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RESULTS & DISCUSSION

FINDINGS

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TRAFFIC FATALITIES AMONG CHILDREN THAT IS CAUSING EXTENSIVE ECONOMIC DAMAGES

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ABSTRACT

In this study the traffic accidents that result in children fatalities is investigated by grouping and comparing several countries. Hierarchical Clustering analysis is used in order to determine similar and different countries according to the children death in traffic accidents. Multidimensional scaling analysis, on the other hand, is used to show the situation of countries and the unknown relation between units in multidimensional space. Cluster analyses showed that, it is possible to separate the countries into 6 groups. Turkey is found to be the most different country from the others where Portugal also forms a single group. The similarities and dissimilarities among the countries are also discussed. It is shown that Turkey and Portugal form single groups, among others. Turkey is found to be lack of safety measures which results in the high dissimilarity between the other countries and Turkey. It is clear that the situation of Turkey in terms of child traffic fatalities is alarming and needs special attention.

KEYWORDS
Child; Safety; Safety system; Traffic accident; Traffic fatality.

1. INTRODUCTION

Being a major global problem, traffic accidents affect all part of the society. According to the World Health Organization's (WHO) report, 2.1% of the deaths in the worldwide and 25% of the deaths in accidents are due to the traffic accidents. Studies showed that if traffic accidents keep going up with the same rate, in 2020 they became the 1st reason for all types of death and will become even worse than AIDS (Peden et al., 2004).

Traffic accidents are commonly accepted as one of the biggest risk for the children health as they are the main reason for the injuries and even deaths for children, and are responsible for 40% of the deaths of children younger than 15 (Peden et al., 2004). As the transportation capability of the current societies has increased, children have been beginning to travel more. However, when designing the roads and the vehicles, this fact hadn't taken into account. As children are different from adults in terms of adaptation, the roads and the vehicles that are designed for adults and the traffic situation create a huge problem for the children. This shows the importance of the traffic safety for the children. Children rarely cause traffic accidents, but have a part as pedestrian, bicycle driver or passenger. In fact, most of these accidents can be avoided. It is showed that the number of traffic accidents that are resulted in children death in developing countries is more than the ones in developed countries (UNICEF, 2001). Considering the fact that the number of vehicles in developing countries is less than the developed ones, the reduced number of fatalities can be dedicated to the safety systems. Moreover, it is previously reported that with the usage of these safety systems avoided the increase in children fatalities more than 70% for the baby seat, 50% for the children seat (SpineCare Foundation, 2005) and 45% for the safety belt (Elvik et al., 1997). Therefore it can be stated that, by the regular use of safety belt, child safety seat, and protective helmet, the severity of the injuries can be reduced.

As another key parameter, the vehicle speed has also effects on the children death. Increase of speed from 30 km/h to 50 km/h increases the death of pedestrian children 8 times (Upadhyay and Sharma, 2004). In addition there is a significant relation between the speed and the severity of the injuries. With the limitation of 20 km/h provided %70 of sectional decrease on pedestrians (Webster and Mackie, 1996).

In Turkey, the risk of the exposure of young children to traffic accidents is at the highest level among other countries (IRTAD, 2004). Children who live in Turkey are 3.43 times more likely to die in a traffic accident than Swedish children, as a pedestrian, passenger, or bicycled (IRTAD, 2004; Christie et al., 2004). Children younger than 14 who live in Turkey have a risk of death more than 11 times of Japanese child, 8.4 times of English child, 3.1 times of German child, 2.7 times of Spanish child, and 2.3 times of French child do because of traffic accidents during vehicle travel (IRTAD, 2004). This situation may have different causes. Beside of the traffic culture of countries, socioeconomic (Peden et al., 2004; Plasencia and Borrell, 2001; Hyder and Ghaffar, 2002) and socio-demographic factors have affect on the death in traffic accidents (van Beeck et al, 1991).

