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# Evaluation of Health Indicators of Provinces in Turkey by Using Cluster Analysis

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## Abstract

*This study aims to divide the provinces in Turkey into clusters in terms of health status and healthcare delivery indicators by using cluster analysis and determinate the differences between these clusters. The data used in this study were obtained from the database of Turkey Statistical Institute. Infant mortality rate, crude mortality rate and life expectancy at birth were considered as indicators of health status; and the number of physicians, nurses and hospital beds per hundred-thousand people were considered as healthcare delivery indicators. The Hierarchical clustering method was applied in the study and the Ward connection method was used. Based on the results of this study, the provinces of Turkey are divided into 4 clusters in terms of health indicators. It was observed that the fourth cluster, which mainly includes Eastern and Southeastern provinces, has the highest infant mortality rate; life expectancy at birth is lowest; the number of physicians, nurses and hospital beds per hundred-thousand people was the lowest. It was determined that the first cluster, which includes big and relatively more socio-economically developed provinces such as Istanbul, Ankara and Izmir, has the highest life expectancy at birth; the highest number of physicians, nurses and hospital beds per hundred-thousand people. As a result, there are significant differences in terms of health indicators among regions and provinces in Turkey. It is recommended to develop specific policies for disadvantaged regions or provinces to minimise these differences.*

**Keywords:** *Comparison of provinces, health indicators, cluster analysis*

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# Türkiye'de İllerin Sağlık Göstergeleri Açısından Kümeleme Analizi İle Değerlendirilmesi

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## Öz

*Bu çalışmanın amacı sağlık statüsü ve sağlık hizmeti sunum göstergeleri açısından Türkiye'de illeri kümeleme analizi ile kümelere (sınıflara) ayırarak belirlenen kümeler arasındaki farkları ortaya koymaktır. Araştırmada kullanılan veriler Türkiye İstatistik Kurumu veri tabanından alınmıştır. Sağlık statüsü göstergeleri olarak bebek ölüm hızı, kaba ölüm hızı ve doğumda beklenen yaşam süresi; hizmet sunum göstergeleri olarak ise yüz bin kişiye düşen hekim, hemşire ve yatak sayısı ise ele alınmıştır. Araştırmada Hiyerarşik kümeleme yöntemi uygulanmış olup Ward bağlantı yönteminden yararlanılmıştır. Araştırma sonucunda Türkiye'de iller sağlık göstergeleri açısından 4 kümeye ayrılmıştır. Ağırlıklı olarak Doğu ve güneydoğu illerinin yer aldığı 4. küme bebek ölüm hızı en yüksek; doğumda beklenen yaşa süresi en düşük; yüz bin kişiye düşen hekim, hemşire ve yatak sayısının en düşük küme olduğu görülmüştür. İstanbul, Ankara, İzmir gibi büyük ve sosyo-ekonomik olarak nispeten daha gelişmiş illerin ağırlıklı olarak yer aldığı 1. kümenin ise doğumda beklenen yaşam süresinin en yüksek; yüz bin kişiye düşen hekim, hemşire ve yatak sayısının en fazla olan küme olduğu belirlenmiştir. Sonuç olarak Türkiye'de bölgeler ve iller arasında sağlık göstergeleri açısından önemli farklar bulunmaktadır. Bu farkların ortadan kaldırılması için dezavantajlı bölge ya da illere özel politikaların geliştirilmesi önerilmektedir.*

**Anahtar Kelimeler:** *İllerin karşılaştırılması, sağlık göstergeleri, kümeleme analizi*

## Introduction

Increasing the health status of the society is very important for people to be happier and to increase the level of well-being. In healthy societies, life expectancy is longer, and the longer people live, the more productive they contribute to the economy. There are many factors that affect the health status of the society and the ability of a country to provide quality health services (WHO, 2020). The achievement of economic development, the welfare of the societies, and the high quality of life of individuals are directly related to the healthy population structure of the society. A healthy society is only possible if the population can benefit from healthcare services and that these services can be provided effectively. All layers of the society and individuals in different regions or provinces must have equal access to healthcare services. However, it is not possible to say that the same conditions, especially geographical differences, can always be achieved in all regions. Elimination of these differences will both increase the quality of life in the regions and prevent problems that will interrupt social infrastructure, especially migration (Cağlar, 2019, p.43).

There is a need for objective, standard and quantitative indicators in order to obtain information about the development of countries by examining the health levels of countries and to make comparisons between them (Alptekin and Yeşil Aydin, 2015, p.138). The indicator is defined as the value obtained from an explanatory parameter or parameters that provide information about the state of an event, environment or area. Indicators provide easily understandable information to the public and decision-makers with reasonable complexity on the issue to be addressed. Generally, indicators have two main functions. Their primary function is that they reduce the number of measurements required when defining a situation. Their second function is to facilitate the announcement of positive and negative developments to politicians, administrators and decision-makers (Saraç and Alptekin, 2017, pp.22-23). A health indicator is a measure designed to summarize information about a given priority topic in population health or health system performance. Health indicators provide comparable and actionable information across different geographic, organizational or administrative boundaries and/or can track progress over time (Canadian Institute for Health Information, 2020). Health indicators are used in determining

policies related to primary healthcare services, management, planning and programming of healthcare services, determining and meeting the demand in healthcare services, evaluating the health levels of communities, determining and solving healthcare-related problems (Çetintürk and Gençtürk, 2020, p.229).

