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The Effect of Rescue and Relief Services on the Severity of Traffic Accidents

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Abstract

INTRODUCTION: According to the official statistics, a high rate of road traffic deaths occurs during the transportation of the injured and in medical centers. The way of transporting the injured to the medical centers, the standard time of dispatch and timely treatment in the hospitals, the land use planning of medical centers and rehabilitation are the three missing links of the post-event phase. Therefore, the researchers aimed to assess the effect of rescue and relief services on the severity of traffic accidents in this study.

METHODS: This applied research was conducted based on an exploratory mixed method. The statistical population in the qualitative section included Amin Police Academy professors, experts of both Red Crescent Society (RCS) of Tehran province and Tehran Emergency Medical Service (EMS), who were selected via purposive sampling method. In the qualitative section, the theme analysis method was used and analyzed by using Maxqda-2020 software. The statistical population of the quantitative part included excellent accident experts of 28 districts of Tehran and experts of the RCS and EMS of Tehran province in a stratified random method. In the following, confirmatory factor analysis using structural equation modeling method was used and analyzed with SmartPLS3 software.

FINDINGS: The dimensions of the impact of rescue and relief services on the severity of traffic accidents from the perspective of Red Crescent Society and Emergency Medical Services experts included equipment (31.077), land use planning (25.610), expertise (23.598), and education (8.243). The most marked impact was related to equipment, and the least impact pertained to education. Furthermore, the dimensions of the effect of rescue and relief services on the severity of traffic accidents from the perspective of accident experts included equipment (42.009), land use planning (34.419), education (33.770), and expertise (8.951). The greatest impact was related to equipment, and the least effect pertained to expertise. In addition, the factor loadings of all dimensions were more than 0.5 being significant at the 0.95 level.

CONCLUSION: Strengthening and developing equipment, land use planning balanced with the geography of missions, and continuous specialized training of rescue and relief of RCS and EMS experts will positively reduce the severity of traffic accidents in the country.

Keywords: Rescue and relief; Traffic accidents; Severity; Mortality

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Introduction

Every day, road accidents claim the lives of numerous people and disable many others, incurring huge economic losses. Nonetheless, due to various reasons, including the dispersion of these accidents, their negative and adverse effects on society have not received sufficient attention.

According to the World Health Organization report, the rate of death relative to the size of the world's population has remained constant. Nonetheless, approximately 1.35 million people die each year due to road traffic crashes, equivalent to one person's death every 24 seconds in the world due to traffic accidents (WHO, 2018).

On the other hand, if we consider effective measures to reduce traffic accidents from the process perspective, there are three stages: pre-

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event, during and post-event. In the stage of the event or the accident scene, there are several categories, including the equipment, preparation for the deployment of service organizations, preparation of circulars, training of rescue and relief forces, legal powers of the scene manager, determining the duties of other organizations, release, and rescue (1). The method and the standard time of transferring the injured to the hospital, timely treatment in the hospital, the land use planning of hospitals, and the rehabilitation are the three missing links in the post-event stage. Moreover, insurance and social security organizations play a prominent role in this stage (2).

Among the most important issues that can be raised in the field of planning, we can refer to transportation systems and traffic accident scene management. Planning to improve safety and prevent future accidents assumes paramount importance in these stages (3). Due to its wide geographical scope, the need to effectively respond to traffic accidents in the country is considered a daunting challenge posed to managers. The critical importance of this issue highlights the need to pay attention to the rescue sector and its development (4). The work experience of researchers in the field of visiting and dealing with serious and chain accidents demonstrates that the timely presence of well-equipped rescue teams can help reduce the pain and severity of the injuries caused by car accidents while using the golden time. Based on this, the time to reach the crash, performing rescue activities, and optimal management of accidents has a significant effect in reducing the effects of accidents.

As the most important elements of response to accidents and incidents in outdoor and inner-city environments, Rescue and Relief Organization of Red Crescent Society in Tehran City and Emergency Medical Services have played a significant role in increasing the capacity of society in traffic accidents, suggesting a need to devote more attention to development and equipping (5). The examination of plausible reasons cited for a marked increase in the number of casualties and injuries in traffic accidents in the country referred to the shortage of rescue facilities as one of the key factors. Consequently, considering the necessity and importance of rescue and relief in traffic accidents and the importance of human life and property, the strengthening of relief organizations has a marked effect on the reduction of the traffic-related death rate (6).