Main aim of this study is to determine similar and different countries and to compare and group them in terms of child traffic fatalities. The grouping and comparisons are made by Hierarchical Clustering and Multi Dimensional Scaling (MSD) Analyses. Although the situation of other countries is presented, special attention is given to the Turkey's situation as it needs urgent actions. The groups and comparisons are discussed in detail in order to understand the key problems in traffic accidents that involve children and several suggestions are proposed in order to reduce the risks.

2. MATERIAL AND METHODS

In this section the methods that are used throughout the study are presented and discussed. Basically two analyses techniques are used in this study. Hierarchical clustering method of cluster analyses technique is used for the separation of countries into homogenous groups in terms of injured children in traffic accidents. Aim of the cluster analyses is to collect similar or different objects together, and make collective description by using the variables obtained from objects. This method is entirely based on numerical data where the number of groups is not known beforehand. The most basic concept of the analyses is the similarity. All the methods of the analyses are based on similarity criterions (Junghagen, 2000) whose rate of choose is subjective (Johnson and Wichern, 2002). In hierarchal clustering method, number of clusters is an unknown. The most similar individuals, depending on the detected criterions, take part in the same cluster. Clustering continues till the last object takes a part in the most similar cluster at the variables set (Oktay, 2001). Clustering methods used in this are: Group Average (Un-weighted Pair-Group), Distance Type: Euclidean, Scale Type: Standard Deviation. The Number Cruncher Statistical Systems (NCSS) used for the analysis.

In addition, Multidimensional Scaling analysis is also used in order to test the success of grouping, and to present the relationship and situation between objects in a multidimensional space. This is done by showing the structure of objects in a k dimensional space depending on the distances between n objects or units according to p ($k<p$) variables. Multidimensional scaling analysis is a method that helps to expose the unknown relationship between units in cases where the distance can be calculated (Özdamar, 2002). Stress measure in MSD analyses represents the fitness of the original distance and the calculated distance from the original values by several methods calculated (Özdamar, 2002). The best fitted position between the data and the solution is obtained by the stress measure. The number of dimensions is equal to the number of the coordinate values which are used to determine the place of a point in the spatial seem, namely the number of axes (Shepard, 1972). If the number of dimensions increases, stress number will decrease and conformity increases. If the number of dimensions decreases, stress number will increase and conformity decreases.

The variables that are determined in this study, in terms of situation of children at the traffic accidents are as follows (IRTAD, WHO, WorldBank and Turkish Statistical Institute):

X1: The number of children who died in traffic accidents per 100 thousands children.
X2: The number of pedestrian children who died in traffic accidents per 100 thousands children.
X3: The number of bicycled children who died in traffic accidents per 100 thousands children.
X4: The number of passenger children who died in traffic accidents per 100 thousands children.

X5: The ratio of male children fatalities (younger than 4) to the total male fatalities at the traffic accidents.
X6: The ratio of male children fatalities (age 5-14) to the total male fatalities at the traffic accidents.
X7: The ratio of female children fatalities (younger than 4) to the total female fatalities at the traffic accidents.
X8: The ratio of female children fatalities (age 5-14) to the total female fatalities at the traffic accidents.
X9: The number of vehicle per individual in the country.
X10: The ratio of children fatalities (younger than 4) to the total fatalities at the traffic accidents.

