2025, 10(2), 338-371

Akademik İzdüşüm Dergisi (AİD)

Journal of Academic Projection (JAP)

https://dergipark.org.tr/tr/pub/beuiibfaid

Geliş/Received: 15/02/2025
Kabul/Accepted: 15/10/2025
Araştırma Makalesi / Research Article

ISSN: 2547-9725

ANALYSIS OF UNIVERSAL HEALTH COVERAGE INDICATORS WITH CLUSTERING METHOD, A STUDY ON OECD COUNTRIES

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Abstract

Health and Quality of Life (SDG3), one of the Sustainable Development Goals implemented by the United Nations Development Programme, aims to ensure that everyone has access to health services at the lowest possible cost. The increase in catastrophic health expenditure due to the COVID-19 pandemic has increased the importance of Universal Health Coverage, which is one of the goals to be achieved through SDG3. This study aims to determine Turkey's relative level of development among OECD countries in terms of Universal Health Coverage goals. In this study, cluster analysis, which is one of the multivariate statistical analysis methods, was used to analyse the countries with similar characteristics among OECD countries in terms of Universal Health Coverage sub-targets. In the analysis, hierarchical and non-hierarchical clustering analyses were carried out using data from 34 OECD countries. Three clusters were obtained in line with the results of both analyses. The main limitation of the study is that the data are not published every year. Compared to other countries in the cluster in which Turkey is included, it can be stated that in order to achieve universal health coverage, the quality and diversity of services included in the social security system should be increased and payment mechanisms should be improved in such a way as to reduce financial catastrophes.

Keywords: *Sustainable Development, Universal Health Coverage, Cluster Analysis.*

JEL Codes: *I14, I15*

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Evrensel Sağlık Kapsayıcılığı Göstergelerinin Kümeleme Yöntemi İle Analizi, OECD Ülkeleri Üzerine Bir İnceleme

Öz

Birleşmiş Milletler Kalkınma Programının yürüttüğü Sürdürülebilir Kalkınma Amaçları arasında yer alan Sağlık ve Kaliteli Yaşam (SKA3) amacı herkesin en düşük maliyetle sağlık hizmetlerine erişimini sağlamayı hedeflemektedir. COVID-19 pandemisi ile katastrofik sağlık harcamalarında meydana gelen artış SKA3 ile ulaşılması amaçlanan hedeflerden biri olan Evrensel Sağlık kapsayıcının önemi artırmıştır. Bu çalışma Türkiye'nin Evrensel Sağlık Kapsayıcılığı hedefleri açısından OECD ülkeleri arasındaki göreli gelişme düzeyinin tespit edilmesi amacını taşımaktadır. Bu çalışmada Evrensel Sağlık Kapsayıcılığının alt hedefleri açısından OECD ülkeleri arasında benzer özellikler gösteren ülkelerin analiz edilmesi amacıyla çok değişkenli istatistiksel analiz yöntemlerinden biri olan kümeleme analizinden yararlanılmıştır. Analizde 34 OECD ülkesinin verisinden yararlanılarak hiyerarşik ve hiyerarşik olmayan kümeleme analizi yapılmıştır. Her iki analizden elde edilen sonuçlar doğrultusunda üç küme elde edilmiştir. Çalışmanın en önemli kısıtı verilerin her yıl açıklanmıyor olmasıdır. Türkiye için dahil olduğu kümede yer alan diğer ülkeler ile karşılaştırıldığında evrensel sağlık kapsayıcılığına ulaşılabilmesi için sosyal güvenlik sistemine dahil olan hizmetlerin kalitesi ve çeşitliliğini artırmanın yanında ödeme mekanizmalarının finansal katastrofiyi azaltacak yönde iyileştirmesi gerektiği ifade edilebilir.

Anahtar Kelimeler: *Sürdürülebilir Kalkınma, Evrensel Sağlık Kapsayıcılığı, Kümeleme Analizi.*

JEL Kodu: *I14 , I15*

1. INTRODUCTION

Although underdeveloped countries, particularly those hit by the debt crisis after the 1980s, have tried to compensate for inadequate resources allocated to health through privatization and out-of-pocket spending, the COVID-19 pandemic has demonstrated the importance of strengthening health systems (Civil Society Engagement Mechanism, 2021). Naturally, Universal Health Coverage (UHC), which ensures that all people receive the health services they need equally and with adequate quality and that the use of these services does not expose the user to financial hardship, has become a priority goal of health reform for both the World Health Organization (WHO) and many countries (WHO, 2025; Gabani et al., 2023; Zhou et al., 2024). Evidence suggests that health systems relying less on public and direct taxes and more on private payments are more

vulnerable to catastrophic health expenditure and that inequalities in health expenditure experienced by financially vulnerable populations pose significant challenges to achieving UHC (Shaltynov et al., 2024). This underscores the significance of economic, political and social measures to remove barriers to achieving UHC. However, government-funded social protection systems may also exhibit undesirable features, such as limited or uniform coverage of health services, especially in less developed countries (Gabani et al., 2023). To achieve UHC, it is crucial to incorporate different types and levels of health services and financial support in national health systems and social protection policies to meet the health needs of households and strengthen primary health care (Okamato et al., 2024; Zhou et al., 2024). Although there are differences in implementation, the goal is to improve insurance coverage globally and remove barriers to individuals' exposure to financial risks.

The objectives of this study and the questions it seeks to answer are as follows: To perform an analysis in terms of the sub-indicators of the Universal Health Coverage target, to identify countries that are similar to Turkey in terms of indicators such as Population with household expenditure on health > 10% of total household expenditure or income (%), Population with household expenditure on health > 25% of total household expenditure or income (%), UHC: Service coverage index, Health expenditure as a percentage of GDP (%), Out-of-pocket expenditure as a percentage of GDP (%), Out-of-pocket expenditure as a percentage of health expenditure (%). This also makes it possible to identify which countries have difficulties in accessing health services. The main contribution of this study to the literature is that it provides an evaluation in terms of universal health coverage indicators, and it is noted that health and social welfare criteria are mostly examined in cluster analysis studies in the health sector. In this respect, it differs from other studies. To determine Türkiye's relative position in the light of global efforts, this study aims to analyze the current situation of OECD countries in terms of the sub-targets of UHC, the similarities between countries, and Türkiye's similarities and differences with other countries. For this purpose, hierarchical and non-hierarchical cluster analysis was conducted using the Orange package program.

This article is structured as follows. First, the conceptual framework of sustainable development, sustainable

development goals and SDG 3 are presented. Then, a literature review is conducted, cluster analysis is introduced, and data and methodology are explained. Finally, the results of the cluster analysis of the data on the sub-goals of the OECD countries identified for SDG3 and the conclusions of the study are presented.

2. SUSTAINABLE DEVELOPMENT AND SUSTAINABLE DEVELOPMENT GOALS

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs in "Our Common Future", also known as the "Brundtland Report", published by the World Commission on Environment and Development in 1987 (WCED, 1987). Looking at the steps taken globally for sustainable development, the adoption of the Rio Declaration on Environment and Development (Agenda 21) and the Paris Agreement, the most important agreement on climate change, in 1992 (Sachs, 2015) and the United Nations Conference on Sustainable Development (Rio+20) held in 2012, 10 years after this conference, are very important milestones for the realization of sustainable development goals (United Nations, 2012). The aim of the Rio+20 conference was to negotiate a new set of global sustainable development goals (SDGs) that would chart the course for sustainable development in the world after 2015 (Osborn et al., 2015). Indeed, the United Nations Millennium Development Goals, shared goals to be achieved by 2015, and subsequent initiatives, such as the 2030 Agenda for Sustainable Development, have played a crucial role in the global agenda (Mishra et al., 2024).

The 2030 Agenda for Sustainable Development is recognized as a global call to action. With the United Nations 2030 Agenda, 17 sustainable development goals and 169 targets related to these goals have been set to end poverty, reduce inequality, and create a more prosperous society (United

Nations, 2015). The Sustainable Development Goals are shown in Figure 1.

Figure 1: Sustainable Development Goals

Source: (United Nations, 2025).