Health indicators are classified into 5 main groups by Organisation for Economic Co-operation and Development (OECD). These are healthcare use, health equipment, health resources, health risks and health conditions (OECD, 2019). Through the analysis made with all or some of these indicators, information can be obtained on the health status and health performance based on provinces, regions and countries. In addition, such analyses can guide policies in the relevant field by enabling society to follow the changes in health status and make regional or international comparisons (Değirmenci and Yakıcı Ayan, 2020, p.231). Health indicators defining the level of health of society and changing in health according to different characteristics as well as the change in health problems over the time is determined and the health level of society can be compared to other societies. In addition, health indicators help to determine the changes and trends in the current situation in a certain period while revealing the current situation. Also, health indicators can be used to determine whether countries use their resources correctly and effectively in healthcare delivery (Şahin, 2017, p.55-56)

Comparing provinces are important for determining the viability of existing policies and producing new policies and ensuring the continuation of the necessary works (Zorlutuna and Erilli, 2018, pp.13-14). The level of healthcare delivery varies from country to country and even from province to province within the same country (Gençoğlu, 2018, p.302). There is need to compare the provinces in Turkey by using health indicators and determine their positions in order to identify differences in terms of health indicators between the provinces, to reveal and meet the deficiencies, to reveal and meet the demand, to identify health problems and to solve these problems of the society as a whole, to guide the healthcare policies. Frequently revealing the differences between provinces and regions in terms of health indicators enables a sustainable measure, control and improvement (Tekin, 2015, p.391-392). The aim of this study is to group the provinces in Turkey with clustering analysis and to reveal the differences between the provincial

groups determined in terms of health indicators. Thus, useful information could be provided to policy-makers, decision-makers and practitioners in eliminating the differences determined in healthcare delivery.

## Materials and Methods

### *Population and Sampling*

The sampling of the study consisted of provinces in Turkey. All provinces are included in this research. The data on health indicators of provinces obtained from the database of Turkey Statistical Institute (TSI). The health indicators selected to be used in the study were infant mortality rate, under-five-year mortality rate, maternal mortality rate, crude mortality rate, life expectancy at birth, number of physicians and nurses, and number of hospital beds. However, since the data on maternal mortality rate could not be obtained separately for each province, it was excluded. In addition, the infant mortality rate and under-five mortality rate were excluded due to the high correlation between them (this was explained in more detail in the data analysis section). Infant mortality rate, crude mortality rate and life expectancy at birth were considered as indicators of health status; and the number of physicians, nurses and hospital beds were considered as healthcare delivery indicators. The data used on health indicators are the most up-to-date data as of the date of the study and belong to 2018. Only data on life expectancy at birth belonged to 2017.

### *Data Analysis*

The data obtained from the databases of TSI were analyzed using the Statistical Package for the Social Science (SPSS) 20 software. In this study, it was determined how the provinces were clustered according to their health indicators. Cluster analysis was used to achieve this. Clustering analysis is an analysis that can be used to create clusters. The purpose of the analysis is to reveal the similarities of the units according to their specific characteristics and to cluster the units based on these similarities. Hierarchical and non-hierarchical clustering methods can be used as cluster methods (Çokluk et al., 2012, pp.138, 141). Hierarchical clustering method was used in this study. Hierarchical clustering method is a preferred cluster method in cases where the sample size is low ($n<250$) (Çokluk et al., 2012, p.141).

The number of provinces included in our study is 81. Therefore, the use of hierarchical clustering method was preferred in this study. The hierarchical clustering method aims to combine the units at certain levels (cluster distance measures) by taking into account the similarities of the units. As hierarchical clustering methods, differential and associative clustering methods can be used (Özdamar, 2013, p.269). Each unit is initially considered as a separate cluster on its own while using combining methods. In the next step, the two closest clusters are grouped as a new cluster (Alpar, 2013, p.322). Later, other units with different similarity levels are added to this cluster and all units are connected (combined) in a cluster (Özdamar, 2013, p.269). In differentiating methods, a process is carried out in the opposite process, which carried out in combining methods. At the beginning of this process, there is a large set containing all the observations. In the next steps, the most different (dissimilar/distant) observations separate from each other to create smaller clusters. This process continues until each observation creates a separate cluster on its own (Alpar, 2013, p.322). In this study, the combining hierarchical (progressive) cluster method was used. Connections, distances and levels of units are shown with tree graphs called dendrograms in combining methods (Özdamar, 2013, pp.269-270). The tree (dendrogram) graph obtained in this study is shown in Figure 1. Different methods can be used to create clusters in the combining clustering method. These are single connection method, average connection method, full connection method, central method, median method and ward method. Ward method was used in this study and the Square Euclidean distance was used. Ward method is based on the distance of the observations located in the middle of a cluster from the observations found for the same cluster (Kalaycı, 2010, p.259). Square Euclidean distance is generally used in the Ward method (Alpar, 2013, p.333). The clusters obtained as a result of the analysis were provided in Table 2.