3. RESULTS

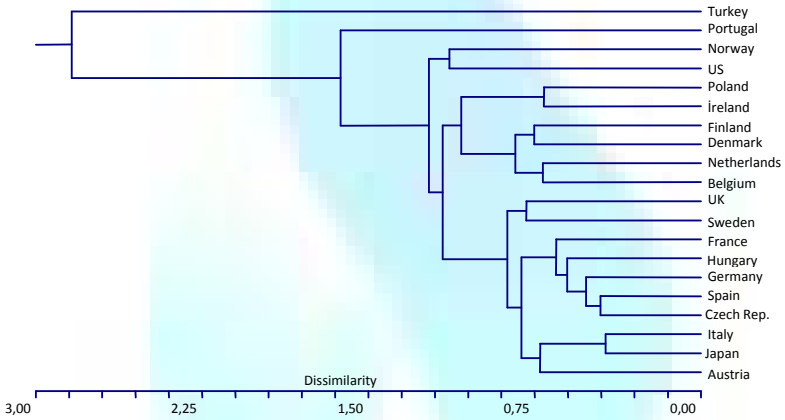
In this section the results obtained from the analyses are presented. First of all, by the cluster analyses following results are obtained: Cophenetic Correlation: 0.945230; Delta (0.5): 0.122038; Delta (1.0): 0.142556. As a result of the cluster analyses, it is showed that the countries can be divided into 6 groups when cluster limitation pre-value is used, which is given in Table 1.

TABLE 1: THE GROUPED COUNTRIES

1st group	2nd group	3rd group	4th group	5th group	6th group
Ireland	Belgium	Austria/Hungary	US	Portugal	Turkey
Poland	Denmark	Japan/Italy	Norway		
	Finland	Czech Rep./UK			
	Netherlands	France/Sweden			
		Germany/Spain			

The Cophenetic correlation, which is the Pearson correlation between real and predicted distances, is determined as 0.94523. Being higher than the basic value of 0.75, it is showed that the grouping is successful. Also since the values of Delta(0.5) and Delta(1.0) are pretty less than the determined value, success compliance is found to be acceptable.

FIG. 1: COUNTRY GROUPS OBTAINED BY THE HIERARCHICAL CLUSTERING METHOD



The most similar countries are Italy-Japan and Spain-Czech Rep. Turkey is the most different country from the others (Figure 1). Moreover, interpretations are conducted by the location of the countries in a multidimensional space in terms of children who died in traffic accidents. Proximity matrix that consists of dissimilarity value is calculated as a Euclid distance and MSD analyses are applied by the XLSTAT software.

FIG. 2: STRESS VALUES

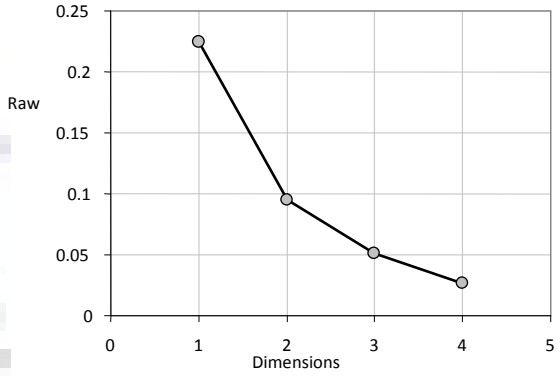


TABLE 2: THE DIMENSIONS AND THE STRESS VALUES

Dimensions	1	2	3	4
Kruskal's stress (1)	0.226	0.095	0.051	0.027
Iterations	500	290	150	173
Convergence	0.000	0.000	0.000	0.000

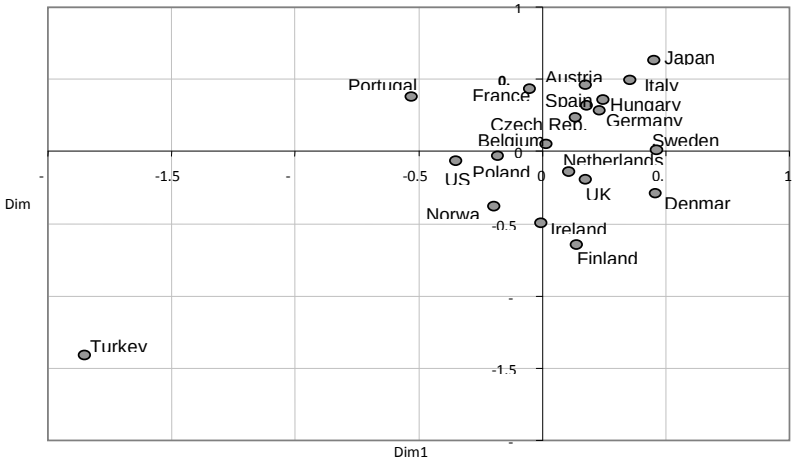
The number of dimensions is decided by the comparison of minimum stress values that are calculated statistically step by step from those who have a few number of dimension seems. For this purpose a plot is generated where the horizontal axis involves the dimensions and the vertical axis involves stress values. In this graph, the dimension corresponds to the sudden decreases in the stress values are accepted as the most available dimension (Churchill, 1991). Observing Table 2 and Figure 2 it can be seen that two dimensioned solution is the most suitable one. Krukal's stress value (1) is found to be 0.095 which is well adapted on two dimension solutions.

