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Research Article

INVESTIGATION OF OECD COUNTRIES WITH MULTI-DIMENSIONAL SCALING ANALYSIS IN TERMS OF TRAFFIC ACCIDENT INDICATORS

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Abstract: *This study tries to compare similarities and differences in Organisation for Economic Co-operation and Development (OECD) countries in terms of traffic accidents utilizing Multidimensional Scale Analysis (MDS), and one of Multivariate Statistical Analysis Techniques. In the study, MDS analysis was carried out utilizing basic indicators such as the number of injuries, deaths and the number of accidents resulting in material damage in the traffic accidents that happened in 2017. As a result of the analysis, stress values and R^2 (correlation coefficient) values turned out to be 0.0000 and 1.0000, respectively. That the stress value has resulted as zero shows that there is no inconsistency, and the fact that R^2 value has been found to be 1 indicates that the accuracy rate of this analysis is high and the values are in excellent coherence. According to results obtained from the analysis, it is seen that Malta and Liechtenstein, in particular, have appeared to be in a very different position from other countries when the countries are compared in terms of traffic accidents. When the matrix of the differences is examined; Turkey and Liechtenstein have seemed to be the two countries very different from each other. It is clear that traffic accidents, a global public health problem, have great impacts on individuals, societies and national economies. Particularly, it will be possible to decrease human and economic losses to minimum levels when the countries with similar traffic accident indicators come together, develop national and international projects and apply them.*

Keywords: *OECD countries, traffic accidents indicators, multivariate statistic, multi-dimensional scale*

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1. Introduction

In the developing world, traffic density and traffic accidents have increased due to the increasing number of vehicles, especially in parallel with the rapid increase in population in recent years. Traffic accident is an important problem in terms of their frequency, health aspect and economic consequences that affect society and individuals deeply. These accidents cause deaths and injuries as well as huge amounts of material damage. Although it is possible to compensate for economic losses, it is not possible to compensate for social losses. Due to these consequences of traffic accidents, human life is deeply affected. Traffic accidents, which are among the most important causes of death in the world, should be a priority issue in terms of public health [1-10].

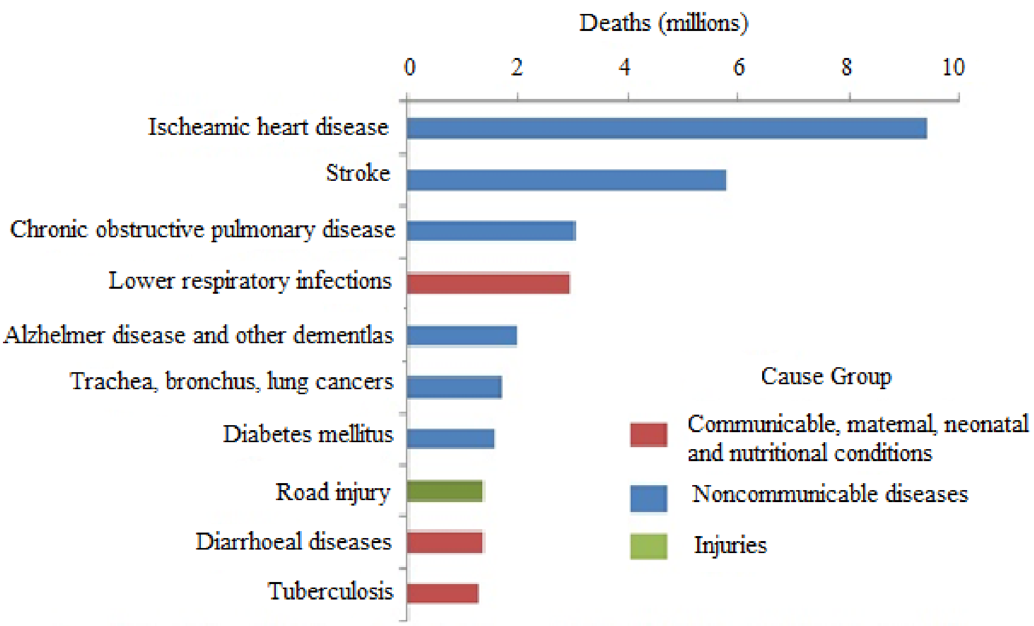

Figure 1. The most important death causes in the world 2000-2016 [11].

Figure 1 shows that traffic accidents take place in the 8th rank among the most important causes of death in the world.

Approximately 1.35 million people lose their lives in traffic accidents in the world every year. Besides this, from 20 to 50 million people are injured and most of them are disabled. As for Turkey, about 10.000 people lose their lives every year due to traffic accidents [11]. Although the great majority of those who lose their lives are drivers and passengers, the share of pedestrians is also considerable. Injuries occurring as a result of traffic accidents cause significant economic losses for families and nations [4].

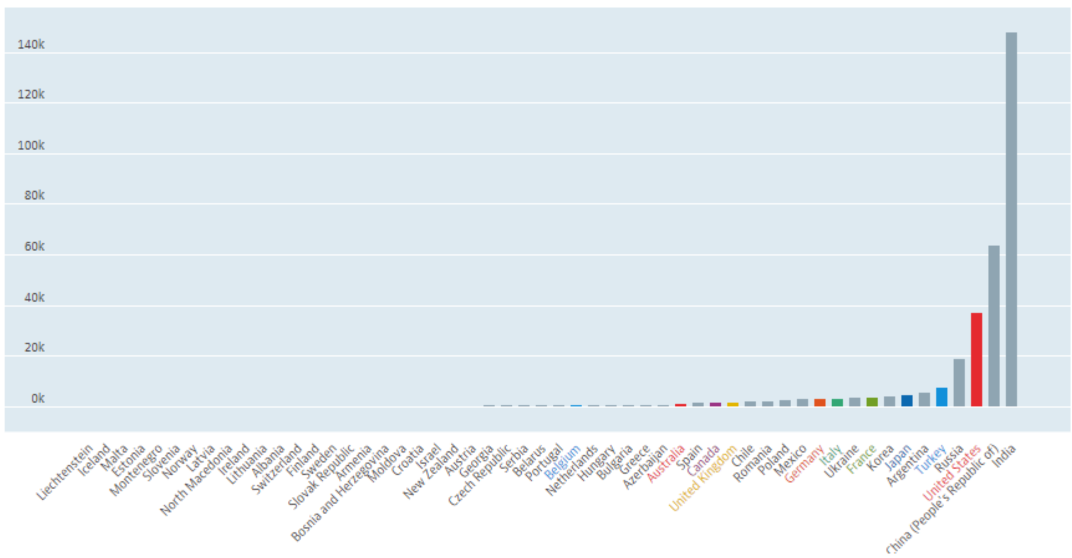

Figure 2. Distribution of traffic accidents in OECD countries in 2017 by the number of deaths [12]