The Sustainable Development Goals consist of universal, indivisible, and interrelated goals covering the period from January 1, 2016 to December 31, 2030 (Sachs, 2015). These 17 interconnected goals represent a holistic approach to global development, and the importance of the cooperation of all segments of society, technology, financial inclusion, and continuous monitoring for the realization of the goals are stated as the main theoretical findings of the Sustainable Development Goals (Mishra et al., 2024).

To ensure the cooperation of all segments and enhance the functionality of the Sustainable Development Goals, Sachs et al. (2019) proposed transformations in six areas. These areas include: (1) education, gender, and inequality; (2) health, well-being, and demography; (3) energy decarbonization and sustainable industry; (4) sustainable food, land, water, and oceans; (5) sustainable cities and communities; and (6) the digital revolution for sustainable development. Implementing these six transformational areas requires meeting technical

standards, combining public and private financing, developing and deploying new technologies, ensuring policy coherence, providing market incentives and regulations, and engaging civil society.

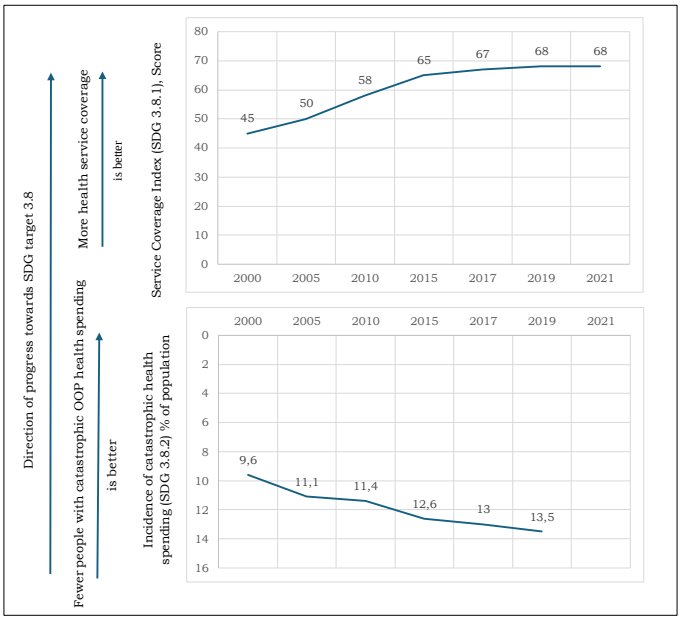
2.1. SDG3: Good Health and Well-Being

Health is one of the most fundamental human rights and a sustainable development goal contributing to social inclusion, equality, poverty eradication, economic growth and human dignity beyond health and well-being (Hoang-Vu Eozenou, et al., 2023). Health and quality of life is the third sustainable development goal, and the provision of equitable and affordable health services for all is one of the highest priority targets under this goal. The main reason for this is that catastrophic health expenditure impoverishes individuals and is one of the barriers to achieving sustainable development goals. According to WHO, out-of-pocket health expenditure will push 344 million people into extreme poverty and 1.3 billion people into relative poverty in 2019 (WHO, 2024a).

SDG3.8 is one of the most critical levers of SDG3, as it aims to achieve UHC or access to health services for all at the lowest cost and advocates for equity in accessing quality health services nationally and internationally (Cerf, 2019). SDG3.8 has two main sub-indicators. SDG3.8.1, the service coverage index, is calculated as the geometric mean of 14 indicators focused on four health service areas: a) family planning, b) communicable diseases, c) noncommunicable diseases, and d) service capacity and access (United Nations, 2023). SDG3.8.2 aims to prevent financial hardship due to out-of-pocket health expenditures. Financial hardship occurs when out-of-pocket health expenditures threaten people's standard of living or impede access to other basic needs, such as food, shelter, clothing, or education (WHO & World Bank, 2023). Every year, millions of people, mostly in low-income countries, are pushed into poverty as a result of excessive or catastrophic spending on health care. With households spending more than 40% of their income on health-related expenses, known as catastrophic health spending, protecting against this spending is a top priority for SDG3 (Chapman, 2016). SDG3.8.2 has two indicators. These

indicators are: Population with household expenditure on health> 10% of total household expenditure or income (%), Population with household expenditure on health> 25% of total household expenditure or income (%). For SDGs 3.8.1 and 3.8.2, global data for 2000-2021 on progress in coverage (SDG 3.8.1) and catastrophic out-of-pocket health expenditure (SDG 3.8.2) are presented in Chart 1.

Chart 1. Progress in service coverage (SDG3.8.1) and catastrophic OOP health spending (SDG3.8.2, 10% threshold), 2000-2021

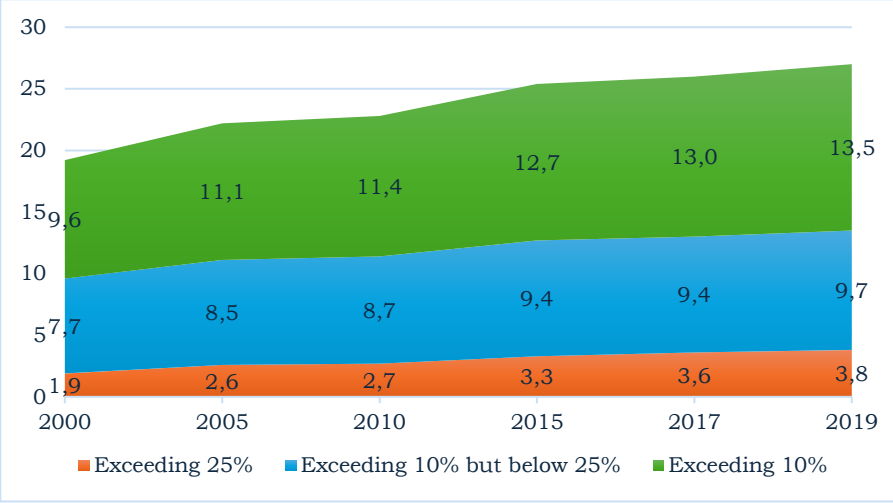


Source: (World Health Organization & The World Bank, 2023).

Chart 1 shows SDG3.8.1 and SDG3.8.2 in an integrated manner. The increase in SDG3.8.1, which monitors the service coverage index, is an indicator of increased coverage of health services. The global average of the service coverage index in the upper part of Chart 1 shows an increase between 2000 and 2021. SDG3.8.2 at the bottom of the graph indicates that the population exposed to catastrophic health expenditure should be reduced, and the global average shows that the population exposed to financial catastrophe due to out-of-pocket health expenditure has increased between 2000 and 2021.

In the global reporting of SDG3.8.2, two thresholds are used to determine household expenditure on health as a proportion of total household consumption or income: a lower threshold of 10% and an upper threshold of 25%. Using these two thresholds, financial hardship in health is measured by the corresponding indicator (WHO, 2024a). Chart 2 shows the proportion of the population with out-of-pocket health expenditure exceeding 10% or 25% of the household budget and the proportion of the population exceeding 10% but below 25% for 2000-2021 globally.

Chart 2. Proportion of the population with out-of-pocket health spending exceeding 10% or 25% of the household budget



Source: (WHO, 2024b).

The proportion of the population whose out-of-pocket health expenditure exceeds 10% or 25% of their household budget is gradually increasing. The graph also shows the proportion of the population whose out-of-pocket health expenditure is above 10% but below 25%. This group is also increasing in parallel with the other two thresholds. The global outlook for SDG3.8 is analyzed by region in Table 1.

Table 1. SDG3.8. Health and Quality Life

Areas	SDG 3.8.		
	3.8.1	3.8.2	
	UHC Service Coverage Index	Population with household expenditures on health> 10% of total household expenditure or income (%)	Population with household expenditures on health> 25% of total household expenditure or income (%)
	2021	2019	2019
African Region	44	8,6	2,6
Region of the Americas	80	7,8	1,5
South-East Asia Region	62	16,1	5,9
European Region	81	7,9	1,3
Eastern Mediterranean Region	57	12,1	2,2
Western Pacific Region	79	19,8	5,3
Global	**68**	**13,5**	**3,8**

Source: (WHO, 2024c).

