the number of health human resources. Afterward, the data for all years were processed with CRITIC and ENTROPY methods and the weights of the indicators were determined by the average of the results of both techniques. Finally, the rankings of the provinces in all years were determined by the CoCoSo method, and the change over the years was analyzed. The techniques used are explained in the rest of the section.

Combined compromise solution (CoCoSo) method

The Combined Compromise Solution method called CoCoSo was introduced by Yazdani et al. (2019) and it is based on the combination of three compromise score functions and thus can provide solutions with highly reliable results (Torkayesh, Ecer, et al., 2021). The method is often preferred for problems seeking a compromise solution (Lahane & Kant, 2021; Lai et al., 2020; Zolfani et al., 2020). The steps of the method are as follows (Yazdani et al., 2019).

Step 1. The decision matrix and basic notations

m alternatives $(A_1, A_2, \dots, A_m)$, n criteria $(C_1, C_2, \dots, C_n)$ and $W = \{w_1, \dots, w_n\}$ w_j is the weight of the criterion C_j.

$$x_{ij} = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix}; \; i = 1,2, \dots, m; j = 1,2, \dots, n \quad (1)$$

Step 2. Normalize the decision matrix

$$r_{ij} = \left\{ \left(\frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} | j \in I \right) or \left(\frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} | j \in J \right) \right\}; j = 1,2, \dots, n \quad (2)$$

Sets I and J cover the benefit and cost criteria, respectively.

Step 3. Calculate the sum of the weighted normalized decision matrix (S_i) and power-weighted normalized decision matrix sequences (P_i) for each alternative.

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$$S_i = \sum_{j=1}^{n} (w_j r_{ij}) \, ; P_i = \sum_{j=1}^{n} (r_{ij})^{w_j} \, ; i = 1,2,\dots,m \tag{3}$$

Step 4. Calculate the value in three different aggregation strategies (a, b, c) for each alternative.

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m} (P_i + S_i)} \tag{4}$$

$$k_{ib} = \frac{S_i}{\min_i S_i} + \frac{P_i}{\min_i P_i} \tag{5}$$

$$k_{ic} = \frac{\lambda(S_i) + (1-\lambda)(P_i)}{\lambda \max_i S_i + (1-\lambda) \max_i P_i} ; 0 \le \lambda \le 1 \tag{6}$$

a expresses the average of sums of S and P, b states a sum of relative scores of S and P compared to the best, c provides the trade-off between S and P with λ. λ is generally accepted to be 0.5.

Step 5. Determine the evaluation scores for each alternative.

$$k_i = (k_{ia} k_{ib} k_{ic})^{\frac{1}{3}} + \frac{1}{3}(k_{ia} + k_{ib} + k_{ic}) \tag{7}$$

k is sorted in descending order to obtain the order of the alternatives.

CRITIC method

It is an approach proposed by Diakoulaki, Mavrotas, & Papayannakis (1995) for the objective determination of criterion weights. The standard deviations of the criteria and the correlation between the criteria are used in determining the criterion weights. The stages of the CRITIC method are as follows.

Step 1. The decision matrix and basic notations

In case there are m alternatives $(A_1, A_2, \dots, A_m | i = 1,2,\dots,m)$ and n criteria $(C_1, C_2, \dots, C_n | j = 1,2,\dots,n)$, the performance of the A_i in the C_j is shown as x_{ij}.

Step 2. Normalizing the decision matrix

$$r_{ij} = \left\{ \left(\frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} | j \in I \right), \left(\frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} | j \in J \right) \right\}, j = 1,2,\dots,n \tag{8}$$

Sets I and J cover the benefit and cost criteria, respectively.