Figure 2 shows that the countries which have the highest number of deaths in the traffic accidents in 2017 are India, China, the USA, Russia, Turkey, Argentina, Japan, and Korea, respectively.

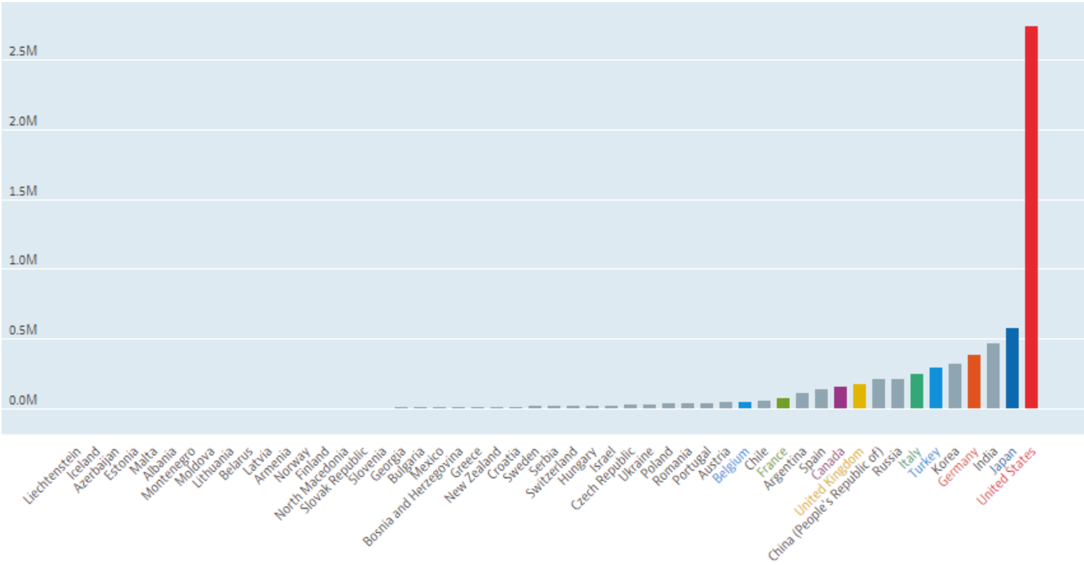

Figure 3. The distribution of the number of injured people in traffic accidents occurring in 2017 in OECD countries [12].

Figure 3 shows that the countries with the highest number of injured in traffic accidents in 2017 are the US, Japan, India, Germany, Korea, and Turkey; however, the least injured countries are Liechtenstein, Ireland, Estonia, Azerbaijan, and Malta.

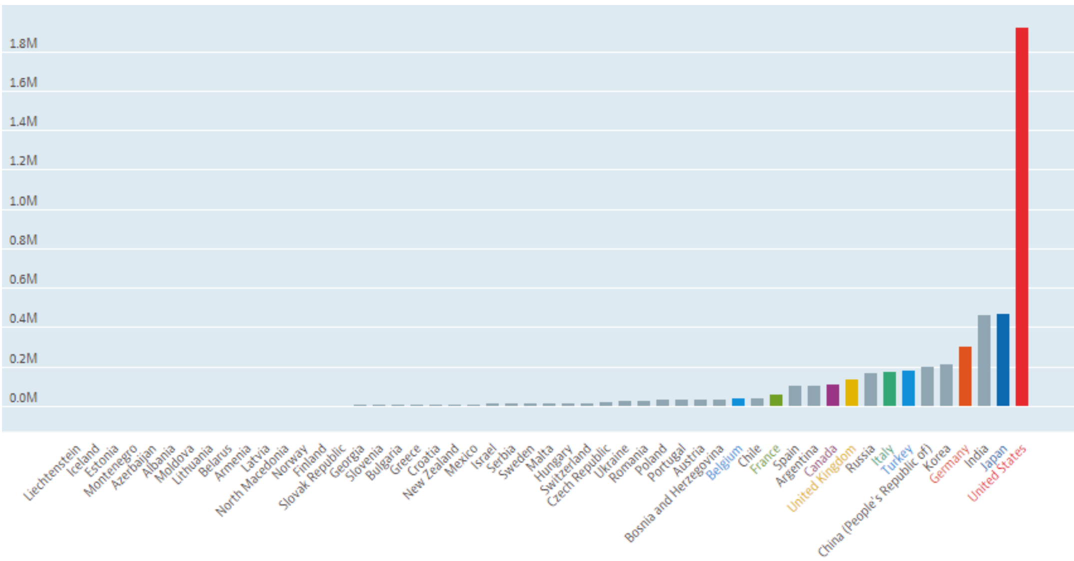

Figure 4. The distribution of the number of material damages in traffic accidents occurring in 2017 in OECD countries [12].

Figure 4 shows that the countries with the highest number of material damages are the US, Japan, India, Germany, Korea, China, and Turkey, while the countries with the least material damages are Liechtenstein, Ireland, Estonia and Azerbaijan, and Malta.