The theoretical importance of conducting this research lies in the fact that the control of the growing trend of accidents and the reduction of the resulting consequences is related to the thorough knowledge of accident situation in the road network of the country, and this research aimed to investigate the factors affecting the reduction of accidents and the role of relief and rescue in this regard. Therefore, according to the concern of the researchers, the main goals of this research are to identify the factors affecting the effectiveness of rescue and relief in the severity of traffic accidents, as well as the components and indicators of the effectiveness of rescue and relief in the severity of traffic accidents. Accordingly, the current research seeks to answer these basic questions: how effective is rescue and relief in the severity of traffic accidents? What are the components and indicators of the effectiveness of rescue and relief in the severity of traffic accidents?

Zamani (2002), in a study entitled Location-allocation of rescue and relief centers using an Analytical Hierarchy Process model, found that the most important criteria in location-allocation and land use planning of rescue and relief centers is easy access to the road transportation network; moreover, 12 points were identified and proposed as suggested places for the establishment of rescue centers (7). The findings of the study by Farrokhimanesh et al. (2019) entitled The components and indicators of improving the quality of rescue and relief public education demonstrated that the quality of rescue and relief public education of the Red Crescent Society can be improved by the quality of human resources and trainers, attention to learners' needs, use of new tools and smart equipment in education, information updating, program design, commitment, and motivation (8).

Asarian-Nejad and Mehri (2015), in a study entitled Evaluation of the role of smart rescue systems in reducing human casualties on the highways of Tehran, pointed out that improving road and vehicle safety by using smart transportation systems, land spatial development taking into account the existing limitations and opportunities, systematizing the rescue system and using the golden time to help the victims of traffic accidents effectively helps in reducing the

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severity of traffic accidents (9). Azani, Moradipour and Jahangir (2015), in a study entitled Investigating the extent of the Red Crescent Society's road bases with specialized and mandatory rescue and rescue equipment found that 49% of the total suburban bases have favorable facilities for providing rescue and relief services in traffic accidents and more than half of these bases (51%) do not have the facilities and equipment needed to provide rescue and relief services and need to be strengthened and developed in this sector (10).

In their research entitled the role of rescue stations in reducing the injuries leading to death on the roads from drivers' point of view, Chaharsoughi Amin et al. (2014) found that equipment and the renovation of road rescue posts can have a positive effect on the reduction of traffic accidents (11). Abid and et al. (2021) in a study entitled Toward an integrated disaster management approach: how artificial intelligence can boost disaster management, found that the integration of geographic information system and remote sensing management in accidents, planning, systematic evaluation of natural, social, economic, and cultural factors, situational awareness and recovery and return to the first state have made it possible to help and rescue the victims of traffic accidents (12).

Vafaeinejad et al. (2020), in their research entitled Location-allocation of fire stations in order to minimize the time to reach traffic accident sites, pinpointed that the use of tabu search algorithm and Simulated Annealing algorithm can help us have a favorable location-allocation of fire stations with the aim of reducing the time to reach the scene of traffic accidents (13).

Heydari and et al. (2018), in a study entitled a systematic review of the role of ordinary people in road accident rescue revealed that factors, such as cultural conditions, knowledge, relief organizations, and demographic factors, affect the interventions of ordinary people in traffic accidents. (14).

Systems theory and Haddon matrix

William Haddon, a western epidemiologist, presented a system framework for safety based on the disease model, encompassing the infrastructure, vehicles, and users before, during, and after the accident, according to Table 1. This system framework is called the Haddon matrix. According to this theory, none of the components of the transportation system is more important than other components for the successful operation of the road, and human error in traffic accidents occurs since the system is not well designed according to human capabilities. The main point of the systems theory is that traffic accidents are the result of the mismatch of relations between the components of complex systems.

Experts have enumerated several factors to reduce the casualties of traffic accidents, and various models have been used to demonstrate them. The three stages are before, during, and after the accident. As illustrated in Haddon's model, after an accident, human components, equipment, and environment in providing timely and appropriate aid play a vital role in the survival of the injured. In our country, since numerous people lose their lives every year due to traffic accidents or suffer physical and mental problems, it is very important to investigate ways to reduce these injuries.

Systems theory seeks to find a solution to reduce traffic-related deaths by improving rescue and relief services. The purpose of rescue and first aid after an accident is to prevent death and reduce the amount of injuries of those who have suffered traffic accidents.