TABLE 3: COORDINATE VALUES

	Dim1	Dim2
Austria	0.175	0.461
Belgium	0.016	0.049
Japan	0.452	0.634
Czech Rep.	0.135	0.237
Denmark	0.462	-0.291
US	-0.347	-0.063
Finland	0.140	-0.646
France	-0.052	0.436
Germany	0.232	0.285
Hungary	0.250	0.356
Ireland	-0.001	-0.498
Italy	0.355	0.495
Turkey	-1.849	-1.409
Norway	-0.192	-0.381
Poland	-0.180	-0.034
Portugal	-0.530	0.376
Spain	0.182	0.317
Sweden	0.465	0.010
Netherlands	0.112	-0.142
UK	0.176	-0.194

As can be seen from Table 3 and Figure 3, Turkey is pretty much different than other countries in the first and the second dimensions. When Figure 3 is examined, it can be seen that Austria, Japan, Czech Republic, France, Germany, Hungary, Italy and Spain's; UK, Netherlands and Denmark's; US and Poland's; Norway, Ireland and Finland's are placed in the same group. In this point of view, the MSD analyses provided supporting results to the cluster analyses.

FIG. 3: THE VIEW OF COUNTRIES IN TWO DIMENSIONAL SPACES



As a similar result, it can be clearly seen from Figure 3 that Turkey constituted another cluster by itself with a pretty much different value than the other countries. Observing Figure 1, it can be deduced that the similarity between countries is also captured by the MSD method. There is more similarity between Czech Republic-Germany, Germany-Spain, Germany-Hungary, Hungary-Spain, Japan-Italy, Czech Republic-Spain, Hungary-Italy, Netherlands-UK and Germany-Italy than the others in terms of children traffic fatality (Table 4). The most different countries are Japan-Turkey, Italy-Turkey, Turkey-Sweden, Austria-Turkey, Germany-Turkey, France-Turkey and the comparisons of Turkey with the rest of the countries as can be seen at Table 4.

TABLE 4: THE MOST SIMILAR AND DIFFERENT COUNTRIES BY MSD ANALYSIS

Pairs	Dissimilarity	Rank		Pairs	Dissimilarity	Rank
Czech Rep. - Germany	1.134	1		Japan - Turkey	15.134	190
Germany - Spain	1.256	2		Italy - Turkey	14.436	189
Germany - Hungary	1.286	3		Turkey - Sweden	14.047	188
Hungary - Spain	1.294	4		Austria - Turkey	13.907	187
Japan - Italy	1.326	5		Germany - Turkey	13.595	186
Czech Rep. - Spain	1.354	6		France - Turkey	13.431	185
Hungary - Italy	1.440	7		Hungary - Turkey	13.408	184
Netherlands - UK	1.440	8		Turkey - Spain	13.352	183
Germany - Italy	1.530	9		Czech Rep. - Turkey	13.076	182
Czech Rep. - Hungary	1.637	10		Denmark - Turkey	12.660	181
Belgium - Czech Rep.	1.795	11		Belgium - Turkey	11.972	180
Belgium - Poland	1.881	12		Turkey - Portugal	11.751	179
Italy - Spain	1.913	13		Turkey - UK	11.671	178
Czech Rep. – France	1.938	14		Turkey - Netherlands	11.479	177
Austria - Germany	1.941	15		Turkey - Norway	11.458	176
Austria - Spain	2.106	16		Ireland - Turkey	11.378	175
Austria - Czech Rep.	2.143	17		Turkey - Poland	11.348	174
Belgium - Netherlands	2.146	18		Finland - Turkey	11.220	173