UHC is highest in Europe (81), the Americas (80), and the Western Pacific (79), as measured by the service coverage index. Empirical evidence shows that a high service coverage index of UHC mitigates the health effects of COVID-19 in Southeast Asia and the Western Pacific Region (Saengtabtim et al., 2023).

With an index value of 44 in 2021, Africa is a region with inadequate health insurance coverage. Academic studies also support this situation. In fact, Kipo-Sunyehzi (2024) examined the policy strategies of four African countries (Rwanda, Tanzania, South Africa, and Ghana) to achieve UHC and found that less than 50% of the population in Rwanda and Ghana are not covered by health insurance and that four African countries spend less than 10% of their GDP on health. With these indicators, it will take some more time to achieve the goal of UHC in Africa by 2030.

The regions with the highest proportion (%) of the population spending more than 10% of total household expenditure or income on health are Western Pacific (19.8%), Southeast Asia (16.1%) and Eastern Mediterranean (12.1%).

The regions with the highest percentage of the population spending more than 25% of total household expenditure or income on out-of-pocket health care are Southeast Asia (5.9%) and Western Pacific (5.3%).

3. LITERATURE REVIEW

In the studies on universal health coverage, health expenditure and health systems are analysed using the cluster analysis method; in the study conducted by Çetintürk & Gençtürk (2020), cluster analysis was used to identify similar OECD countries according to the types of expenditures and to determine Türkiye's place among the OECD countries. 14 different expenditure variables used by 36 OECD countries for health services between 2003 and 2017 were analyzed using the Ward method. Countries were clustered according to their health expenditure types. Estonia, Latvia, Mexico, Czech Republic, Luxembourg, Belgium and Australia were identified as the countries with which Türkiye had the most similarities in different types of health expenditure. The study shows that Türkiye lags behind developed countries in health expenditure and clustering with countries with relatively low health expenditure.

In Demircioğlu & Eşiyok's (2020) study, health data from 36 OECD and EU member countries were evaluated, countries with similarities were identified, and Türkiye's place in these countries was tried to be determined. The K-means method, one of the clustering algorithms, was used to analyze the data. As a result, the countries were divided into binary, triple and quadruple clusters.

Gabani et al. (2023) examined the impact of health financing systems on health system outcomes using the clustering method including variables related to UHC and found that countries' social security systems perform better when the informal sector is smaller, GDP per capita is higher, corruption control is higher, and labor force reductions are lower.

Wagstaff & Neelsen (2020) measured the progress of 111 countries towards UHC using an index based on eight services and found that most countries increased their UHC index. However, the increases in the index did not necessarily coincide

with improvements in financial protection. The study emphasized that this is a possible trade-off between the two dimensions of UHC and that progress towards UHC requires improvements in financial protection and service coverage.

In the study of Özen (2024), 11 health provinces selected to classify the provinces in Türkiye based on health indicators were clustered according to the health structures of 81 provinces using hierarchical and non-hierarchical clustering methods. The results of the analysis performed with the "Ward Method and Squared Euclidean" distance, which is one of the hierarchical clustering methods, show which provinces have similar characteristics in terms of health indicators and which provinces are in a better/worse situation in terms of the health indicators considered.

The study by Köse (2022) determined how 36 OECD countries were grouped in 2019 according to the k-means clustering method in terms of selected indicators related to health workforce, health status, and health sector resources. In countries with high levels of wealth, such as Norway and Sweden, the health care quality is improving and access to health services is increasing as investments in health are prioritized.

Çuhadar & Altin (2023) examined the socioeconomic data of OECD countries during the COVID-19 period using cluster analysis. According to the data used in the study and the results of the cluster analysis, it was observed that Türkiye was in the same group as the countries that were at the bottom of the OECD countries in terms of education and health expenditure.

An analysis of studies on universal health coverage shows that studies have been conducted to investigate how to ensure progress by 2030 on the sub-criteria of this goal (Hogan et al., 2018; Rahman et al., 2018). This study differs from other studies in that it aims to identify countries that are similar to Türkiye in terms of the level of achievement of the sub-targets set for the goal of UHC (SDG3.8).

4. METHOD: CLUSTER ANALYSIS

Cluster analysis is defined as a multivariate statistical analysis technique that allows the researcher to find similar groups in any data set under study and divide them into clusters that are identical but different from others (Dalmaijer, 2022; Gnanadesikan, 2011). Cluster analysis is a common data mining technique that aims to classify n of units or entities into homogeneous and heterogeneous clusters according to the determined characteristics of p variables (Lund & Ma, 2021). Two methods, hierarchical and non-hierarchical clustering, are used in the analysis, and the clustering analysis consists of the steps shown in Figure-2.

Figure 2. Stages of cluster analysis

Source: Created by the author.

Although data standardization is the first step in clustering analysis, original values can also be used (Altun Ada, 2011). The distance or similarity between the data is determined using different distance values, such as Euclidean, Manhattan, and Minkowski. Euclidean distance method is used to understand the closeness or distance between data points. This distance calculation calculates the shortest distance between n-dimensional points (Yılmaz et al., 2023:3). The Manhattan distance value is obtained as the absolute value of the differences of the points. The Minkowski distance value is obtained by generalizing the Euclidean distance and the Manhattan distances (Yılmaz et al., 2023:3). The number of clusters is determined using hierarchical and non-hierarchical clustering methods.

The classification of the OECD countries included in the study in terms of SDG3.8 indicators was carried out using cluster analysis, one of the multivariate statistical methods. The Orange package was used for the analysis. This program is a Python-based tool for data visualization and data mining. In this study, the research material consists of secondary data on UHC

indicators obtained from the WHO database. The variables, the years to which the variables belong and the sources from which the data were obtained are presented in Table-2.

Table 2. Variables and Sources

Variable	Explanations	Year	Source
X1	Population with household expenditures on health> 10% of total household expenditure or income (%)	2019	https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4844
X2	Population with household expenditures on health> 25% of total household expenditure or income (%)	2019	https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4844
X3	UHC: Service coverage index	2021	https://www.who.int/data/gho/data/themes/topics/service-coverage
X4	Health spending percentage of gdp (%)	2021	https://www.who.int/data/gho/data/indicators
X5	Out of pocket percentage of gdp %	2021	https://www.who.int/data/gho/data/themes/topics/financial-protection
X6	Out of pocket percentage of health expenditure (%)	2021	https://www.who.int/data/gho/data/themes/topics/financial-protection

The summary statistics for the parameters listed in Table 2 are presented in Table 3.

Table 3. Summary Stats

Variable	Mean	Mode	Median	Dispersion	Min.	Max
X1	8,306	4,3	7,2	0,601	1,5	21,4
X2	1,303	0,7	0,9	0,867	0,00	5,7
X3	83,235	82,0	84,0	0,051	74,5	91,0
X4	9,55088	4,565	9,431	0,25797	4,565	17,363
X5	1,77218	0,505	1,61	0,36497	0,505	3,228
X6	19,1675	8,906	17,0635	0,39588	8,906	41,371

According to summary statistics; the variable X3 (mean 83.235, dispersion 0.051) is almost constant. This means that the values of this variable are very close to each other. Variables X2 and X6 have a wider distribution and there are large differences between the values of these variables. Variables X1 and X4 show a medium degree of variability.

4.1. Results of Analysis

The Orange program calculates the distances between rows or columns in a data set to find the distance matrix. The data are normalized to ensure that data features are treated equally in the matrix. The normalization is performed on a column-by-column basis. The distance matrix allows only a two-dimensional comparison between variables. It does not perform hierarchical clustering as in a dendrogram (Aytaç, 2021). The distance matrix obtained based on Euclidean distance is given in Table-4.