The motorway is mostly preferred in transportation in Turkey. Traffic accidents occurring on motorways in the world and Turkey are among the most important causes of death [13-16]. In 2017, a total of 1,202,716 traffic accidents occurred in Turkey. Of these accidents, 1,020,47 were materially damaged and 182,669 were fatal or injured traffic accidents. In 2017, 74.4% of fatal or injured traffic accidents occurred in the city and 25.6% of them occurred outside the city. As a result of these accidents, 7,427 people were killed and 300,383 people were injured [14]. When compared with OECD countries in terms of the number of deaths, injuries and the number of material damages in traffic accidents in 2017, Turkey, unfortunately, ranks at the top [13-14].

Traffic accident statistics in Turkey belonging to 2008-2017 are given in Table 1.

Table 1. Statistics of Traffic Accidents in Turkey 2008-2017

Years	The number of total accidents	The number of positive, injury accidents	The number of material damage accidents	The number of deaths			The number of injured
				Total	At the scene of the accident	Post-accident (1)	
2008	950,120	104,212	845,908	4,236	4,236	-	184,468
2009	1,053,345	111,121	942,224	4,324	4,324	-	201,380
2010	1,105,201	116,804	988,397	4,045	4,045	-	211,496
2011	1,228,928	131,845	1,097,083	3,835	3,835	-	238,074
2012	1,296,634	153,552	1,143,082	3,750	3,750	-	268,079
2013	1,207,354	161,306	1,046,048	3,685	3,685	-	274,829
2014	1,199,010	168,512	1,030,498	3,524	3,524	-	285,059
2015	1,313,359	183,011	1,130,348	7,530	3,831	3,699	304,421
2016	1,182,491	185,128	997,363	7,300	3,493	3,807	300,812
2017	1,202,716	182,669	1,020,047	7,427	3,534	3,893	300,383

(1) It includes the people who died within thirty days due to accidents sent to the health centers after they were injured in traffic accidents [17].

Table 1 provided that between the years of 2008-2017, 11 million and 739 thousand and 158 traffic accidents occurred in Turkey. It can be observed that 49,656 people were killed, while 2,596,001 people were injured in the accidents happened. Also, it is understood that the number of deaths and injuries in traffic accidents occurring in recent years has nearly doubled compared to the previous years.

It is known that there are numerous studies dealing with traffic accidents in Turkey. Sungur et al. [3] investigated the problem of road security and traffic accidents in Turkey. Kuşkapan et al. [4] studied the traffic accidents caused by pedestrians in Turkey. Eşiyok et al. [8] handled the traffic accidents and their shortcomings in Turkey. Kırmızıoğlu and Tuydes Yaman [14] carried out a study about the literacy of drivers of traffic signs in Turkey. Çodur and Tortum [6] employed Artificial Neural Network (ANN) to estimate traffic accidents of the Erzurum province of Turkey. Çelik and Oktay [16] investigated the risk factors affecting injuries related to traffic accidents happened in Erzurum and Kars provinces of Turkey. Tortum et al. [5] tried to determine the effects of road factors on traffic security employing the Linear Regression method. Erdoğan [7] compared the traffic accidents and death rates in the provinces of Turkey using the Explorative Spatial Analysis method. Bektaş and Hınıs benefitted from the Logistic Regression method to determine factors having an influence on traffic accidents. Similarly, Karacasu et al. [13] tried to estimate the causes of traffic accidents applying Discriminant Analysis and Logistic Regression analysis to the data in Eskişehir province. Murat and Şekerler [19] tried to establish the reasons causing accidents by using Cluster analysis and modeling traffic accident data. Eygü [20] used Structural Equation Modelling in establishing the factors affecting traffic accidents. Likewise, Cansız [21] employed Logarithmic Regression and Artificial Neural Network methods in order to estimate death numbers in traffic accidents. Tercan and Beşdok [22] established the relations between parameters that affect traffic accidents and by using the Biplot method. Tercan et al. [23] modeled the data of traffic accidents by utilizing Evolutionary Data Clustering and Resilient Neural

Network methods. Uçar and Tatlıdil [24] made use of the Ordered Orbit Model so as to determine the factors affecting the severity of the accident. Acı and Yılmaz [25] developed a model called Adaptive Network-Based Fuzzy Logic Inference System to find out the sensitive defect in traffic accidents with property damage. Arı [26] investigated the data of traffic accidents using the Log-Linear method. Güler [27] developed an Accident Analysis Segments model for traffic accidents. Doğrul et al. [28] investigated the data of traffic accidents with the help of Association Rules analysis, one of the data mining techniques. Similarly, Söylemez et al. [29] analysed the data of traffic accidents using Association Rules. While several different statistical analyses were used in the above-mentioned studies, no study was encountered where Multi-Dimensional Scaling analysis was employed. When literature scanning was carried out, the limited number of studies were found in terms of traffic accident indicators of OECD countries [30, 31]. However, there are a number of studies where MDS analysis, the method used in this study as well, was used. Tokçuoğlu [32] and Gürçaylar Yenidoğan [33] measured the brand perception of university students employing MDS analysis. Büyüker İşler [34] benefited from MDS analysis to establish the process of brand locating of gas stations. Ekiyor [35] determined the perception maps of hospitals by employing MDS analysis. Ersöz [36] benefitted from MDS analysis to compare the health levels and health expenditures of Turkey and OECD countries. Acar [37] compared with OECD countries and Turkey in terms of basic indicators of the labor market with the help of the MDS method. Tüzüntürk [38] used the MDS method so that they could establish the similarities and differences of 81 provinces in Turkey in terms of crime types. Similarly, Etikan et al. [39] investigated judicial statistics of provinces through MDS. Ersöz et al. [40] benefitted from MDS analysis to compare biomass energy production in OECD countries. İhtiyaroğlu [41] investigated similarities and differences between provinces in Turkey in terms of student placement in the associate degree, undergraduate and open education faculties of universities. Finally, Akın and Eren [42] benefitted from the MDS method to compare education indicators of OECD countries.