Since the data have different structures (thousandths, hundredths, years), they were analysed by taking standardized Z values before being analysed. Some assumptions should be met before carrying out cluster analysis. According to Çokluk et al. (2012), the representation of the sample and the problem of multiple connections between variables are two critical points that researchers should focus on (p.154). Since all units (provinces) are included in the scope of this research, there is no problem in terms of

the representation of the sample. Pearson correlation analysis was conducted between variables to test whether there was a multiple connection problem between variables. In addition, the variance inflation factor (VIF) values of the variables were examined. The high correlation between variables (r> 0.90) and VIF values above 10 indicate a multiple connection problem (Çokluk et al. 2012, p.35). In the study, since there is a high correlation (r = 0.94) between infant mortality rate under-five-years mortality rate, as well as the value of VIF for mortality rate under-five-years, was over 10, it was excluded from this study. After the under-five-years mortality rate was excluded, VIF values for other variables were found as below 10 (ranged from 1,284 to 4,655).

One-way analysis of variance (ANOVA) was conducted to test whether there was a significant difference between clusters in the study. Tukey test was conducted to determine which group caused the difference or among which groups there was a significant difference. Kurtosis and skewness values were examined to evaluate whether the data were normally distributed. In addition, Kolmogorov-Smirnov Z test was performed and it was observed that the data were distributed normally. Homogeneity of variances was evaluated by Levene test. When the assumption of homogeneity of variances could not be achieved, Welch statistics (Alpar, 2013, p.256), which does not require the assumption of homogeneity of variances, was used and Tamhane T2 test was used as further analysis.

### *Aspect of Research Ethics*

Ethics Committee Permission (date and number: 10.11.2020, 2020/5-1) was obtained from the Batman University Ethics Committee to conduct the study.

## Results

The indicators regarding Turkey and its provinces were provided in Table 1. According to data from 2018, in Turkey, the infant mortality rate was 9.3 per thousand; the crude mortality rate was 5.2 per thousand; the number of physicians was 187 per hundred-thousand; the number of nurses was 232 and the number of hospital beds was 283 per hundred-thousand population. According to the data of 2017, life expectancy at birth is 78 in Turkey.

The first five provinces with the highest infant mortality rate are Gaziantep, Sirnak, Kilis, Cankiri and Kilis, respectively. The first five provinces with the lowest infant mortality rate are Tunceli, Canakkale, Kirklareli, Edirne and Giresun, respectively. The first five provinces with the highest crude mortality rate are Kastamonu, Sinop, Balikesir, Edirne, Artvin and Canakkale, respectively. The first five provinces with the lowest crude mortality rate are Sirnak, Hakkari, Batman, Sanliurfa and Van, respectively. The first five provinces with the highest life expectancy at birth are Tunceli, Mugla, Trabzon, Gumushane and Mardin, respectively. The first five provinces with the lowest life expectancy at birth are Kilis, Agri, Kutahya, Gaziantep and Ardahan, respectively. The first five provinces with the highest number of physicians per hundred thousand population are Ankara, Edirne, Izmir, Isparta and Bolu, respectively. The first five provinces with the lowest number of physicians per hundred thousand population are Sirnak, Agri, Mus, Hakkari and Igdir, respectively. The first five provinces with the highest number of nurses per hundred thousand people are Isparta, Trabzon, Bolu, Edirne and Eskisehir, respectively. The first five provinces with the lowest number of nurses per hundred thousand people are Sirnak, Hakkari, Agri, Sanliurfa and Mardin, respectively. The first five provinces with the highest number of hospital beds per hundred thousand people are Elazig, Erzurum, Edirne, Bolu and Isparta, respectively. The first five provinces with the lowest number of hospital beds per hundred thousand people are Sirnak, Hakkari, Bilecik, Igdir and Agri, respectively.