Table 4. Distance Matrix

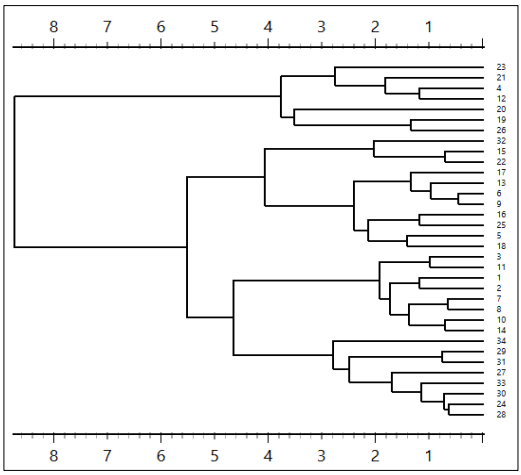
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1		1.174	1.131	2.557	1.817	1.657	1.193	1.029	1.938	0.969	1.218	3.251	2.296	1.525	2.337	2.406	1.693	1.968	2.882	4.739	3.320	2.935	3.807	1.919	3.143	3.726	2.413	2.249	2.224	2.182	2.465	3.673	2.434	2.868
2	1.174		1.595	1.781	1.626	1.504	1.543	1.733	1.680	1.082	2.001	2.622	1.820	1.457	2.444	1.632	1.326	1.615	2.174	3.950	2.806	3.078	3.727	2.077	2.459	2.915	2.667	2.511	2.064	2.338	2.415	3.737	2.753	3.178
3	1.131	1.595		3.116	2.457	2.323	1.548	1.669	2.667	1.283	0.976	3.966	2.960	1.293	2.589	2.581	2.133	2.210	2.913	5.268	4.015	3.073	4.490	1.854	3.452	3.830	2.765	2.355	2.408	2.234	2.598	4.140	2.246	2.828
4	2.557	1.781	3.116		2.545	2.105	2.937	3.048	1.972	2.449	3.471	1.185	1.767	2.817	3.533	2.055	1.794	2.786	1.693	3.043	1.874	4.095	2.835	3.205	2.618	2.170	3.264	3.532	2.468	3.352	2.739	4.127	3.797	4.161
5	1.817	1.626	2.457	2.545		1.139	1.289	1.484	1.225	1.572	2.487	3.068	1.734	1.899	1.698	1.625	1.772	1.404	2.950	3.667	2.526	2.338	3.525	2.195	2.095	3.732	2.379	2.287	2.516	2.372	3.127	2.723	2.946	3.550
6	1.657	1.504	2.323	2.105	1.139		1.218	1.446	0.452	1.237	2.360	2.598	1.016	1.665	1.582	1.594	1.211	1.889	2.603	3.980	2.287	2.196	2.800	1.943	1.988	3.551	1.802	2.079	2.152	2.287	2.662	2.521	2.845	3.702
7	1.193	1.543	1.548	2.937	1.289	1.218		0.639	1.558	0.763	1.413	3.544	2.010	1.040	1.186	1.970	1.610	1.533	3.047	4.702	3.235	1.807	3.759	1.353	2.500	3.991	1.817	1.551	2.199	1.771	2.659	2.769	2.196	3.082
8	1.029	1.733	1.669	3.048	1.484	1.446	0.639		1.701	0.968	1.250	3.538	2.151	1.431	1.528	2.360	1.722	1.693	3.267	4.814	3.261	2.078	3.687	1.486	2.817	4.128	1.783	1.562	2.191	1.726	2.565	2.825	2.106	2.803
9	1.938	1.680	2.667	1.972	1.225	0.452	1.558	1.701		1.505	2.644	2.289	0.675	1.934	1.768	1.574	1.180	1.922	2.564	3.676	1.893	2.331	2.516	2.099	1.777	3.407	1.806	2.171	2.100	2.340	2.622	2.375	2.948	3.738
10	0.969	1.082	1.283	2.449	1.572	1.237	0.763	0.968	1.505		1.258	3.078	1.762	0.696	1.655	1.712	1.050	1.418	2.469	4.468	2.961	2.212	3.526	1.121	2.339	3.368	1.752	1.527	1.624	1.521	2.016	3.019	1.930	2.751
11	1.218	2.001	0.976	3.471	2.487	2.360	1.413	1.250	2.644	1.258		4.083	2.936	1.360	2.303	2.815	2.113	2.102	3.294	5.455	4.002	2.686	4.345	1.430	3.437	4.125	2.262	1.760	2.185	1.676	2.319	3.682	1.631	2.253
12	3.251	2.622	3.966	1.185	3.068	2.598	3.544	3.538	2.289	3.078	4.083		1.878	3.495	3.926	2.666	2.222	3.250	2.371	2.884	1.462	4.407	2.395	3.642	2.751	2.426	3.398	3.820	2.709	3.647	2.883	4.048	4.149	4.409
13	2.296	1.820	2.960	1.767	1.734	1.016	2.010	2.151	0.675	1.762	2.936	1.878		2.128	2.107	1.576	1.121	2.076	2.401	3.514	1.652	2.590	2.378	2.239	1.518	3.090	1.924	2.334	1.986	2.426	2.438	2.504	3.059	3.802
14	1.525	1.457	1.293	2.817	1.899	1.665	1.040	1.431	1.934	0.696	1.360	3.495	2.128		1.630	1.637	1.352	1.431	2.452	4.652	3.284	2.065	3.881	0.873	2.290	3.387	1.869	1.422	1.678	1.408	2.104	3.089	1.731	2.762
15	2.337	2.444	2.589	3.533	1.698	1.582	1.186	1.528	1.768	1.655	2.303	3.926	2.107	1.630		2.165	2.070	1.905	3.546	4.884	3.359	0.708	3.806	1.558	2.177	4.448	1.589	1.421	2.556	1.944	3.076	1.899	2.478	3.619
16	2.406	1.632	2.581	2.055	1.625	1.594	1.970	2.360	1.574	1.712	2.815	2.666	1.576	1.637	2.165		1.311	1.431	1.719	3.178	2.169	2.615	3.345	1.992	1.181	2.530	2.390	2.297	1.867	2.197	2.529	2.964	2.733	3.515
17	1.693	1.326	2.133	1.794	1.772	1.211	1.610	1.722	1.180	1.050	2.113	2.222	1.121	1.352	2.070	1.311		1.570	1.785	3.746	2.063	2.537	2.742	1.454	1.772	2.604	1.617	1.747	1.028	1.628	1.535	2.804	2.140	2.905
18	1.968	1.615	2.210	2.786	1.404	1.889	1.533	1.693	1.922	1.418	2.102	3.250	2.076	1.431	1.905	1.431	1.570		2.623	3.741	2.787	2.369	3.952	1.545	1.851	3.166	2.279	1.754	1.819	1.487	2.405	2.941	2.050	2.500
19	2.882	2.174	2.913	1.693	2.950	2.603	3.047	3.267	2.564	2.469	3.294	2.371	2.401	2.452	3.546	1.719	1.785	2.623		3.289	2.384	3.947	3.243	2.747	2.478	1.328	3.101	3.164	1.874	2.858	2.206	4.123	3.108	3.645
20	4.739	3.950	5.268	3.043	3.667	3.980	4.702	4.814	3.676	4.468	5.455	2.884	3.514	4.652	4.884	3.178	3.746	3.741	3.289		2.283	5.292	4.039	4.806	3.193	2.944	4.809	4.922	4.017	4.659	4.513	4.755	5.172	5.248
21	3.320	2.806	4.015	1.874	2.526	2.287	3.235	3.261	1.893	2.961	4.002	1.462	1.652	3.284	3.359	2.169	2.063	2.787	2.384	2.283		3.747	1.935	3.269	2.050	2.665	2.861	3.296	2.460	3.200	2.926	3.064	3.758	4.197
22	2.935	3.078	3.073	4.095	2.338	2.196	1.807	2.078	2.331	2.212	2.686	4.407	2.590	2.065	0.708	2.615	2.537	2.369	3.947	5.292	3.747		4.055	1.776	2.439	4.828	1.659	1.481	2.831	2.101	3.317	1.678	2.558	3.822
23	3.807	3.727	4.490	2.835	3.525	2.800	3.759	3.687	2.516	3.526	4.345	2.395	2.378	3.881	3.806	3.345	2.742	3.952	3.243	4.039	1.935	4.055		3.706	3.232	3.839	2.797	3.628	3.024	3.742	3.262	3.157	4.138	4.829
24	1.919	2.077	1.854	3.205	2.195	1.943	1.353	1.486	2.099	1.121	1.430	3.642	2.239	0.873	1.558	1.992	1.454	1.545	2.747	4.806	3.269	1.776	3.706		2.306	3.570	1.289	0.623	1.367	0.676	1.772	2.623	1.065	2.357
25	3.143	2.459	3.452	2.618	2.095	1.988	2.500	2.817	1.777	2.339	3.437	2.751	1.518	2.290	2.177	1.181	1.772	1.851	2.478	3.193	2.050	2.439	3.232	2.306		2.971	2.324	2.369	2.175	2.383	2.789	2.375	3.040	3.859
26	3.726	2.915	3.830	2.170	3.732	3.551	3.991	4.128	3.407	3.368	4.125	2.426	3.090	3.387	4.448	2.530	2.604	3.166	1.328	2.944	2.665	4.828	3.839	3.570	2.971		3.943	3.939	2.459	3.487	2.608	4.840	3.739	3.859
27	2.413	2.667	2.765	3.264	2.379	1.802	1.817	1.783	1.806	1.752	2.262	3.398	1.924	1.869	1.589	2.390	1.617	2.279	3.101	4.809	2.861	1.659	2.797	1.289	2.324	3.943		0.978	1.676	1.439	2.039	1.745	1.865	3.080
28	2.249	2.511	2.355	3.532	2.287	2.079	1.551	1.562	2.171	1.527	1.760	3.820	2.334	1.422	1.421	2.297	1.747	1.754	3.164	4.922	3.296	1.481	3.628	0.623	2.369	3.939	0.978		1.615	0.706	2.018	2.159	1.162	2.457
29	2.224	2.064	2.408	2.468	2.516	2.152	2.199	2.191	2.100	1.624	2.185	2.709	1.986	1.678	2.556	1.867	1.028	1.819	1.874	4.017	2.460	2.831	3.024	1.367	2.175	2.459	1.676	1.615		1.217	0.756	3.010	1.531	2.256
30	2.182	2.338	2.234	3.352	2.372	2.287	1.771	1.726	2.340	1.521	1.676	3.647	2.426	1.408	1.944	2.197	1.628	1.487	2.858	4.659	3.200	2.101	3.742	0.676	2.383	3.487	1.439	0.706	1.217		1.604	2.648	0.739	1.852
31	2.465	2.415	2.598	2.739	3.127	2.662	2.659	2.565	2.622	2.016	2.319	2.883	2.438	2.104	3.076	2.529	1.535	2.405	2.206	4.513	2.926	3.317	3.262	1.772	2.789	2.608	2.039	2.018	0.756	1.604		3.520	1.701	2.199
32	3.673	3.737	4.140	4.127	2.723	2.521	2.769	2.825	2.375	3.019	3.682	4.048	2.504	3.089	1.899	2.964	2.804	2.941	4.123	4.755	3.064	1.678	3.157	2.623	2.375	4.840	1.745	2.159	3.010	2.648	3.520		3.184	4.256
33	2.434	2.753	2.246	3.797	2.946	2.845	2.196	2.106	2.948	1.930	1.631	4.149	3.059	1.731	2.478	2.733	2.140	2.050	3.108	5.172	3.758	2.558	4.138	1.065	3.040	3.739	1.865	1.162	1.531	0.739	1.701	3.184		1.566
34	2.868	3.178	2.828	4.161	3.550	3.702	3.082	2.803	3.738	2.751	2.253	4.409	3.802	2.762	3.619	3.515	2.905	2.500	3.645	5.248	4.197	3.822	4.829	2.357	3.859	3.859	3.080	2.457	2.256	1.852	2.199	4.256	1.566	