2. Materials and Methods

MDS analysis is a multivariate statistical analysis method that shows the relationships between objects by reducing the size, revealing the positions of these objects in one or multidimensional space based on the distances between n objects or units determined according to the p variable [34-35,37-38, 43-44]. In the graphical representation, points representing similar objects in space are close to each other, dissimilar ones are far from each other [47]. Although MDS analysis, which is considered as a data reduction analysis, was developed as an alternative to Factor Analysis, there are differences between the two methods. While applying factor analysis, some assumptions such as normality, linearity etc. should be provided, while the MDS analysis does not have any assumptions. In factor analysis, the variance-covariance matrix or correlation matrix is used to see the relationships between variables, while the distance matrix is used to see the relationships between units in the MDS [32, 36-37, 44,48-49]. MDS is used when the relationships between units or objects are not absolutely known and the distance matrix can be obtained [50]. The MDS analysis provides an analytical layout that shows the relationship structure of the data in multi-dimensional space very close to the original position in order to better understand the similarities/dissimilarities between the variables [38,51]. MDS analysis was first developed by Householder and Young in the 1930s and later developed by Tagerson et al. [31,36]. MDS was born in the field of psychometry, its use was not limited to psychology, though. It is widely used in fields such as medicine, science and social sciences, education, economics, archaeology and so on

[27,33]. MDS analysis is frequently used in the analysis of data such as religious beliefs, behaviours, and expectations of individual preferences [36,52-53].

The techniques applied according to the scale and data type used in the MDS analysis differ. In this analysis, the Ordinal Scale, Interval Scale, and Ratio scale can be applied to various data types [34].

The data to be used in MDS analysis are multivariate data. Data with many variables including the number of variables p and number of observations (measurements) n are shown as follows:

$$X = \begin{bmatrix} x_{11} & x_{12} \dots\dots & x_{1n} \\ x_{21} & x_{22} \dots\dots & x_{2n} \\ \vdots & \vdots \cdots & \vdots \end{bmatrix} = [x_1, x_2, \dots . x_n]_{pxn} \quad (1)$$

This matrix is called a data matrix. Here, for j = 1,2,..., p; i = 1,2,...,n, i^{th} is the observation result over ji x : j^{th} variable. As the variables can be in different scale types and different measurement units, the analysis results may be affected. Therefore, it is recommended to convert the values to score values or standard values to reduce the effects [43]. In the data sets obtained with range and proportional scale; Euclidean distance, Square Euclidean distance, Chebychef, City-Block, Minkowski distances can be selected. In MDS analysis, the most important point is to determine the distance measure; and the distance acquisition methods appropriate to the data types should be preferred. In binary scale data types; Euclidean distance, Square Euclidean distance, Pattern difference, Lance Williams distance can be preferred [43].

In MDS analysis, the most known and prevalently used distance measurement is Euclid distance. This distance is calculated by taking the square root of the sum of the squares of the differences between the observation vectors. The City-Block distance, also known as the Manhattan distance, is equal to the sum of the absolute differences between the units' variables. As this distance measure is used, the effect of the differences decreases since the difference is not squared. Chebyshev distance is a metric distance measure that takes the difference in size with the maximum difference between the two observation vectors as the distance between the two observation vectors. Minkowski distance is a general and metric measure and is one of the distance functions used for quantitative data [44]. One of the most important problems when performing the MDS analysis is to decide the number of dimensions. The number of dimensions in which the resulting graphical representation is easier to understand and interpret should be preferred. Usually, two and three-dimensional ones are used. The stress value is used to determine whether the number of dimensions to be used is appropriate.

Stress statistics are used to determine the number of dimensions as a result of size reduction. Stress statistics converge to a certain value as a result of iterations. The number of dimensions belonging to the converged value can be selected. Apart from this method, the number of dimensions can be decided by using the eigenvalues of the positive half-defined B matrix obtained by the product of the raw data matrix and the transposition [47].

Compliance between original distances and display distances is measured by Kruskal stress statistics. Stress measurement is calculated via the following formula [43].

$$\boldsymbol{S} = \frac{\left[\sum_{i<k}\left(\boldsymbol{d_{ik}} - \hat{\boldsymbol{d}}_{ik}\right)^2\right]^{\frac{1}{2}}}{\sum_{i<k}(\boldsymbol{d_{ik}})^2} \quad (2)$$

Kruskal tolerance ratios are used to interpret the configuration distances according to the magnitude of stress values. These tolerance ratios are as follows:

Table 2. Consistency Level according to Stress Values

Stress Value	Consistency
≥ 0.20	Inconsistency representation
0.10 - < 0.20	Low consistency
0.05 - < 0.10	Good consistency
0.025 - < 0.05	Excellent consistency
0.000 - < 0.025	Full consistency

A high-stress value indicates a high inconsistency; while a low-stress value indicates a low inconsistency [38, 43, 54].

In MDS, the square of the correlation coefficient (R^2) is often used as a consistency index. R^2 is a measure determining how much MDS model is compatible with the data. If R^2 is 1, it is understood that the compatibility is complete. In the analysis, it is generally acceptable that R^2 is greater than 60%, but it can be said that as R^2 value gets bigger, the consistency becomes better [47].

Depending on the type of MDS analysis data, metric MDS and non-metric MDS are used. Metric MDS is applied to data based on quantitative and metric distances. It is used since values obtained through measurement. In this scaling, representation and data distances are calculated by linear or polynomial function method. Non-metric MDS, on the other hand, is applied to score, order and categorical data. In non-metric scaling, the representation and data distances are calculated by the monotonic function method [43]. In practice, non-metric MDS is more preferred because it requires less assumption. Although it is known that the results obtained from the two methods are very close to each other when metric and non-metric MDS is applied to the same data set in the MDS, the approach appropriate to the distance matrix should be preferred [47].