Table 1. Haddon matrix in the prevention of traffic accident-related deaths

Stage		**Factors causing accidents**		
		Human being	**Environment**	**Vehicle**
Before	Prevention of accident	Education, clusterization & dealing with violations	Road safety inspection, rectification of accident-prone areas	Internet of things, use of intelligent systems in cars
During	Prevention of injuries	Reduction of damages and injuries	Road safety inspection, cleaning, and restoring traffic to normal condition	Use of safety equipment to protect passengers
After	Continuing life	First aid training and the availability of aid centers	Timely and appropriate assistance Equipment and facilities	Vehicle fire prevention

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Land use planning

It actually includes measures to organize and systematize natural, social, and economic spaces at the regional and national levels. It is based on the formulation of the main directions of sustainable development in the form of integration relying on regional capabilities and limitations in coordinated and long-term planning. This approach provides the basis for the interaction between the three elements of humans, space, and activity in the field of land (15). Land use planning aims to create a balance of development between regions, use resources for development, fair distribution of income and activities between different regions, and an emphasis on the development of resources in deprived areas and the coordinated development of growth centers (16). Finally, some experts have referred to land planning as the best, cheapest, and most effective solution for environmental management and planning, economic components, and social welfare (17).

In general, previously conducted studies on the role of rescue stations in reducing the injuries leading to death, the location-allocation of rescue centers, the role of intelligent rescue systems in reducing human casualties, the integrated management approach of relief organizations in accidents using artificial intelligence reveal the spatial model of traffic accident simulation for better use of Emergency Medical Services. In the meantime, there is a research gap regarding the impact of rescue and relief services on the severity of traffic accidents since the reduction in the number of traffic-related deaths is affected by timely measures of relief organizations.

Methods

In this research, systems theory and Haddon matrix were used for the effect of rescue and relief services on the severity of traffic accidents. In this way, considering the existing background, it is possible to propose research hypotheses and draw the conceptual model of the research. In addition, theoretical saturation was obtained by receiving the opinions of 16 experts in this field. Moreover, the semi-structured interviews (SSI) employed open-ended questions. In order to check the data collected from the interview, the content analysis method was used using Maxqda-2020 software. The structural equation modeling method was used to validate the model obtained in the qualitative section.

After the completion of the interview, in the qualitative section, open coding was performed, and concepts were obtained from the categories; thereafter, based on the acquired concepts, axial coding was performed. Following that, the indices obtained through the sub-categories of the core concepts were compiled in the form of a researcher-made questionnaire. Before distribution, the content validity of this questionnaire was verified, and to check the validity, the opinions of experts from Amin Police Academy, the Red Crescent Society, and the Emergency Medical Services in Iran were used. In the quantitative section, based on the data extracted from the previous stage, a researcher-made questionnaire was designed and evaluated based on the studies of theoretical foundations and interviews with experts.

Thereafter, the statistical population of the quantitative section included 420 senior accident experts from 28 districts of Tehran. Among this population, 140 cases were selected via stratified random sampling method, the questionnaires were distributed among them, and necessary information was analyzed. The examination of formal validity and reliability through Cronbach's alpha indicated that the sum of calculated categories was more than 0.74, which is confirmed. In order to analyze the data collected from the researcher-made questionnaire, confirmatory factor analysis was used using Smartpls3 software.

Findings

A) Findings of the qualitative section

First stage: In the process of identifying the indicators, the components were identified, and the characteristics and dimensions related to each concept were discovered, as displayed in Table 2. According to the research questions and selective coding considered based on theoretical foundations, the interviewees were free to answer the questions, and the interview was semi-structured. After the interviews and indexing, the components and dimensions were extracted, as illustrated in Table 2.

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Table 2. Results of central and selective coding of the effect of rescue and relief services on the severity of traffic accidents

Selective encoding	Axial coding	Frequency
Equipment	Strengthening and developing equipment to help the injured and secure the operation scene	30
	Standardization of specialized equipment	31
	Provision of specialized rescue facilities and equipment	22
	Development of road rescue bases	27
	Having access to air rescue facilities	33
	Logistics and support equipment	24
Expertise	Continuous identification of specialized needs of employees according to environmental changes	15
	Technical knowledge continuity according to the conditions	12
	Diversity of specialized programs with the aim of better learning scientific content	23
	Using new developments in specialized training	20
Education	Determining the educational needs of the organization	17
	Having a vision for the implementation of educational programs	26
	Using new tools and smart equipment in education	19
	Diversity in educational programs with the aim of better learning scientific content	24
Land use planning	Systematic assessment of natural, social, economic, and cultural factors	22
	Balanced and coordinated geographic distribution of all missions	21
	Targeted planning in the distribution of facilities and equipment	28
	Spatial development of the land, taking into account the capabilities, opportunities, and limitations	25
	Constructive interaction of society, nature, and land management system	29
	Location-allocation based on traffic volume, accident hot spots, and proximity to medical centers	31