According to the distance matrix, the countries with the lowest correspondence are 28 (Slovenia) and 24 (Norway), 24 (Norway) and 27 (Slovakia), 24 (Norway) and 30 (Sweden). The countries with the highest agreement are 20 (Latvia) and 11 (Germany), 20 (Latvia) and 3 (Canada).

4.1.1. Hierarchical Cluster Analysis

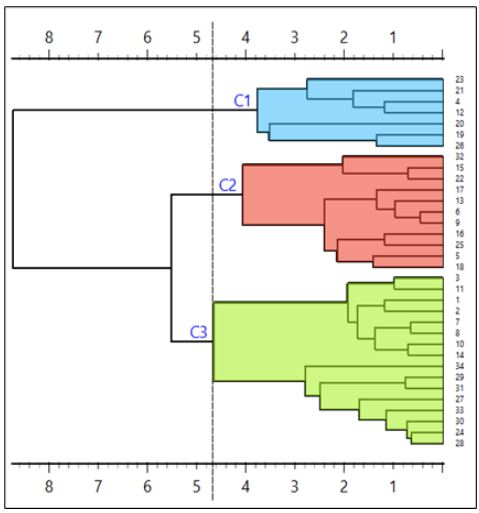
Hierarchical clustering analysis was performed using Ward's linkage method, which employs dendrograms that are grouped in a nested pattern. Dendrograms can be used to comment on the closeness or similarity of data between clusters (MathWorks.com). Figure-3 shows the dendogram generated by Ward's method.

Figure 3. Hierarchical clustering (Dendogram of Ward's Method)



The dendogram shows the order in which the graphical clusters are combined. It is therefore interpreted by examining the height at which the objects that make up the dendogram are brought together. The similarity between countries 28 and 24, 31 and 29, 10 and 14, 8 and 7, 2 and 1, 11 and 3 is strong; the similarity between countries 18 and 5, 25 and 16, 9 and 6, 22 and 15 is high; 26 and 19, 12 and 4 are also highly similar. The clusters related to the dendogram by Ward method are given in Figure 4.

Figure 4. Dendogram and cluster numbers of Ward's Method



The number of clusters obtained using the dendogram chart was determined as three according to the non-progressive clustering method. X1: Population whose household health expenditure is more than 10% of total household expenditure or income (%), X2: Population whose household health expenditure is more than 25% of total household expenditure or income (%), X3: UHC: service coverage index, X4: Health expenditure as a percentage of GDP (%), X5: Out-of-pocket expenditure as a percentage of GDP (%), X6: Clusters obtained from data of out-of-pocket expenditure as a percentage of health expenditure (%) are shared in Table-5.

Table 5. Clusters According to Wards's Method

	Countries	Cluster	X1	X2	X3	X4	X5	X6
1	AUT	C3	4.3	0.7	84.5	12.096	1.909	15.779
2	BEL	C3	11.4	1.4	85.6	11.043	1.972	17.856
3	CAN	C3	3.5	0.8	91.0	12.334	1.730	14.023
4	CHL	C1	14.6	2.1	82.3	9.343	2.828	30.266
5	COL	C2	8.2	2.2	79.6	9.018	1.233	13.670
6	CRI	C2	7.4	1.1	81.1	7.569	1.570	20.742
7	CZE	C3	4.6	0.8	84.2	9.489	1.208	12.726
8	DNK	C3	2.9	0.5	82.0	10.824	1.364	12.598
9	EST	C2	8.8	1.2	79.3	7.491	1.653	22.074
10	FIN	C3	6.7	0.7	85.7	10.250	1.650	16.101
11	DEU	C3	1.5	0.1	88.0	12.934	1.558	12.044
12	GRC	C1	16.9	1.6	77.2	9.173	3.057	33.330
13	HUN	C2	12.3	0.9	79.5	7.376	1.817	24.640
14	ISL	C3	7.0	0.9	88.9	9.734	1.426	14.647
15	IRL	C2	5.6	0.5	82.7	6.717	0.718	10.688
16	ISR	C2	12.8	2.6	85.5	7.905	1.565	19.799
17	ITA	C2	9.3	1.1	83.8	9.384	2.055	21.894
18	JPN	C2	11.1	2.0	83.5	11.299	1.256	11.114
19	KOR	C1	12.0	2.9	89.1	9.331	2.715	29.099
20	LVA	C1	21.4	5.7	74.6	9.045	2.441	26.982
21	LTU	C1	12.9	2.7	75.3	7.823	2.359	30.158
22	LUX	C2	4.3	0.2	83.1	5.668	0.505	8.906
23	MEX	C1	4.4	1.2	74.5	6.079	2.515	41.371
24	NOR	C3	5.1	0.5	87.0	9.919	1.394	14.055
25	POL	C2	16.1	2.0	82.0	6.439	1.278	19.847
26	PRT	C1	18.4	3.3	87.9	11.137	3.228	28.988
27	SVK	C3	2.7	0.0	81.8	7.751	1.504	19.404
28	SVN	C3	3.7	0.3	84.4	9.478	1.222	12.897
29	ESP	C3	7.9	1.1	85.3	10.740	2.255	20.997
30	SWE	C3	5.5	0.7	85.2	11.247	1.472	13.085
31	CHE	C3	7.9	0.3	86.3	11.801	2.628	22.265
32	TUR	C2	4.2	0.7	75.6	4.565	0.743	16.271
33	GBR	C3	2.4	0.6	87.8	12.365	1.568	12.678
34	USA	C3	4.6	0.9	85.7	17.363	1.858	10.700