3. Results

The aim of this study is to compare the OECD countries with the Multidimensional Scaling analysis in terms of traffic accident indicators and to determine the similarities or differences of the countries and to reveal the variables that affect the differentiation. Traffic Accident Indicators taking place in "Road Accident" database published by OECD Data were used in the study [12]. These indicators include the number of injuries in traffic accidents, the number of fatalities and the number of accidents with material damage. In this study, data from 39 countries were used since not all countries could be evaluated due to the lack of some data from OECD countries. MDS analysis, which was conducted to find similarities and differences between OECD countries in terms of traffic accident indicators, was applied to the SPSS 21.0 package program in two dimensions since it is easier to understand graphically.

Within the context of the study, the main indicators of 2017 traffic accidents of 39 OECD member countries were used. Accident Statistics of OECD Countries for 2017 are given in Table 3.

Table 3. Accident Statistics of OECD Countries for 2017

Country	Year	Number of injured	Number of accidents with material damage	Number of deaths
Argentina	2017	113173	102623	5420
Armenia	2017	5179	3535	279
Azerbaijan	2017	1719	1833	750
Belgium	2017	48451	38020	609
Bulgaria	2017	8680	6888	682
Switzerland	2017	21413	17799	230
Czech Republic	2017	27079	21263	577
Germany	2017	390312	302656	3180
Estonia	2017	1725	1406	48
Finland	2017	5576	4752	238
France	2017	73384	58613	3448
The UK	2017	178321	136063	1856
Georgia	2017	8461	6079	517
Greece	2017	12925	10647	731
Croatia	2017	14608	10939	331
Hungry	2017	21451	16489	625
India	2017	470975	464910	147913
Iceland	2017	1371	939	16
Italy	2017	246750	174933	3378
Japan	2017	580113	472165	4431
Korea	2017	322829	216335	4185
Lichtenstein	2017	87	436	2
Latvia	2017	3567	3059	136
Latonia	2017	4818	3874	191
Moldova	2017	2928	2479	302
Mexico	2017	8905	11873	2919
Macedonia	2017	6224	4019	155
Malta	2017	1854	15003	19
Montenegro Republic	2017	2648	1831	63
Norway	2017	5262	4086	106
New Zealand	2017	13892	11126	378
Poland	2017	39466	32760	2831
Romania	2017	40211	31106	1951
Russia	2017	215374	169432	19088
Slovakia	2017	21139	14691	276
Slovenia	2017	6884	5638	104
Serbia	2017	7901	6185	578
Sweden	2017	19662	14849	252
Turkey	2017	300383	182669	7427

(OECD DATA, 2017) [12].

In Table 3, the data of 39 OECD member countries take place. The data of the other countries are not included in the assessment as they do not take place in the database. When Table 3 is examined, it is seen that Japan and India are the countries that have the highest number of material damage accidents and that Argentina, Japan, Korea, India, Russia, and Turkey are the countries that have the highest number of deaths. On the other hand, it is understood that Lichtenstein is the country that has the least values in terms of traffic indicators.

Kruskal-Stress Statistics and R^2 values that are obtained as a result of the MDS analysis conducted to compare OECD countries in terms of traffic accidents are given below in Table 4.

Table 4. Results of Multidimensional Scaling analysis

Stress Statistic Results of Young		
Iteration	S-stress	Improvement
1	.0000	

When Table 4 is examined, it can be seen that iteration was halted since stress statistics for k=2 had a value of 0.00000 in the first iteration according to Stress Statistics of Young. Stress and R^2 were obtained as 0.00000 and 1.00000, respectively. In the study, if the stress value is zero, there is no inconsistency, and if the R^2 value is 1, it means that the accuracy rate of this analysis is high and the values are in perfect agreement.

Table 5. Stimulating coordinates

Order No	Country	Countries	1.Dimension	2. Dimension
1	ARG	Argentina	.2613	.3050
2	ARM	Armenia	-.9753	-.3349
3	AZE	Azerbaijan	**1.2845**	.5706
4	BEL	Belgium	-.3425	.0422
5	BGR	Bulgaria	-.3859	.0199
6	CHE	Switzerland	-.0916	.1619
7	CZE	Czech Republic	-.3267	.0503
8	DEU	Germany	-.3842	.0208
9	EST	Estonia	-.2208	.1022
10	FIN	Finland	.0096	.2059
11	FRA	France	-.2710	.0780
12	GBR	The UK	-.4381	-.0075
13	GEO	Georgia	-.7875	-.2107
14	GRC	Greece	-.1874	.1181
15	HRV	Croatia	-.5179	-.0510
16	HUN	Hungry	-.4484	-.0131
17	IND	India	.6414	.4284
18	ISL	Iceland	-.8380	-.2430
19	ITA	Italy	-.736	-.1790
20	JPN	Japan	-.1856	.1189
21	KOR	Korea	-.9364	-.3082
22	LIE	Lichtenstein	**5.2494**	-.3212
23	LTU	Latvia	-.0260	.1907
24	LVA	Latonia	-.2730	.0770
25	MDA	Moldova	-.1302	.1445
26	MEX	Mexico	**-2.0472**	**.6378**
27	MKD	Macedonia	**-1.0818**	-.4103
28	MLT	Malta	**5.5832**	-.5687
29	MNE	Montenegro Republic	-.8670	-.2619
30	NOR	Norway	-.3971	.0141
31	NZL	New Zealand	-.2576	.0845
32	POL	Poland	-.0979	.1591
33	ROU	Romania	-.4464	-.0120
34	RUS	Russia	-.3177	.0548
35	SVK	Slovakia	-.1593	.1312
36	SVN	Slovenia	-.3589	.0339
37	SRB	Serbia	-.8368	-.2423
38	SWE	Sweden	-.4797	-.0300
39	TUR	Turkey	**-1.2732**	-.5559

When Table 5 is analysed, it is seen that Liechtenstein and Malta are the most important disintegrants in this dimension as the countries with the highest positive value in the first dimension. That is to say, it is understood that these countries are perceived to be similar in terms of the number of deaths, number of injuries and number of daily accidents in traffic accidents. Also; it is seen that Azerbaijan is different from other countries with a positive value above 1 and that Mexico, Macedonia, and Turkey seem to be the most diverse countries because they have high negative values above 1. In the second dimension, countries do not have positive load values above 1. However, Mexico, with a value of 0.6378 as the positive value closest to 1, can be considered the most important separator for this dimension.