***Table 1. Health Indicators of Turkey and its Provinces (2017-2018)***

| Kod | Provinces | Infant Mortality Rate* | Crude Mortaliy Rate* | Life Expectay at Birth | Number of Physician** | Number of Nurses** | Number of Beds** |
|---|---|---|---|---|---|---|---|
| TR | Turkey | 9,3 | 5,2 | 78 | 187 | 232 | 283 |
| 1 | Adana | 8,3 | 4,8 | 77,5 | 194 | 227 | 317 |
| 2 | Adiyaman | 11 | 4,1 | 79,7 | 143 | 215 | 209 |
| 3 | Afyonkarahisar | 9,5 | 7,1 | 77,1 | 146 | 217 | 301 |
| 4 | Agri | 12,3 | 3,4 | 76,8 | 94 | 150 | 163 |
| 5 | Amasya | 7,7 | 7,7 | 78,5 | 133 | 218 | 247 |
| 6 | Ankara | 7,6 | 4,8 | 79,4 | 304 | 285 | 332 |
| 7 | Antalya | 7,2 | 4,5 | 79,3 | 211 | 226 | 296 |
| 8 | Artvin | 8,7 | 8,4 | 79,3 | 147 | 238 | 199 |
| 9 | Aydin | 8,3 | 7,3 | 78,5 | 192 | 228 | 287 |
| 10 | Balikesir | 7,2 | 8,8 | 77,5 | 147 | 228 | 272 |
| 11 | Bilecik | 8,4 | 7,1 | 77,8 | 121 | 186 | 150 |
| 12 | Bingol | 9,5 | 3,9 | 78,8 | 113 | 225 | 245 |
| 13 | Bitlis | 10,2 | 3,3 | 78,4 | 115 | 217 | 274 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14 | Bolu | 8,6 | 7 | 79,2 | 237 | 340 | 464 |
| 15 | Burdur | 8 | 8,2 | 79,2 | 147 | 237 | 281 |
| 16 | Bursa | 7,3 | 5,6 | 77,7 | 165 | 212 | 246 |
| 17 | Canakkale | 5,1 | 8,4 | 78 | 189 | 254 | 307 |
| 18 | Cankiri | 13,8 | 8,2 | 78 | 110 | 194 | 215 |
| 19 | Corum | 7,8 | 7,7 | 78,6 | 143 | 260 | 310 |
| 20 | Denizli | 9,9 | 6 | 78,2 | 188 | 248 | 314 |
| 21 | Diyarbakır | 9,9 | 3 | 78,9 | 153 | 213 | 267 |
| 22 | Edirne | 6,4 | 8,6 | 77,4 | 288 | 332 | 470 |
| 23 | Elazig | 9,4 | 5,2 | 78,6 | 164 | 301 | 502 |
| 24 | Erzincan | 7,4 | 6,3 | 79,2 | 177 | 225 | 229 |
| 25 | Erzurum | 10,5 | 5,4 | 77,3 | 207 | 316 | 472 |
| 26 | Eskisehir | 6,7 | 6,7 | 78 | 219 | 330 | 407 |
| 27 | Gaziantep | 15,3 | 3,9 | 76,9 | 143 | 206 | 297 |
| 28 | Giresun | 6,4 | 8,2 | 79,7 | 149 | 262 | 347 |
| 29 | Gumushane | 7,9 | 5,3 | 79,8 | 114 | 203 | 201 |
| 30 | Hakkari | 13,3 | 2,8 | 77,1 | 95 | 149 | 137 |
| 31 | Hatay | 10,1 | 4,6 | 77,9 | 142 | 195 | 260 |
| 32 | Isparta | 8,5 | 7,2 | 78,7 | 245 | 364 | 458 |
| 33 | Mersin | 8 | 5,1 | 78,2 | 156 | 219 | 262 |
| 34 | Istanbul | 7,6 | 4,2 | 78,7 | 219 | 229 | 261 |
| 35 | Izmir | 7,1 | 6,2 | 78,6 | 256 | 234 | 277 |
| 36 | Kars | 10,5 | 4,9 | 77,3 | 142 | 197 | 255 |
| 37 | Kastamonu | 9 | 10,2 | 77,4 | 131 | 219 | 287 |