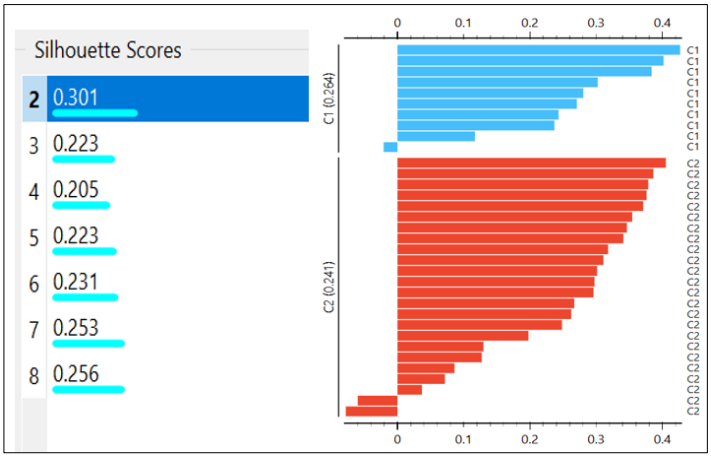
Countries in Cluster C1 are Chile, Greece, Korea, Latvia, Lithuania, Mexico, and Portugal. Countries in Cluster C2 are

Colombia, Costa Rica, Estonia, Hungary, Ireland, Israel, Italy, Japan, Luxembourg, Poland, and Türkiye. Countries in Cluster C3 are Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, Germany, Iceland, Norway, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

4.1.2. Non-Hierarchical Cluster Analysis

The data of the countries included in the analysis are clustered using the K-means method. The clustering is done using the silhouette method created in the orange program. The silhouette method was first introduced by Rousseeuw in 1987 and uses the average dissimilarity of the object to all other objects in the cluster. The silhouette value ranges from -1 to 1. The closer the value is to 1, the closer the relationship between the object and the cluster (Prabaswara et al., 2024). In other words, this value indicates how a data point belongs to a cluster; if the value is close to 1, the data point fits into that cluster. The number of clusters can be determined using the average silhouette coefficient in K-means. When the silhouette score is examined according to the K-means method, it is suggested that the OECD member countries should be classified into two clusters in terms of UHC indicators with a score of 0.301, as shown in Chart 5.

Chart 5. Silhouette Plot Graph



Using the K-means method, it can be seen that the OECD member countries consist of two clusters according to the silhoutte value in terms of UHC indicators, and the clusters and silhoutte values are presented in Table-6.

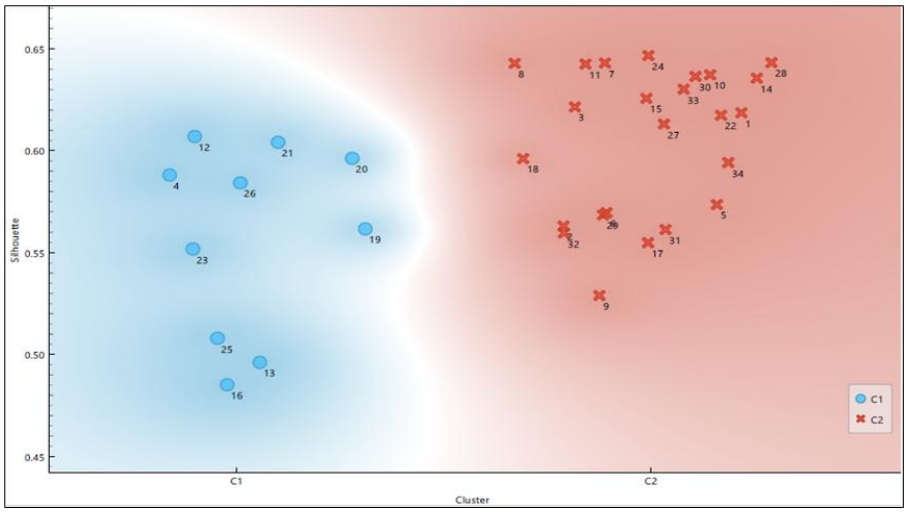
Table 6. Clusters & Silhoutte values according to the K-means method

Country Code	Countries	Cluster	Silhouette Scores
1	AUT	C2	0.618600
2	BEL	C2	0.563014
3	CAN	C2	0.621514
4	CHL	C1	0.588072
5	COL	C2	0.573593
6	CRI	C2	0.569595
7	CZE	C2	0.643055
8	DNK	C2	0.642913
9	EST	C2	0.528956
10	FIN	C2	0.637282
11	DEU	C2	0.642543
12	GRC	C1	0.606977
13	HUN	C1	0.496132
14	ISL	C2	0.635598
15	IRL	C2	0.625695
16	ISR	C1	**0.485164**
17	ITA	C2	0.554857
18	JPN	C2	0.596122
19	KOR	C1	0.561636
20	LVA	C1	0.596244
21	LTU	C1	0.604156
22	LUX	C2	0.617410
23	MEX	C1	0.551776
24	NOR	C2	0.646715
25	POL	C1	**0.507996**
26	PRT	C1	0.584231
27	SVK	C2	0.613114
28	SVN	C2	0.643233
29	ESP	C2	0.568497
30	SWE	C2	0.636482
31	CHE	C2	0.561317
32	TUR	C2	0.559640
33	GBR	C2	0.630219
34	USA	C2	0.594202

Comparing the data of the two clusters formed according to the silhouette score, the countries in cluster C1 have values above 0.49, and Israel differs from other countries as it has a value below this score. However, it is included in Cluster C1. The silhouette score of the countries in Cluster C2 is above approximately 0.56. Therefore, Estonia and Italy are included in cluster C2, although they are negatively differentiated from other countries as they have values below 0.56. The two clusters

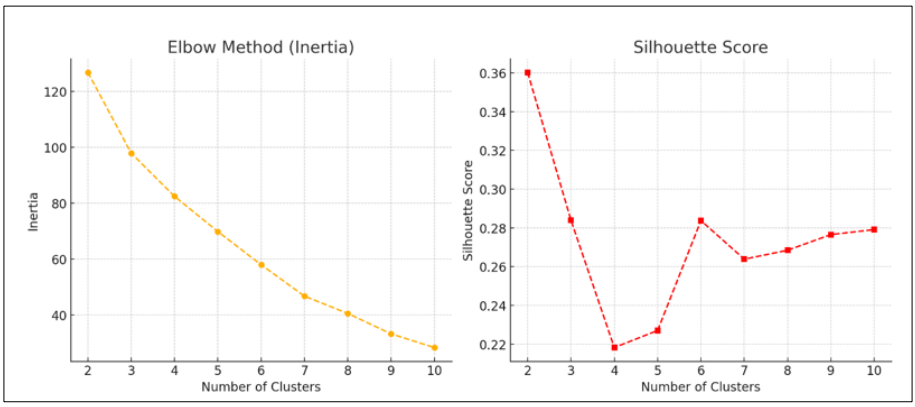
formed according to the Silhouette score are shown in the Chart-6.