The difference matrix obtained after the excitation coordinate table is given below. In this matrix, it can be said that countries with values close to 0 are similar and countries with values above 1 are different from the others. Since this matrix, where the distances between the 39 countries are calculated, is large, it is given below part by part.

Table 6. Differences matrix

	ARG	ARM	AZE	BEL	BGR	CHE	CZE	DEU	EST	FIN	FRA	GBR	GEO
ARG	0.000												
ARM	.682	0.000											
AZE	.517	1.199	0.000										
BEL	.322	.360	.839	0.000									
BGR	.346	.336	.863	**.024**	0.000								
CHE	.187	.495	.704	.136	.160	0.000							
CZE	.314	.368	.831	**.009**	**.032**	.127	0.000						
DEU	.345	.337	.862	**.023**	**.002**	.159	**.032**	0.000					
EST	.256	.426	.773	**.066**	**.090**	**.069**	**.058**	.089	0.000				
FIN	.133	.549	.650	.190	.214	**.054**	.181	.213	.123	0.000			
FRA	.283	.399	.800	**.039**	**.063**	**.097**	**.030**	**.062**	**.027**	.151	0.000		
GBR	.375	.307	.892	**.053**	**.029**	.188	**.061**	**.030**	.119	.242	.092	0.000	
GEO	.572	.110	1.090	.250	.226	.386	.259	.227	.316	.440	.289	.197	0.000
GRC	.238	.444	.755	**.084**	.108	**.051**	**.076**	.107	**.018**	.105	**.045**	.137	…
HRV	.419	.263	.936	**.097**	**.073**	.233	.106	**.074**	.163	.287	.136	**.044**	…
HUN	.381	.301	.898	**.058**	**.034**	.194	**.067**	**.035**	.124	.248	**.097**	**.006**	…
IND	.196	.878	.322	.518	.542	.382	.509	.541	.452	.328	.479	.570	…
ISL	.602	**.080**	1.119	.279	.256	.415	.288	.256	.346	.469	.318	.227	…
ITA	.543	.139	1.060	.221	.197	.357	.229	.198	.287	.411	.260	.168	…
JPN	.237	.445	.754	**.085**	.109	**.051**	**.077**	.108	**.019**	.105	.046	.138	…
KOR	.659	**.023**	1.176	.337	.313	.473	.345	.314	.403	.527	.376	.284	…
LIE	2.443	3.120	1.933	2.762	2.786	2.628	2.754	2.785	2.697	2.574	2.724	2.815	…
LTU	.151	.531	.669	.171	.195	.035	.162	.194	.105	**.019**	.132	.223	…
LVA	.284	.398	.801	**.038**	**.062**	**.098**	**.029**	**.061**	**.028**	.152	.002	.091	…
MDA	.207	.475	.724	.115	.139	**.021**	.106	.138	**.049**	**.075**	**.076**	.168	…
MEX	.888	1.570	.371	1.210	1.234	1.075	1.202	1.233	1.144	1.021	1.171	1.263	…
MKD	.746	**.064**	1.263	.423	.399	.559	.432	.400	.490	.613	.462	.371	…
MLT	2.617	3.279	2.123	2.929	2.952	2.797	2.921	2.951	2.865	2.745	2.891	2.980	…
MNE	.618	**.064**	1.136	.296	.272	.432	.305	.273	.362	.486	.335	.244	…
NOR	.352	.330	.869	**.030**	**.006**	.166	**.039**	**.007**	**.096**	.220	**.069**	**.023**	…
NZL	.276	.406	.793	**.046**	**.070**	**.089**	**.038**	**.069**	**.020**	.144	**.007**	**.099**	…
POL	.190	.492	.707	.132	.156	**.003**	.124	.155	**.066**	**.057**	**.093**	.185	…
ROU	.379	.303	.897	**.057**	**.033**	.193	**.066**	**.034**	.123	.247	**.096**	**.005**	…
RUS	.309	.373	.826	**.014**	**.037**	.122	**.005**	**.036**	**.053**	.176	**.025**	**.066**	…
SVK	.223	.459	.740	**.099**	.123	**.036**	**.091**	.122	**.033**	**.090**	**.060**	.152	…
SVN	.331	.351	.848	**.009**	**.015**	.145	**.018**	**.014**	**.075**	.199	**.048**	**.044**	…
SRB	.601	**.081**	1.118	.279	.255	.414	.287	.256	.345	.468	.318	.226	…
SWE	.398	.284	.915	**.076**	**.052**	.211	**.084**	**.053**	.142	.265	.115	.023	…
TUR	.862	.180	1.380	.540	.516	.676	.549	.517	.606	.730	.579	.488	…