| 38 | Kayseri | 10,5 | 5,2 | 77,9 | 196 | 247 | 329 |
| 39 | Kırklareli | 5,1 | 8,3 | 77,7 | 139 | 201 | 251 |
| 40 | Kirsehir | 10 | 6,8 | 78,5 | 150 | 201 | 195 |
| 41 | Kocaeli | 8,3 | 4,6 | 78,1 | 158 | 214 | 227 |
| 42 | Konya | 9,4 | 5,3 | 78,3 | 193 | 245 | 341 |
| 43 | Kutahya | 7,2 | 8 | 76,8 | 132 | 250 | 326 |
| 44 | Malatya | 10,6 | 5,3 | 79 | 214 | 279 | 372 |
| 45 | Manisa | 11,3 | 7,1 | 77,1 | 166 | 228 | 320 |
| 46 | Kahramanmaras | 12 | 4,4 | 79,2 | 141 | 238 | 257 |
| 47 | Mardin | 14,9 | 3,3 | 79,8 | 111 | 166 | 174 |
| 48 | Mugla | 7,3 | 5,8 | 80,3 | 171 | 199 | 211 |
| 49 | Mus | 12,8 | 3,2 | 77,5 | 95 | 169 | 181 |
| 50 | Nevsehir | 9,5 | 6,5 | 77,8 | 124 | 185 | 234 |
| 51 | Nigde | 10,2 | 5,7 | 77,6 | 121 | 199 | 243 |
| 52 | Ordu | 8 | 7 | 79,3 | 139 | 234 | 278 |
| 53 | Rize | 8,5 | 6,6 | 79 | 201 | 285 | 318 |
| 54 | Sakarya | 7,6 | 6 | 77,5 | 154 | 184 | 191 |
| 55 | Samsun | 8,9 | 6,5 | 78,1 | 205 | 285 | 346 |
| 56 | Siirt | 13,8 | 3,3 | 78,4 | 114 | 213 | 259 |
| 57 | Sinop | 8,3 | 9,4 | 78,4 | 134 | 251 | 243 |
| 58 | Sivas | 6,8 | 6,6 | 78 | 187 | 300 | 404 |
| 59 | Tekirdag | 7,5 | 5,6 | 77,6 | 138 | 182 | 259 |
| 60 | Tokat | 8,1 | 7,3 | 77,5 | 152 | 269 | 359 |
| 61 | Trabzon | 7,1 | 6,3 | 80 | 219 | 351 | 402 |
| 62 | Tunceli | 5 | 6,4 | 80,7 | 167 | 235 | 170 |
| 63 | Sanliurfa | 13,5 | 2,9 | 77,7 | 111 | 151 | 198 |
| 64 | Usak | 9,4 | 7,1 | 78,1 | 138 | 251 | 336 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 65 | Van | 11,4 | 2,9 | 77 | 125 | 214 | 257 |
| 66 | Yozgat | 7,5 | 7,4 | 77,5 | 152 | 255 | 303 |
| 67 | Zonguldak | 7,7 | 7,4 | 77,8 | 173 | 285 | 366 |
| 68 | Aksaray | 9,4 | 4,9 | 78,3 | 124 | 189 | 193 |
| 69 | Bayburt | 8,2 | 6,1 | 79,1 | 136 | 247 | 243 |
| 70 | Karaman | 7,3 | 6,4 | 78,7 | 130 | 237 | 237 |
| 71 | Kirikkale | 8,8 | 6,5 | 77,8 | 223 | 211 | 438 |
| 72 | Batman | 10,3 | 2,8 | 79,3 | 120 | 199 | 217 |
| 73 | Sirnak | 14,5 | 2,6 | 77,6 | 87 | 126 | 120 |
| 74 | Bartın | 13,3 | 8,2 | 77,9 | 125 | 214 | 217 |
| 75 | Ardahan | 6,8 | 7,7 | 76,9 | 135 | 225 | 202 |
| 76 | Igdir | 9,2 | 4 | 78,8 | 104 | 186 | 159 |
| 77 | Yalova | 9,1 | 6,6 | 78,6 | 148 | 205 | 217 |
| 78 | Karabuk | 10,6 | 7,2 | 78,4 | 171 | 271 | 289 |
| 79 | Kilis | 14,5 | 5,5 | 76,1 | 194 | 294 | 225 |
| 80 | Osmaniye | 12,6 | 4,6 | 78 | 121 | 195 | 242 |
| 81 | Duzce | 8,5 | 6,1 | 77,5 | 169 | 200 | 204 |