Chart 6. Cluster Analysis Results



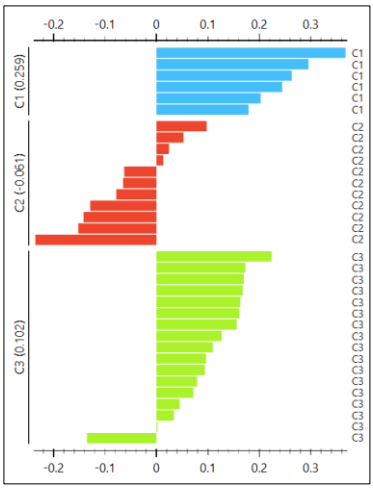
As the formation of three clusters according to the Silhoutte value provides a more homogeneous view, OECD member countries are also considered to form three clusters in terms of universal health coverage indicators. Various metrics such as the Elbow Method and Silhouette Score were used to determine the optimal number of clusters. The elbow method is a method that looks at the percentage of variance explained as a function of the number of clusters (Bholowalia & Kumar, 2014). The scores for the three clusters are shown in Chart 7.

Chart 7. Elbow Method and Silhouette Score



According to the elbow method, the significant break point of the curve indicates 2 or 3 clusters. According to Silhouette Score, 2 clusters are highest, but 3 clusters are also high. In line with these results, it is determined that the most logical approach is to divide the OECD countries into 3 different groups. The details of Silhouette Score are given in Chart 8.

Chart 8. Silhoutte Score



The three clusters formed by the K-means method according to the silhoutte value in terms of UHC indicators of OECD member countries are presented in Table-7.

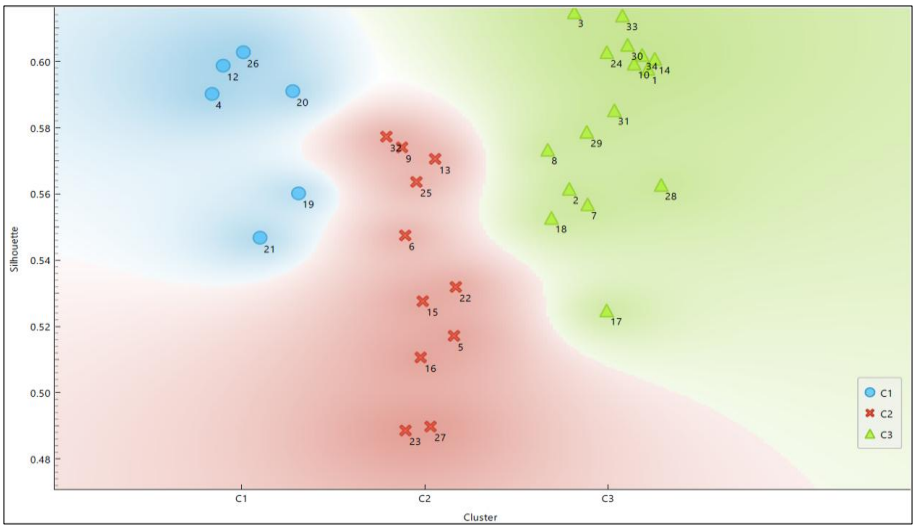
Table 7. Clusters & Silhoutte values according to the K-means method

Country Code	Countries	Cluster	Silhouette Scores
1	AUT	C3	0.597679
2	BEL	C3	0.561461
3	CAN	C3	0.614725
4	CHL	C1	0.590116
5	COL	C2	**0.517129**
6	CRI	C2	0.547421
7	CZE	C3	0.556771
8	DNK	C3	0.573260
9	EST	C2	0.573993
10	FIN	C3	0.599232
11	DEU	C3	0.626648
12	GRC	C1	0.598637
13	HUN	C2	0.570515
14	ISL	C3	0.600715
15	IRL	C2	**0.527568**
16	ISR	C2	**0.510608**
17	ITA	C3	**0.524787**
18	JPN	C3	0.552711

Country Code	Countries	Cluster	Silhouette Scores
19	KOR	C1	0.560109
20	LVA	C1	0.590936
21	LTU	C1	0.546740
22	LUX	C2	**0.531877**
23	MEX	C2	**0.488563**
24	NOR	C3	0.602722
25	POL	C2	0.563548
26	PRT	C1	0.602692
27	SVK	C2	**0.489770**
28	SVN	C3	0.562668
29	ESP	C3	0.578662
30	SWE	C3	0.604911
31	CHE	C3	0.585169
32	TUR	C2	0.577214
33	GBR	C3	0.613738
34	USA	C3	0.601889

Comparing the silhouette scores of the three clusters, we see that they are above 0.54. Colombia, Ireland, Israel, Mexico and Slovakia in cluster C2 and Italy in cluster C3 are different from the other countries as they have a silhouette score below 0.54. The silhouette scores of the countries in clusters C1 and C3 are above 0.54. In this respect, the countries included in the two clusters are the closest countries in terms of silhouette score. The results in terms of the silhouette score obtained according to the K-means non-hierarchical clustering method are presented in Chart-9.

Chart 9. Cluster Analysis Results



When the clusters obtained by the K-means method are evaluated, the countries in cluster C1 are Chile, Greece, Korea, Latvia, Lithuania and Portugal. The countries in cluster C2 are Colombia, Costa Rica, Estonia, Hungary, Ireland, Israel, Luxembourg, Mexico, Poland, Slovakia and Türkiye. Countries in Cluster C3 are Austria, Belgium, Canada, Czech Republic, Denmark, Finland, Germany, Iceland, Italy, Japan, Norway, Slovenia, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Countries are included in different clusters according to the hierarchical and non-hierarchical clustering methods; Mexico is in cluster C1 according to the hierarchical clustering method, while it is in cluster C2 according to the non-hierarchical clustering method. Italy, Japan and Slovakia are in cluster C2 according to the hierarchical clustering method and cluster C3 according to the non-hierarchical clustering method. Türkiye is in cluster C2 according to both hierarchical and non-hierarchical clustering methods. The silhouette value is the closest to 1 among the countries in cluster C2. According to the K-means method, the data for the countries in Cluster C2 are presented in Table-8.

Table 8. Countries in cluster C2 according to the K-means method

Country	Cluster	Silhouette Scores	X1	X2	X3	X4	X5	X6
			Pop. with household expenditures on health> 10% of total household expenditure or income (%)	Pop. with household expenditures on health> 25% of total household expenditure or income (%)	UHC: Service coverage index	Health spending per. of GDP (%)	Out of pocket per. of GDP %	Out of pocket per. of health exp. (%)
COL	C2	0.51712	8,2	2,2	79,6	9,01	1,23	13,6
CRI	C2	0.54742	7,4	1,1	81,1	7,56	1,57	20,7
EST	C2	0.57399	8,8	1,2	79,3	7,49	1,65	22,0
HUN	C2	0.57051	12,3	0,9	79,5	7,37	1,81	24,6
IRL	C2	0.52756	5,6	0,5	82,7	6,71	0,71	10,6
ISR	C2	0.51060	12,8	2,6	85,5	7,90	1,56	19,7
LUX	C2	0.53187	4,3	0,2	83,1	5,66	0,50	8,9
MEX	C2	0.48856	4,4	1,2	74,5	6,07	2,51	41,3
POL	C2	0.56354	16,1	2	82	6,43	1,27	19,8
SVK	C2	0.48977	2,7	0	81,8	7,75	1,50	19,4
TUR	C2	0.57721	4,2	0,7	75,6	4,56	0,74	16,2

When Türkiye's current situation is compared with the countries in the same cluster, in terms of the variable of the population with health expenditure more than 10% of total household expenditure or income (%), the value of (4.2%) is below the C2 cluster average of (7. 89%). In terms of the variable of the population with health expenditure more than 25% of total household expenditure or income (%), the value of (1%) is below the C2 cluster average of (1%), (15%), (1.37%) for the variable of out-of-pocket expenditure as a percentage of GDP, and (19.76%) for the variable of the out-of-pocket percentage of health expenditure (%) are positive steps towards achieving UHC. However, the fact that the service coverage index and the percentage of GDP spent on health (%) are below the averages of (80.43) and (6.96%), respectively, indicates that there are challenges in achieving UHC. Within the framework of the results obtained from the study, according to the K-means averages method, it is seen that Luxembourg and Ireland have achieved more favorable results than Türkiye in terms of access to UHC in terms of all variables in terms of countries in cluster C2, where Türkiye is located.