Its continuation

Table 6. Differences Matrix

	GEO	GRC	HRV	HUN	IND	ISL	ITA	JPN	KOR	LIE	LTU	LVA	MDA	MEX
GEO	0.000													
GRC	.334	0.000												
HRV	.153	.181	0.000											
HUN	.192	.143	.039	0.000										
IND	.768	.434	.615	.576	0.000									
ISL	.029	.364	.182	.221	.797	0.000								
ITA	.029	.305	.124	.163	.739	.058	0.000							
JPN	.335	.002	.182	.143	.433	.364	.306	0.000						
KOR	.087	.421	.240	.279	.855	**.058**	.116	.422	0.000					
LIE	3.011	2.679	2.859	2.820	2.250	3.040	2.982	2.678	3.097	0.000				
LTU	.421	**.086**	.268	.229	.347	.450	.392	.086	.508	2.593	0.000			
LVA	.288	**.046**	.135	.096	.480	.317	.259	**.047**	.375	2.725	.133	0.000		
MDA	.365	**.031**	.212	.173	.403	.394	.336	**.030**	.452	2.648	**.056**	**.077**	0.000	
MEX	1.461	1.126	1.307	1.269	.693	1.490	1.431	1.125	1.547	1.571	1.040	1.172	1.095	0.000
MKD	.173	.508	.326	.365	.941	.144	.202	.508	**.086**	3.183	.594	.461	.538	…
MLT	3.172	2.847	3.023	2.986	2.429	3.200	3.144	2.846	3.257	1.060	2.763	2.892	2.817	…
MNE	**.046**	.380	.199	.238	.814	**.017**	**.075**	.381	.041	3.057	.467	.334	.411	…
NOR	.220	.114	**.067**	**.028**	.548	.249	.191	.115	.307	2.792	.201	**.068**	.145	…
NZL	.296	**.038**	.143	.104	.472	.326	.267	**.039**	.383	2.717	.125	**.008**	**.069**	…
POL	.382	**.048**	.229	.191	.386	.412	.353	**.047**	.469	2.631	**.038**	**.094**	**.017**	…
ROU	.193	.142	.040	**.001**	.575	.222	.164	.142	.280	2.819	.228	**.095**	.172	…
RUS	.264	**.071**	.110	**.072**	.504	.293	.234	.072	.350	2.749	.157	**.024**	.102	…
SVK	.350	**.015**	.196	.158	.418	.379	.320	**.014**	.436	2.664	**.071**	**.061**	**.016**	…
SVN	.241	**.093**	**.088**	**.049**	.527	.270	.212	**.094**	.328	2.771	.180	**.047**	.124	…
SRB	**.029**	.363	.182	.220	.797	.004	**.058**	.364	**.058**	3.039	.449	.317	.394	…
SWE	.174	.160	**.021**	**.017**	.594	.204	.145	.161	.261	2.837	.246	.114	.191	…
TUR	.290	.625	.443	.482	1.058	.261	.319	.625	.203	3.300	.711	.578	.655	…

Its continuation

Table 6. Differences Matrix

	MEX	MKD	MLT	MNE	NOR	NZL	POL	ROU	RUS	SVK	SVN	SRB	SWE	TUR
MEX	0.000													
MKD	1.634	0.000												
MLT	1.776	3.341	0.000											
MNE	1.507	.127	3.217	0.000										
NOR	1.240	.393	2.958	.266	0.000									
NZL	1.164	.470	2.884	.342	**.076**	0.000								
POL	1.078	.556	2.801	.429	.162	**.086**	0.000							
ROU	1.268	.366	2.984	.239	**.027**	.103	.190	0.000						
RUS	1.197	.437	2.916	.310	**.043**	**.033**	.119	**.071**	0.000					
SVK	1.111	.523	2.832	.396	.129	**.053**	**.033**	.157	**.086**	0.000				
SVN	1.219	.414	2.938	.287	**.021**	**.055**	.141	**.048**	**.023**	.108	0.000			
SRB	1.489	.145	3.200	**.018**	.249	.325	.411	.221	.292	.378	.270	0.000		
SWE	1.286	.348	3.002	.221	**.046**	.122	.208	**.018**	**.089**	.175	**.067**	.203	0.000	
TUR	1.751	.117	3.455	.244	.510	.586	.673	.483	.554	.640	.531	.262	.465	0.000

It is seen that countries display similarities in terms of traffic accidents. They have values close to 0 in the differences matrix given above. For example; Armenia has close values as Iceland, Korea, Macedonia, Montenegro Republic, and Serbia. Belgium has close values as Bulgaria, Czech Republic, Germany, Estonia, France, The UK, Greece, Croatia, Hungry, Japan, Latvia, Norway, New Zealand, Romania, Russia, Slovenia, Slovakia, and Sweden. Bulgaria has close values with Czech Republic, Germany, Estonia, France, the UK, Croatia, Hungry, Latvia, Norway, New Zealand, Romania, Russia, Slovenia, Sweden, and Switzerland has close values as Estonia, Finland, France, Greece and Japan; and Latvia, Latonia, Moldova, New Zealand, Poland, and Slovakia. Czech Republic has close values as Germany, Estonia, France, the UK, Greece, Japan, Latonia, Norway, New Zealand, Romania, Russia, Slovenia, Slovakia, and Sweden. Germany has close values as Estonia, France, the UK, Croatia, Hungry, Latonia, Norway, New Zealand, Romania, Russia, Slovenia, and Sweden Estonia has close values as France, Greece, Japan, Latonia Moldova, Norway, New Zealand, Poland, Slovenia, and Slovakia. Finland has close values as Latvia, Moldova, Poland, and Slovenia. France has close values as Greece, the UK, Hungry, Japan, Latonia Moldova, New Zealand, Poland, Romania, Russia, Slovakia, Slovenia, and Sweden the UK has close values as Croatia, Hungry, Latonia, Norway, Romania, Russia, and Slovenia. Georgia has close values as Iceland, Italy, Montenegro Republic, and Serbia. Greece has close values as Japan, Latonia, Latvia, Moldova, New Zealand, Poland, Russia Slovenia, Slovakia and Croatia and Hungry, Norway, Romania, Slovenia, and Sweden. Hungry has close values as Latvia, Norway, Romania, Russia, Slovenia, and Sweden. Iceland has close values as Italy and Korea, Montenegro Republic and Serbia. Italy has close values as the Montenegro Republic and Serbia. Japan has close values as Montenegro Republic, New Zealand, Poland, Russia Slovenia, and Slovakia. Korea has close values as Macedonia, Montenegro Republic, and Serbia. Latvia has close values as Moldova. Latonia has close values as Montenegro Republic, Norway, New Zealand, Poland, Romania, Russia, Slovakia, and Slovenia. Moldova has close values as New Zealand, Poland and Slovakia; and the Montenegro Republic with Serbia; and Norway with New Zealand, Romania, Slovenia, and Sweden. Romania has close values as Russia, Slovenia, and Sweden. Russia has close values as Slovakia, Slovenia, and Sweden.