*Per Thousand, ** Per Hundred Thousand People

There is no standard in determining the number of clusters in the hierarchical cluster analysis. It is often considered the best approach to benefit from the experience and knowledge of the researcher. In contrast, $k = \sqrt{n} / 2$ formula can be used to approximate the number of clusters (Alpar, 2013, p.321). Accordingly, since the number of units in our study was 81, it was calculated as $k = \sqrt{81} / 2 \sim 6$. However, when the number of clusters is considered as 6, it is seen that there is only 1 unit in one cluster and only 2 units in another cluster. A similar situation occurs when considered as 5 clusters. Therefore, the number of clusters was determined as 4, taking into account the tree graph (Figure 1). In addition, when the number of clusters was evaluated as 4, a significant difference was found between clusters in terms of all variables.

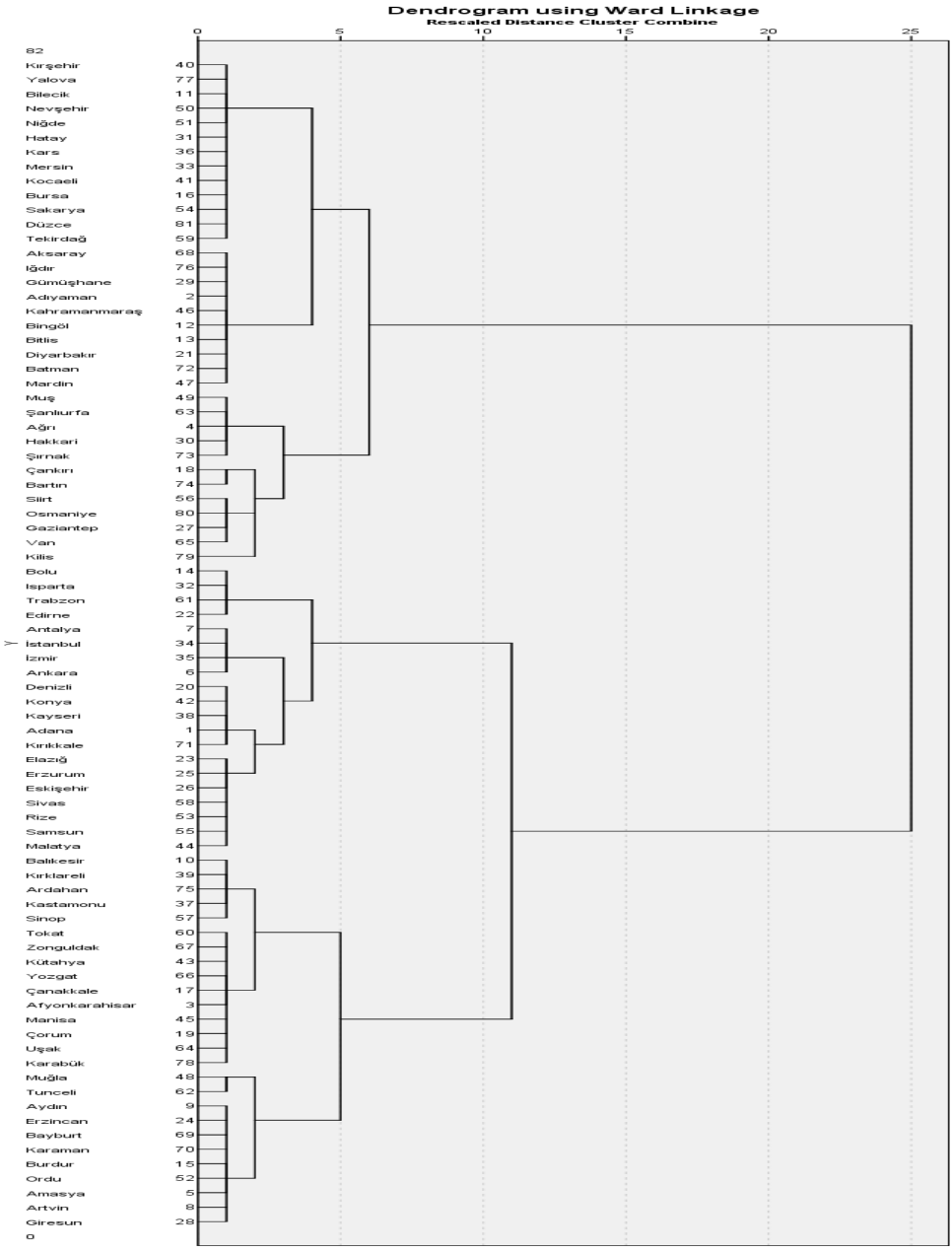


*Figure 1. Tree Chart (Dendrogram)*

The clusters obtained are shown in Table 2. When Table 2 is examined, There are 20 provinces in cluster 1; 23 provinces in cluster 2; 26 provinces in cluster 3; and 12 provinces in cluster 4.

***Table 2. Distribution of Provinces by Clusters***

| Cluster 1 (20 Provinces) | Cluster 2 (23 Provinces) | Cluster 3 (26 Provinces) | Cluster 4 (12 Provinces) |
|---|---|---|---|
| Adana | Adiyaman | Afyonkarahisar | Agri |
| Ankara | Aksaray | Amasya | Bartın |
| Antalya | Batman | Ardahan | Cankiri |
| Bolu | Bilecik | Artvin | Gaziantep |
| Denizli | Bingol | Aydin | Hakkari |
| Edirne | Bitlis | Balikesir | Kilis |
| Elazig | Bursa | Bayburt | Mus |
| Erzurum | Diyarbakır | Burdur | Osmaniye |
| Eskisehir | Duzce | Canakkale | Siirt |
| Isparta | Gumushane | Corum | Sanliurfa |
| Istanbul | Hatay | Erzincan | Sirnak |
| Izmir | Igdir | Giresun | Van |
| Kayseri | Kahramanmaras | Karabuk | |
| Kirikkale | Kars | Karaman | |
| Konya | Kirsehir | Kastamonu | |
| Malatya | Kocaeli | Kırklareli | |
| Rize | Mardin | Kutahya | |
| Samsun | Mersin | Manisa | |
| Sivas | Nevsehir | Mugla | |
| Trabzon | Nigde | Ordu | |
| | Sakarya | Sinop | |
| | Tekirdag | Tokat | |
| | Yalova | Tunceli | |
| | | Usak | |
| | | Yozgat | |
| | | Zonguldak | |

The comparison of clusters obtained as a result of cluster analysis according to health indicators is shown in Table 3. Statistically significant differences were found in all clusters in terms of health indicators. When the clusters were examined according to the infant mortality rate, it was seen that the infant mortality rate of the provinces in cluster 4 was significantly higher than the other clusters (13.43 per thousand), and there was a statistically significant difference between the 4th cluster and all other clusters ($p < 0.01$). When looking at the crude mortality rate; It was observed that the average mean mortality rate of the provinces in cluster 3 (7.57) was higher than the other clusters and there was a statistically significant difference between the cluster 3 and all other clusters ($p < 0.01$). As regards to the life expectancy at birth; although the mean of this value is close to each other in all clusters, it

was observed that the average life expectancy (77.42) of the provinces in the 4th cluster was less than other clusters and there was a statistically significant difference between the 4th cluster and all other clusters (p<0,01). Considering the number of physicians per hundred thousand people; it was observed that the average number of physicians per hundred thousand people in provinces in cluster 1 was higher than other clusters and there was a statistically significant difference between cluster 1 and all other clusters (p <0.01). The mean number of hospital beds per hundred thousand people in provinces in cluster 1 (218.5) is approximate twice the mean number of hospital beds per hundred thousand people in provinces in cluster 4 (117.33). Considering the number of nurses and hospital beds, similarly, in the provinces in cluster 1, the mean number of nurses per hundred thousand people (281.75) and the mean number of beds (376) is higher than the other clusters and it was found that there was a statistically significant difference in terms of the number of nurses and beds between cluster 1 and all other clusters (p <0.01).