At this point, the questions of what the health spending share should be and whether health spending is being used efficiently come to the fore. A health expenditure share of less than 4-5% of GDP makes it challenging to achieve UHC (Jowett et al., 2016). Empirical studies also suggest that 5% of GDP public health spending is necessary to achieve UHC (Mcintyre et al., 2017). According to the Report on Financing Health Systems on the Road to Universal Coverage (2010), countries whose entire population has access to most services typically spend around 5-6% of GDP on health, but it is also noted that 20-40% of this expenditure is wasted due to inefficiency (WHO, 2010). Reducing corruption, prioritizing basic health services, improving the quality of health services and reducing inequalities are as important as ensuring the efficiency of health budgets to achieve UHC (Civil Society Engagement Mechanism, 2019). In Türkiye, adjusting the sub-parameters that make up the service coverage index, increasing the variety of services covered by the social security system, and reducing the share of out-of-pocket health expenditures, although it remains below

the average than other OECD countries are crucial for eliminating health inequalities.

5. CONCLUSION

In this study, cluster analysis was conducted using the indicators related to UHC, one of the primary targets of the health and quality of life goal, the third of the United Nations Sustainable Development Goals. The aim was to identify countries with similar characteristics to Türkiye using data on UHC-related variables from 34 countries for which data were available for analysis. For this purpose, Ward's technique, one of the hierarchical clustering methods, and the K-means technique, one of the non-hierarchical clustering methods, were used.

As a result, Türkiye was found to be in cluster C2 in terms of hierarchical and non-hierarchical clustering methods. The hierarchical clustering analysis indicates that the countries in cluster C2 are Colombia, Costa Rica, Estonia, Hungary, Ireland, Israel, Italy, Japan, Luxembourg and Poland. According to the non-hierarchical clustering analysis results, Türkiye is included in cluster C2 with Colombia, Costa Rica, Estonia, Hungary, Ireland, Israel, Luxembourg, Mexico, Poland and Slovakia. Both hierarchical and non-hierarchical clustering methods Show that Mexico, Italy, Japan and Slovakia are included in different clusters.

According to the K-means non-hierarchical clustering method, Luxembourg and Ireland have more positive results than Türkiye in terms of access to UHC in terms of all variables analyzed in the study. For Türkiye, the quality, diversity and inclusion rate of services in payment mechanisms should be increased, especially regarding the sub-parameters that make up the service coverage index and the services included in the social security system. However, to make progress towards UHC, the share of out-of-pocket health expenditure should be reduced. Khan et al. (2017) argue that large and unpredictable health payments can expose households to significant financial risks, which can lead to poverty. In addition, as Gaddam, R., & Rao (2023) point out, the catastrophic burden of out-of-pocket expenditures can shift the inequality caused by financial

catastrophes from the rich to the poor. Reducing the share of out-of-pocket expenditure will decrease financial catastrophes and is also important for eliminating health inequalities. Panda et al. (2024) report that Indian households spend 11 per cent of their monthly consumption expenditure on inpatient health care, and 28 per cent of households have an increased financial burden due to increased inpatient health care expenditure. Similarly, in Ethiopia, out-of-pocket health expenditure accounts for 31 per cent of the population, leading to catastrophic and impoverishing expenditure (Tadiwos et al., 2025). Protecting individuals against financial risks is therefore of paramount importance.

Türkiye spends the lowest share of GDP on health (4.5%) than the countries in Cluster C2. To make progress towards UHC, it is recommended that this ratio be around 5-6% of GDP. In addition to increasing the share of health expenditure in GDP, it is also essential to ensure the efficient use of these resources, diversify the range of services provided under the umbrella of social security, and redirect them towards areas that promote a more qualitative development of the services provided. In further studies, different analyses can be conducted on the allocation of health budgets, both according to the time interval and whether the share of countries' health expenditures is public or private.

Etik Beyanı: *Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu beyan ederim. Aksi bir durumun tespiti halinde Akademik İzdüşüm Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.*

Destek ve Teşekkür: *Bu araştırmanın hazırlanmasında herhangi bir kurumdan destek alınmamıştır.*

Katkı Oranı Beyanı: *Araştırmanın tüm süreci makalenin beyan edilen tek yazarı tarafından gerçekleştirilmiştir.*

Çatışma Beyanı: *Araştırmada herhangi bir çıkar çalışması bulunmamaktadır.*

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ANALYSIS OF UNIVERSAL HEALTH COVERAGE INDICATORS WITH CLUSTERING METHOD, A STUDY ON OECD COUNTRIES

Extended Summary

Aim:

This study aims to analyze the current situation of OECD countries in terms of the sub-targets of UHC, the similarities between countries, and Türkiye's similarities and differences with other countries.

Method(s):

In this study, cluster analysis was conducted using the indicators related to UHC, one of the primary targets of the health and quality of life goal, the third of the United Nations Sustainable Development Goals. The aim was to identify countries with similar characteristics to Türkiye using data on UHC-related variables from 34 countries for which data were available for analysis. For this purpose, Ward's technique, one of the hierarchical clustering methods, and the K-means technique, one of the non-hierarchical clustering methods, were used. The main contribution of this study to the literature is that it provides an assessment in terms of UHC indicators.

This study differs from other studies in that it aims to identify countries that are similar to Türkiye in terms of the level of achievement of the sub-targets set for the goal of UHC (SDG 3.8). The classification of the OECD countries included in the study in terms of SDG 3.8 indicators was carried out using cluster analysis, one of the multivariate statistical methods. The Orange package was used for the analysis. This program is a Python-based tool for data visualization and data mining. In this study, the research material consists of secondary data on UHC indicators obtained from the WHO database.

Findings:

First, a hierarchical clustering analysis was performed. Hierarchical clustering analysis was performed using Ward's linkage method. According to Wards's Method Countries in

Cluster C1 are Chile, Greece, Korea, Latvia, Lithuania, Mexico, and Portugal. Countries in Cluster C2 are Colombia, Costa Rica, Estonia, Hungary, Ireland, Israel, Italy, Japan, Luxembourg, Poland, and Türkiye. Countries in Cluster C3 are Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, Germany, Iceland, Norway, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Non-hierarchical Cluster Analysis was then performed. The data of the countries included in the analysis are clustered using the K-means method. The number of clusters can be determined using the average silhouette coefficient in K-means. Comparing the data of the two clusters formed according to the silhouette score, the countries in cluster C1 have values above 0.49, and Israel differs from other countries as it has a value below this score. However, it is included in Cluster C1. Although there are countries with negative scores, since the formation of three clusters according to silhouette value provides a more homogeneous view. Therefore, the OECD member countries are also considered to form three clusters with respect to the UHC indicators. As a result, Turkey is placed in cluster C2. When Türkiye's current situation is compared with the countries in the same cluster, in terms of the variable of the population with health expenditure more than 10% of total household expenditure or income (%), the value of (4.2%) is below the C2 cluster average of (7. 89%). In terms of the variable of the population with health expenditure more than 25% of total household expenditure or income (%), the value of (1%) is below the C2 cluster average of (1%), (15%), (1.37%) for the variable of out-of-pocket expenditure as a percentage of GDP, and (19.76%) for the variable of the out-of-pocket percentage of health expenditure (%) are positive steps towards achieving UHC.

Conclusion and Discussion:

For Türkiye, the quality, diversity and inclusion rate of services in payment mechanisms should be increased, especially regarding the sub-parameters that make up the service coverage index and the services included in the social security system. However, to make progress towards UHC, the share of out-of-pocket health expenditure should be reduced. Reducing the share of out-of-pocket expenditure will decrease

financial catastrophes and is also important for eliminating health inequalities.

Türkiye spends the lowest share of GDP on health (4.5%) than the countries in Cluster C2. To make progress towards UHC, it is recommended that this ratio be around 5-6% of GDP. In addition to increasing the share of health expenditure in GDP, it is also essential to ensure the efficient use of these resources, diversify the range of services provided under the umbrella of social security, and redirect them towards areas that promote a more qualitative development of the services provided. In further studies, different analyses can be conducted on the allocation of health budgets, both according to the time interval and whether the share of countries' health expenditures is public or private.