When the differences matrix is analysed, it is understood that Turkey and Malta are the most diverse countries. On the other hand, it is seen that Lichtenstein and Turkey; Sweden, Korea, Georgia and Macedonia, and furthermore Malta and Georgia, Armenia, Croatia, Iceland, and Korea are countries that are very different from each other due to the high difference values.

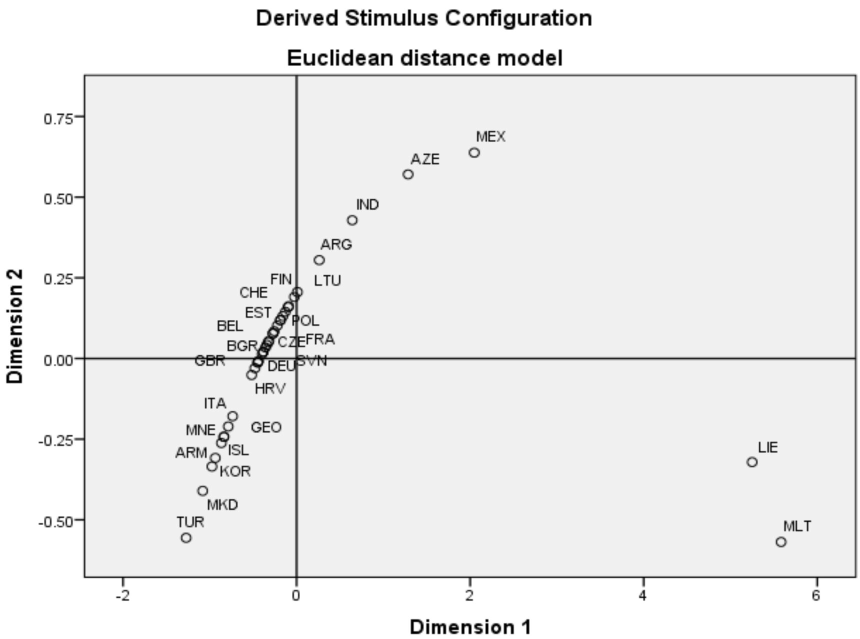

Figure 4. Linear Relation between Distances and Differences

When Figure 4 is examined, it is seen that similar OECD countries are gathered together. As a result of the MDS analysis examined in Figure 5, it is seen that countries are collected in three different groups in two-dimensional space according to the traffic accident indicators of interest. While Liechtenstein, Malta emerges in a separate group, and Turkey, Macedonia, Korea, Iceland, Armenia, the Republic of Montenegro, Italy, Georgia, Croatia, Germany emerge in another group, and the rest of the countries emerges as another group.

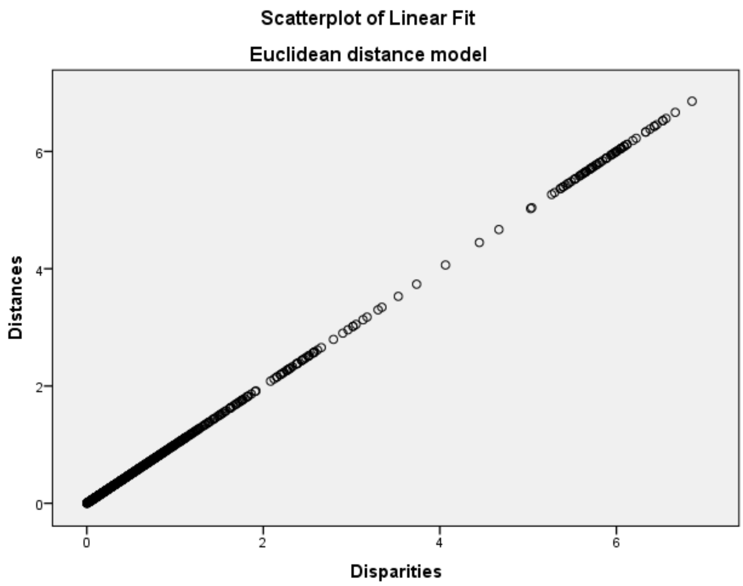

Figure 5. Euclidean Distance Model

When Figure 5 is examined, it is determined that the number of dimensions and distances and the differences are in a linear relationship.

4. Conclusions and Recommendations

In this study, it is aimed to examine the position of 39 OECD member countries in terms of traffic accident indicators and to reveal the similarities or differences between countries with Multivariate Statistical Techniques, which is one of the Multidimensional Scaling Techniques. As a result of the analysis, it is seen that the OECD countries are similar to each other in three-dimensional locations in two-dimensional space. In the first dimension; Liechtenstein and Malta are the most important parsers and appear to be in a very different position from other countries. In the second dimension, countries do not have positive load values above 1. However, Mexico, which has a value of 0.6378 as the positive value closest to 1, can be considered the most important parser for this dimension. It is seen that Liechtenstein and Malta are similar, but appear to be taking place at a location different from other countries. It is seen that Turkey, Macedonia, Korea, Iceland, Armenia, the Republic of Montenegro, Italy, Georgia, Croatia, and Germany are similar to each other and form a separate group, while the rest are located in a different group. When the differences matrix is examined; it is understood that Turkey and Malta are the most different countries from each other among the OECD countries.

It is obvious that traffic accidents, a global public health problem, have a huge impact on individuals and communities and national economies. The countries especially, those which take place on the top with regard to the traffic accident indicators, such as the US, Japan, India, Germany, Korea, and Turkey should come together and confront this problem and develop national and international projects. In addition, taking serious measures on a local basis (infrastructure services, increasing traffic fines, and training, etc.) will help minimize human and economic losses. Thanks to these measures, reducing traffic accidents, which are among the most important causes of death in our country and some other countries, will have a positive effect on both individual and public health.

The compliance to the Research and Publication Ethics: This study was carried out in accordance with the rules of research and publication ethics.
Ethical Process: Ethics committee approval is not required for this study.

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