***Table 3. Multiple Comparison of Province Clusters in Turkey by Health Indicators***

| Indicators | Clusters | n | Mean* | SD* | F | p | SD* |
|---|---|---|---|---|---|---|---|
| Infant Mortality Rate (Per Thousand) | Cluster 1 | 20 | 8,42 | 1,34 | 43,630 | <0,001 | 1-4, 2-4, 3-4, 2-3 |
| | Cluster 2 | 23 | 9,53 | 1,68 | | | |
| | Cluster 3 | 26 | 7,80 | 1,49 | | | |
| | Cluster 4 | 12 | 13,43 | 1,07 | | | |
| Crude Mortality Rate (Per Thousand) | Cluster 1 | 20 | 5,95 | 1,08 | 25,190 | <0,001 | 1-3, 1-4, 3-4, 2-3 |
| | Cluster 2 | 23 | 4,97 | 1,25 | | | |
| | Cluster 3 | 26 | 7,57 | 1,01 | | | |
| | Cluster 4 | 12 | 4,29 | 2,00 | | | |
| Life Expectancy at Birth | Cluster 1 | 20 | 78,45 | 0,73 | 4,641 | <0,001 | 1-4, 2-4, 3-4 |
| | Cluster 2 | 23 | 78,40 | 0,78 | | | |
| | Cluster 3 | 26 | 78,36 | 1,04 | | | |
| | Cluster 4 | 12 | 77,42 | 0,65 | | | |
| Number of Physicians (Per Hundred Thousand People) | Cluster 1 | 20 | 218,50 | 34,00 | 56,487 | <0,001 | 1-2, 1-3, 1-4, 3-4 |
| | Cluster 2 | 23 | 135,91 | 19,09 | | | |
| | Cluster 3 | 26 | 151,38 | 18,39 | | | |
| | Cluster 4 | 12 | 117,83 | 28,97 | | | |
| Number of Nurses (Per Hundred Thousand People) | Cluster 1 | 20 | 281,75 | 46,79 | 29,417 | <0,001 | 1-2, 1-3, 1-4, 2-3, 3-4 |
| | Cluster 2 | 23 | 201,30 | 16,46 | | | |
| | Cluster 3 | 26 | 239,38 | 21,10 | | | |
| | Cluster 4 | 12 | 189,58 | 44,85 | | | |
| Number of Nurses and Beds (Per Hundred Thousand People) | Cluster 1 | 20 | 376,00 | 72,93 | 27,805 | <0,001 | 1-2, 1-3, 1-4, 2-3, 3-4 |
| | Cluster 2 | 23 | 223,43 | 35,74 | | | |
| | Cluster 3 | 26 | 276,96 | 51,46 | | | |
| | Cluster 4 | 12 | 209,25 | 52,33 | | | |

* Mean, Standard deviation, Significant difference

## Discussion

It has been observed that there are significant differences between the clusters of provinces determined in this study, which is aimed to evaluate health indicators of the provinces in Turkey with clustering analysis. The first cluster, which includes the provinces of Adana, Ankara, Antalya, Bolu, Denizli, Edirne, Elazig, Erzurum, Eskisehir, Isparta, Istanbul, Izmir, Kayseri, Kirikkale, Konya, Malatya, Rize, Samsun, Sivas and Trabzon, identified as having the highest life expectancy at birth; the cluster has the highest number of physicians, nurses and beds per hundred thousand people. Statistically significant difference was found between the 1st cluster and other clusters in terms of the specified indicators. The fourth cluster, which includes the provinces of Agri, Bartin, Cankiri, Gaziantep, Hakkari, Kilis, Mus, Osmaniye, Siirt, Sanliurfa, Sirnak and Van, has the highest infant mortality rate; life expectancy at birth is lowest; the number of physicians, nurses and beds per hundred thousand people was the lowest. Cluster 4 was found to be the cluster with the lowest statistics in five of the six health indicators included in the study, and it is statistically significant from other clusters. The provinces in the 4. cluster, except for Osmaniye, Cankiri and Bartin, are located in the Eastern and Southeastern Anatolia regions. A study conducted by Caglar and Keten (2019), which compare the health index of provinces, found that Trabzon, Malatya, Burdur, Denizli, Bolu are the first five provinces, while Van, Mus, Agri, Hakkari and Sirnak are the last five provinces. Also, eight of the eleven provinces (Bingol, Sanliurfa, Kars, Van, Mus, Agri, Hakkari, Sirnak) with less than 0.40 health index were found to be Eastern or Southeastern Anatolia region which is two of the seven geographical regions. A study carried out by Santas and Santas (2018), which aim to determine the current status and ranking of regions and provinces of Turkey and OECD countries, Western Anatolia Region is in the first rank in relation to health status, health care infrastructure, and the Southeastern Anatolia Region is the latest one in the list. In the mentioned study, it was also seen that the provinces in the Eastern Region constitute the last places in health services utilization. In a study where provinces were classified according to the health indicators, it was seen that the Eastern and Southeastern provinces such as Hakkari, Sirnak, Sanliurfa, Kilis, Agri, Kars, Mus and Van were in the worst condition (Celik, 2013). It can be said that the current

research results and the results of other literature are consistent with each other and according to the results obtained, provinces in the East and Southeast regions are generally disadvantageous in terms of health indicators, with a few exceptions.