Step 3. Calculation of correlation of criteria

$$\rho_{jk} = \frac{\sum_{i=1}^{m} (r_{ij} - \bar{r}_j) * (r_{ik} - \bar{r}_k)}{\sqrt{\sum_{i=1}^{m} (r_{ij} - \bar{r}_j)^2 * \sum_{i=1}^{m} (r_{ik} - \bar{r}_k)^2}}, j, k = 1,2,\dots,n \tag{9}$$

Step 4. Calculation of the amount of information for each criterion

$$C_j = \sigma_j \sum_{k=1}^{n} (1 - \rho_{jk}), j = 1,\dots,n \tag{10}$$

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Step 5. Determination of criterion weights

$$W_j = \frac{C_j}{\sum_{k=1}^{n} C_k}, j = 1, \dots, n \quad (11)$$

ENTROPY method

The entropy method, like the CRITIC method, is a technique that allows the weights of the criteria to be determined objectively by using the data in the decision matrix. The Entropy technique, which focuses on the differentiation in criteria, follows the following stages (Wang & Lee, 2009; Zhu et al., 2020).

Step 1. The decision matrix and basic notations

In case there are m alternatives $(A_1, A_2, \dots, A_m | i = 1,2, \dots, m)$ and n criteria $(C_1, C_2, \dots, C_n | j = 1,2, \dots, n)$, the performance of the A_i in the C_j is shown as x_{ij}.

Step 2. Normalizing the decision matrix

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (12)$$

Step 3. Calculating the Entropy values of the criteria

$$E_j = \frac{-1}{\ln(n)} \sum_{i=1}^{m} (p_{ij} * \ln(p_{ij})) \quad (13)$$

Step 4. Determination of criterion weights

$$w_j = \frac{1 - E_j}{\sum_{i=1}^{m} (1 - E_j)}, j = 1,2, \dots, n \quad (14)$$

IMPLEMENTATION AND FINDINGS

In the implementation phase, the numbers of human resources (specialists, general practitioners, dentists, pharmacists, nurses, midwives) in Turkey's 81 provinces between 2014-2019, are publicly available, were obtained from the health statistics yearbook of the Ministry of Health of the Republic of Turkey[1]. In the analysis, the indicators were calculated as the population per human resource. Indicator weights determined by Entropy and Critic methods are shown in Table 1. The bottom line is the weight set to be used in the analysis.

Table 1. Weights Calculated by CRITIC and ENTROPY by Years

	Years	Specialist Physician	General Practitioner	Dentist	Pharmacist	Nurse	Midwife
IK OP	2014	23.1%	3.8%	23.7%	17.7%	10.4%	21.3%

[1] https://www.saglik.gov.tr/TR,84930/saglik-istatistikleri-yilliklari.html

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	2015	24.0%	4.3%	24.2%	17.1%	9.7%	20.7%
	2016	23.7%	5.2%	24.7%	16.6%	9.5%	20.3%
	2017	20.5%	6.6%	30.1%	17.5%	8.4%	17.0%
	2018	22.8%	6.7%	29.5%	12.4%	9.2%	19.4%
	2019	20.4%	8.4%	25.0%	11.4%	19.4%	15.3%
CRITIC	2014	19.4%	30.3%	16.5%	12.0%	10.4%	11.4%
	2015	18.6%	33.1%	15.6%	13.0%	9.9%	9.8%
	2016	18.1%	37.0%	14.9%	13.6%	8.5%	7.9%
	2017	18.5%	31.5%	17.2%	13.9%	9.0%	9.8%
	2018	17.9%	21.9%	15.4%	12.2%	10.0%	22.5%
	2019	17.0%	28.1%	14.6%	16.0%	15.0%	9.3%
	Average	**20.3%**	**18.1%**	**21.0%**	**14.4%**	**10.8%**	**15.4%**

Table 1 signals two different biases in the weighting process. First, if the weights in each technique are compared yearly, data bias is detected. The sensitivity of the techniques to the data caused the same technique to produce different weight sets with data from different years. Secondly, if the weights in different techniques for the same year are compared, technical bias is detected. The algorithm of techniques caused them to produce different weight sets with the same data. Averaging all weight sets reduced both biases, assessing objective as possible.

The main objective of the weights is to determine to what extent the indicators will affect the result. In other words, the weights determine which indicator is more decisive in separating the alternatives. Accordingly, the weights show the power of the indicators to distinguish the provinces in terms of health human resources distribution. High-weighted indicators have high inter-provincial volatility, and vice versa. If the distribution of health human resources were fair, the indicator weights would be expected to be equal or close to each other. Then, since the weights will express the degree of inequity in the distribution, the order of health human resources from largest to smallest according to the degree of inequity is as follows: ***Dentist > Specialist > General Practitioner > Midwife > Pharmacist > Nurse***. This order also determines the policy priorities to improve the inequity in the distribution of health human resources. Accordingly, it can be claimed that the actions to support the increase in the supply of dentists and specialists are urgent.