4. DISCUSSION

From the foregoing analysis, as a common result, it can be stated that there is no similarity between Turkey and the other countries in terms of children death in traffic accidents. Turkey which sacrifices the children in much more proportion than the others is placed as the most hazardous country (IRTAD, 2004; Christie et al., 2004) where 74% of children fatalities are due to the traffic accidents. Observing the usage of child restraint systems and amount of child death because the traffic accidents in Turkey, will answer the reason why Turkey sacrificed more kids than the other countries. There is a respectable relation between the development level of countries and apportionment of kids on the accidents (Darcin and Darcin, 2007). This situation shows a clear truth: traffic is an educational and cultural problem (Darcin and Darcin, 2004).

Behavior of adults and traffic culture also affect the differences of countries in children death at the traffic accidents. Depending on the education level of adults, usage of child restraint system increases (Russell et al., 1994). Usage of drivers' safety belt is the most prominent indicator of child restraint system usage (Russell et al., 1994; Decina and Knoebel, 1997; Edwards and Sullivan, 1997; Miller et al., 1998). Turkey must provide a high importance on the safety systems inside the vehicles as it is in a worse situation much more than the other countries, in order to reduce the severity of the injuries. The rate of pedestrian younger than 14 died at the traffic accident in Turkey is quite high (Christie et al., 2004). Pedestrian education by age groups to develop education of pedestrian must be kept topical by voluntary associations as practical complementary of school education. Special attention must be taken about obeying the speed limits where the children are intensively living.

Turkey doesn't show any similarity with the other countries. 74% of children traffic fatality in Turkey occurs in a vehicle. Turkey must care child safety system usage much more than the other countries to prevent the children death. Children deaths cause from bicycle are the fewest in Turkey, whereas this is one of the basic reasons of children death of traffic accident in the other countries. As a result the children death reasons are not same with the other countries and the difference of these reasons are sourced from lack of basic safety system usage in Turkey that the other countries used.

As another country which seems to form a single group is found to be is the Portugal. Both the hierarchical clustering and MSD analysis support this result. It is also stated after a series of surveys that the child fatality in Portugal is mainly for the pedestrian children, with high values different than the other countries (UNICEF, 2001). Portugal is at the second place for the annual deaths among children aged 1 to 14 caused by transport accidents. It is also reported that only Portugal, among existing EU members, had a worse record over 1991-95 (Christie et al., 2004). Therefore this suggests that Portugal, in particular, to tackle their problem of injuries among young children.

The countries which are collected at the second group according to the hierarchical clustering analysis (Table 1) are the Belgium, Denmark, Finland, and Netherlands. Firstly these countries are successful in terms of child fatalities. Their similarity comes from the measure they have taken. It is well shown that, the speed reduction measures and signalized crossing in these countries are well applied and maintained (UNICEF, 2001). They have those measures outside many schools. Moreover they conduct national publicity campaigns for the children safety. US and Norway which forms the fourth group (Table 1) have a similar GDP per capita. Also, their situation about child traffic fatality is similar for pedestrian and bicyclist children (UNICEF, 2001; Christie et al., 2004).

5. CONCLUSIONS

In this study the countries are grouped and compared in terms of children death in traffic accidents. Two methods are used for the analysis, Hierarchical Clustering and Multi Dimensional Scaling Analysis. As a main result it is shown that the countries can be divided into six groups. The similar and dissimilar countries are obtained and discussed. It is shown that Turkey and Portugal form single groups, among others. It is clear that the situation of Turkey in terms of child traffic fatalities needs special attention.

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