In the research, infant mortality rate, crude mortality rate and life expectancy at birth were included as indicators of health status. The mentioned indicators are among the most important interrelated health indicators and are accepted as an important instrument in measuring and improving the quality of healthcare services at both national and international levels. Especially the infant mortality rate is seen as an important indicator of health in most contries as it is associated with a variety of factors, such as maternal health, quality of healthcare and access, socio-economic conditions and public health practices. In addition, this indicator is influenced by other factors that are likely to affect the health status of the entire population, such as economic development, general living conditions, social welfare, disease rates and the quality of the environment. The infant mortality rate is considered as the most important indicator of the health of a society and it is seen as the main focus of health policy. Countries generally formulate their health strategies, priorities and outcome measurement by taking this indicator into account (Songur et al., 2017, p.2-3). The number of physicians, nurses and hospital beds per 100,000 people was included healthcare delivery indicators in the study. The determined indicators are among the important indicators showing the health infrastructure. The efficient allocation of healthcare resources in health infrastructure is one of the most complex issues in health policy (Santas and Santas, 2018). Significant differences emerged between the clusters determined in terms of both healthcare delivery indicators and health status indicators. There are significant differences between cluster 1 and cluster 4 especially in terms of healthcare delivery indicators. The number of physicians, nurses and beds per hundred thousand people in the provinces in the 1st cluster is approximately 1.5 times more than the number of physicians, nurses and beds per hundred thousand people in the provinces in the 4th cluster. Health status indicators are affected by health services as well as many cultural, social and economic indicators. With health investments to be made in a region, it may not be possible to make significant improvements in these indicators in a short time. However, since healthcare delivery indicators are directly related to

health investments made in a region, health investments can be increased in disadvantaged regions or provinces, and improvement in healthcare delivery indicators (the number of physician, nurse, beds, etc.) can be achieved in the short term.

Article 21/2 of the Universal Declaration of Human Rights, which was approved by the Council of Ministers in 1949 and published in the official gazette, states that "everyone has the right to equally benefit from public services in their country" (Bulut, 2019, p.81). In addition, the right to a healthy life has been defined as the most fundamental human right in many international documents, and the duty of health protection, treatment and rehabilitation of disease has been undertaken by states as a public service (Erol and Ozdemir, 2014, p.9). In Turkey, there is need for policymakers to produce solutions to eliminate differences between provinces that have significant differences in terms of health indicators. In a study by Ozturk and Meral (2016), it was determined that the inequality in the distribution of hospital beds by provinces decreased from 1970 to 2014, except for some exceptional years. Accordingly, even if the differences between provinces decrease over time, it can be said that there are still significant differences.

There may be several reasons for the differences in health indicators between regions and provinces. Historical, cultural, geographic, socio-economic and demographic differences are shown among these reasons (Tekin, 2015, p.391; Taban, 2006, p.31). It is observed that especially socio-economically more developed regions or provinces have better health indicators. In a study conducted by Taban (2006), it was determined that there is a close and reciprocal relationship between the health level of the society and economic development. Intense migration events caused by socio-economic development differences create a major population pressure and also cause urbanisation problems, which have become a major problem across the country. Education and health services have become inadequate in cities that grow with migration (Zorlutuna and Erilli, 2018, p.13-14). Therefore, it can be said that the measures to be taken as a contribution to the development of underdeveloped provinces can contribute not only to these provinces but also to the solution of certain problems of developed provinces.

## Limitation of Research

It is a limitation of the study that clustering analysis was performed using only six health indicators (infant mortality rate, maternal mortality rate, crude mortality rate, life expectancy at birth, number of physicians and nurses, and number of hospital beds). Conducting research with other health indicators may increase the content validity of the research.

## Conclusion

In this study, provinces in Turkey were divided into clusters (classified) based on health indicators by clustering analysis. In the study, provinces were divided into 4 clusters and significant differences were found between clusters in terms of both health status and healthcare delivery indicators. In Turkey, the Health Transformation Program has been introduced 2003 and radical reforms have been made. Significant progress has been made over the years in terms of health indicators. However, there are still significant differences between regions or provinces. In order to eliminate these differences, the right distribution of healthcare resources between regions or provinces should be ensured. Health investments should be increased in disadvantaged regions. Since health indicators are affected by other factors except for healthcare delivery such as education, culture and socio-economic development, it is recommended to develop policies that can provide improvement in these areas. It is recommended for the researchers to conduct research on which specific policies can be developed for disadvantaged regions or provinces.

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