The rankings of the provinces and the standard deviations and trends of these rankings are shown in Table 2. Changes in the ranking of a province depend on two components: *i) change in health human resources*, *ii) change in population*. The standard deviation (σ) symbolizes the magnitude of the effect created by the composite influence of both components. The last column (T) shows the trend of rank. Let φ be the rank difference between 2014 and 2019. If $-3 \leq \varphi \leq 3$, the trend is considered stationary and symbolized by $\leftrightarrow$. If $\varphi > 3$, the trend is in the upward direction and is symbolized by $\uparrow$. If $\varphi < -3$, the trend is down and is symbolized by $\downarrow$.

Table 2. Ranking of Cities by Years

Cities	2014	2015	2016	2017	2018	2019	σ	φ	T
Adana	33	32	39	36	26	34	**4.0**	**-1**	↔
Adıyaman	71	71	66	67	50	45	**10.3**	**26**	↑
Afyonkarahisar	56	50	45	52	52	47	**3.6**	**9**	↑

Cities	2014	2015	2016	2017	2018	2019	σ	φ	T
Ağrı	79	79	78	79	79	81	**0.9**	**-2**	↔
Amasya	28	27	34	25	43	29	**6.0**	**-1**	↔
Ankara	14	19	46	34	15	32	**11.6**	**-18**	↓

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Cities	2014	2015	2016	2017	2018	2019	σ	φ	T
Antalya	8	10	17	24	6	12	6.1	-4	↓
Artvin	38	44	26	12	46	28	11.7	10	↑
Aydın	9	8	12	16	12	18	3.5	-9	↓
Balıkesir	24	29	33	31	32	27	3.1	-3	↔
Bilecik	58	59	48	55	59	56	3.8	2	↔
Bingöl	69	70	68	62	69	61	3.6	8	↑
Bitlis	72	73	73	71	73	70	1.2	2	↔
Bolu	4	3	8	3	2	5	2.0	-1	↔
Burdur	11	13	3	22	18	22	6.7	-11	↓
Bursa	42	49	53	53	47	58	5.1	-16	↓
Çanakkale	13	9	6	11	19	17	4.5	-4	↓
Çankırı	41	45	43	39	66	50	9.0	-9	↓
Çorum	47	42	37	41	39	37	3.5	10	↑
Denizli	12	14	18	21	23	21	4.0	-9	↓
Diyarbakır	64	68	70	64	64	63	2.6	1	↔
Edirne	3	4	1	2	3	4	1.1	-1	↔
Elazığ	20	24	23	20	16	9	5.0	11	↑
Erzincan	27	31	28	28	28	6	8.4	21	↑
Erzurum	43	40	25	30	14	19	10.5	24	↑
Eskişehir	5	6	10	17	9	14	4.2	-9	↓
Gaziantep	68	67	71	68	63	68	2.4	0	↔
Giresun	32	34	24	23	30	24	4.3	8	↑
Gümüşhane	61	60	69	66	67	69	3.6	-8	↓
Hakkari	80	80	79	80	80	78	0.8	2	↔
Hatay	59	57	56	56	51	74	7.2	-15	↓
Isparta	1	1	4	1	1	1	1.1	0	↔
Mersin	39	47	44	46	40	43	2.9	-4	↓
İstanbul	67	62	58	72	37	76	12.7	-9	↓
İzmir	7	11	20	19	7	23	6.4	-16	↓
Kars	60	63	62	60	68	53	4.5	7	↑
Kastamonu	48	51	50	50	48	51	1.2	-3	↔
Kayseri	30	33	38	43	24	35	6.0	-5	↓
Kırklareli	26	26	13	26	29	25	5.1	1	↔
Kırşehir	31	23	27	29	44	30	6.5	1	↔
Kocaeli	51	55	51	49	77	67	10.2	-16	↓
Konya	36	36	36	42	25	44	6.0	-8	↓
Kütahya	55	46	52	54	42	55	5.0	0	↔
Malatya	16	16	9	8	8	7	3.8	9	↑
Manisa	25	37	35	40	38	36	4.8	-11	↓
Kahramanmaraş	66	66	61	59	61	60	2.8	6	↑
Mardin	74	76	74	73	71	66	3.2	8	↑
Muğla	6	5	2	5	11	8	2.8	-2	↔
Muş	77	78	80	78	78	79	0.9	-2	↔
Nevşehir	53	54	54	57	53	52	1.6	1	↔
Niğde	65	64	64	61	62	62	1.4	3	↔
Ordu	40	38	31	32	33	26	4.6	14	↑
Rize	17	20	22	13	10	15	4.1	2	↔
Sakarya	54	53	60	58	54	54	2.6	0	↔
Samsun	19	18	19	14	13	16	2.4	3	↔
Siirt	78	75	76	75	72	71	2.4	7	↑
Sinop	34	25	29	45	34	38	6.4	-4	↓
Sivas	23	21	11	10	17	11	5.2	12	↑
Tekirdağ	46	58	59	65	60	65	6.4	-19	↓
Tokat	44	39	32	37	36	33	4.0	11	↑
Trabzon	2	2	5	6	5	31	10.2	-29	↓
Tunceli	22	17	14	4	22	2	8.0	20	↑
Şanlıurfa	76	74	77	77	76	75	1.1	1	↔
Uşak	21	30	21	15	27	20	4.9	1	↔
Van	75	77	75	76	75	73	1.2	2	↔
Yozgat	50	48	47	38	45	42	4.0	8	↑
Zonguldak	29	22	30	27	31	41	5.7	-12	↓
Aksaray	63	65	63	69	57	57	4.3	6	↑
Bayburt	52	41	65	35	58	59	10.5	-7	↓
Karaman	35	35	41	44	41	40	3.3	-5	↓
Kırıkkale	10	7	16	18	20	10	4.8	0	↔
Batman	70	69	67	70	70	77	3.1	-7	↓
Şırnak	81	81	81	81	81	80	0.4	1	↔
Bartın	45	43	40	48	49	49	3.3	-4	↓
Ardahan	57	61	57	33	56	46	9.5	11	↑
Iğdır	73	72	72	74	74	72	0.9	1	↔
Yalova	37	28	42	47	35	39	5.9	-2	↔
Karabük	15	12	15	9	21	13	3.7	2	↔
Kilis	18	15	7	7	4	3	5.6	15	↑
Osmaniye	49	52	49	51	55	48	2.4	1	↔
Düzce	62	56	55	63	65	64	3.9	-2	↔

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If Table 2 is interpreted using the σ and φ values, keeping in mind that the change in the ranking of a province is affected by the change in the two components highlighted above, it can present the following information to the decision-maker.

- Rankings by year present the relative rank of the province across the country. The relative order allows the health human resources of the province to be compared with the country in general. The provinces at the top of the ranking have relatively more health human resources, and vice versa. For example, according to the 2019 rankings, in terms of health human resources, the best three provinces are Isparta, Tunceli, and Kilis, while the three worst provinces are Ağrı, Şırnak, and Muş, respectively. Ranking can be a guide when it is desired to determine a policy that will change the distribution of health human resources for a specific province or group of provinces. For example, since the last quarter of the ranking is extremely disadvantageous in terms of human resources, short-term privileges may be granted to the provinces in this quarter.
- σ is a numerical indicator of the volatility of the population per health person resource of a province over the years. For example, Istanbul has the most volatility. The macro indicator σ is not sufficient to explain the cause of volatility. The change in factors that may cause the change in the ranking should be examined. In this way, you can have an idea of whether the problem is temporary or permanent. The change in the population and health human resources in Istanbul, with 2014 being the base year, is shown in Table 3.

Table 3. An illustrative comparison of the percentage change in population and health human resources of a province

İstanbul	2015	2016	2017	2018	2019
Population	1.95%	1.00%	1.52%	0.26%	3.00%
Specialist Physician	5.17%	12.55%	-6.19%	10.69%	4.21%
General Practitioner	13.59%	16.29%	-5.52%	3.57%	5.18%
Dentist	7.46%	13.61%	3.33%	-1.15%	10.62%
Pharmacist	1.35%	0.90%	0.86%	10.97%	9.95%
Nurse	17.70%	-0.42%	11.40%	25.82%	1.64%
Midwife	5.13%	0.63%	3.80%	1.75%	-2.80%

This table is derived from the tables in the appendices.

Although the increase in the health and human resources according to the population is high on an annual basis, it is not at a level to keep the same Istanbul's rank constant. While the population has increased relatively consistently, the change in health human resources does not follow a pattern. The striking increase observed in the number of Specialists and General Practitioners in 2016 improved the ranking, but the decrease detected in 2017 significantly reduced the ranking. This volatility causes serious disruptions, planning, and coordination problems in health service delivery in Istanbul.

- φ provides information about the direction of the change in the distribution of health human resources in the province. Of the provinces, 22 show an increasing trend (↑), 26 show a decreasing trend (↓) and 33 show a stable trend (↔). The fact that the provinces with a decreasing trend are more than those with an increasing trend is clear evidence that

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the supply of health human resources throughout the country is insufficient. In another respect, the population is increasing more than expected. This situation can be explained by migrant mobility. The implementation of policies to increase the supply of health human resources, the supply of qualified health human resources from abroad, and the search for opportunities to utilize retired health personnel can be considered a solution. Looking at the change in the trend on a provincial basis, the three provinces with a strong increasing trend are Adıyaman, Erzurum, and Erzincan, respectively, and the three provinces with a strong decreasing trend are Trabzon, Tekirdağ, and Ankara. If provinces with a high trend are considered centers of attraction for health human resources, additional practices can be developed for these provinces to protect and strengthen these characteristics.

While the information in Table 2 allows making individual evaluations about the provinces, the visualization of the rankings gives the opportunity to visually control the distribution of health human resources and to observe the effects of policies. When the maps in Table 4 are examined, it is seen that the provinces in the eastern and southeastern regions of the country are at the bottom of the ranking, and the provinces in the western regions are at the top of the ranking. This outlook proves the imbalance in the distribution of health human resources. The low socio-economic level of the provinces in the eastern and southeastern regions motivates the westward mobility of health personnel. Mandatory service and attractiveness-enhancing practices cannot tolerate the impact of this mobility.

Table 4. Display of rankings on the map by years

2014 Ranking

2015 Ranking

2016 Ranking

2017 Ranking

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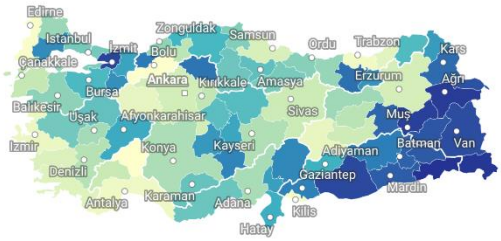
2018 Ranking



2019 Ranking

CONCLUSION

In the health sector, the planning of health human resources is important in terms of ensuring that all individuals have equal access to health services, which is the basic health policy. Provinces are monitored with health human resource indicators to determine that this policy has been allocated and to compensate for possible deviations. In this study, the distribution of health human resources at the level of 81 provinces of Turkey was analyzed.

In the analysis, the population per 6 health human resources of 81 provinces for the years 2014-2019 was used. The evaluation of the provinces for each year was carried out by the CoCoSo method and the indicator weights were determined with the help of CRITIC and ENTROPY methods.

Indicator weights indicate under which criteria the distribution of health human resources at the provincial level is uneven. The ranking of the provinces based on years allows for making comments about the health human resources of the provinces according to the country in general. The rank volatility of the provinces over the years indicates the disproportionateness of the change in the population and health human resources that affect the rank. The difference between the 2014 and 2019 rank values represents the improvement in the health human resources of the provinces. The findings of the analysis allow policymakers to observe regional differences in the country in general and the effects of practices that eliminate these differences.

Conflict of Interest Statement

There is no conflict of interest.

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