Table 3. Information related to research questionnaires and alpha coefficient

Dimension	Component	Number of questions	Alpha coefficient of the senior accident experts questionnaire	Alpha coefficient of RCS experts' questionnaire
Equipment	Strengthening and developing equipment to help the injured and secure the operation scene	3	0.857	0.849
	Standardization of specialized equipment	3	0.865	0.857
	Provision of specialized rescue facilities and equipment	2	0.862	0.859
	Development of road rescue & relief bases	3	0.821	0.816
	Having access to air rescue facilities	5	0.874	0.887
	Logistics and support equipment	2	0.762	0.791
Expertise	Continuous identification of specialized needs of employees according to environmental changes	2	0.732	0.729
	Technical knowledge continuity according to the conditions	3	0.715	0.706
	Diversity of specialized programs with the aim of better learning scientific content	4	0.752	0.764
	Using new developments in specialized training	3	0.741	0.753
Education	Determining the educational needs of the organization	3	0.736	0.737
	Having a vision for the implementation of educational programs	4	0.774	0.754
	Using new tools and smart equipment in education	4	0.741	0.734
	Diversity in educational programs with the aim of better learning scientific content	3	0.757	0.762
Land use planning	Systematic assessment of natural, social, economic, and cultural factors	3	0.830	0.826
	Balanced and coordinated geographic distribution of all missions	2	0.785	0.769
	Targeted planning in the distribution of facilities and equipment	3	0.849	0.857
	Spatial development of the land, taking into account the capabilities, opportunities, and limitations	3	0.837	0.867
		4	0.856	0.836
		5	0.865	0.850

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Axial coding

After performing the open coding process and determining the main dimensions and components of the research, axial coding was carried out to combine and integrate the data collected from the interviews in the open coding stage. In axial coding, one of the components of open coding is selected as the main phenomenon and placed in the center of the process, and other categories will be related to it.

B) Findings of the quantitative section

In order to check the reliability of the researcher-made questionnaire, it was first randomly tested on 22 subjects from the statistical population, and again Cronbach's alpha was used to analyze the questions and determine their correlation. All the categories related to the variables, according to Table 3, were higher than 0.82 and their reliability was confirmed. In addition, to validate the model obtained from the qualitative section, the structural equation modeling confirmatory factor analysis using Smart PLS3 software was used, and the results obtained from the software output of the factor loadings of all indicators, components, and dimensions are presented in Table 3.

Kaiser-Meyer-Olkin (KMO) index and Bartlett's test: In the process of factor analysis, it is necessary to ensure whether the obtained data can be used for investigation. In simpler words, are the data in question sufficient for factor analysis? Bartlett's test and KMO index were used for this purpose in this research. Based on these tests, the appropriateness of data is sufficient for factor analysis when the KMO index is >0.7 and the significance level of Bartlett's is less than 0.05. If the above conditions are met, the desired sample volume is sufficient for exploratory factor analysis. The results of these tests for the researcher-made questionnaire are presented in Table 4.

Table 4. KMO and Bartlett's tests for questionnaire data

Statistics		Accident experts	RCS & EMS experts
KMO test		0.819	0.839
Bartlett's test	Chi-square	1216.697	1567.741
	Degrees of freedom	200	139
	Significant level	0.000	0.000

The values of KMO and Bartlett's tests and their significance level are reported in Table 4. Therefore, the selected sample size is sufficient for factor analysis. It is worth mentioning that considering that the significance level of Bartlett's test is lower than 0.05, factor analysis is desirable and sufficient for identifying the structure of the considered model. In the present research, the KMO indices for the questionnaires of the senior experts of Tehran Traffic Police and the experts of Tehran Emergency Department were calculated at 0.819 and 0.839, and all the measurements obtained are greater than 0.7, demonstrating that the selected samples are sufficient to perform factor analysis. Table 5 illustrates the degree of convergence and validity of the effect of rescue and relief services on the severity of traffic accidents using exploratory factor analysis.

Based on the output of the software, the composite validity of the measurement model of the main research categories for the effect of rescue and relief services on the severity of traffic accidents in terms of equipment, including strengthening and developing equipment, standardization, providing facilities, developing bases, having air rescue facilities and logistic and support equipment for accident experts were equal to 0.809, 0.726, 0.578, 0.692, 0.704, 0.599. These values were calculated at 0.812, 0.819, 0.721, 0.763, 0.822, and 0.740 for RCS and EMS experts. Moreover, the effect of rescue and relief services on the severity of traffic accidents in the dimension of expertise, including continuous identification of specialized needs, technical knowledge continuity, diversity of specialized programs, and the use of new developments for senior accident experts, were equal to 0.823, 0.709, 0.786 and 0.777. These values were 0.851, 0.784, 0.940, and 0.914 for RCS and EMS experts.

However, in the education dimension, including determining educational needs, and having an educational perspective of using new tools, diversity in educational programs were 0.754, 0.861, 0.820, and 0.848 for accident experts. For RCS and EMS experts, these values were obtained at 0.707, 0.819, 0.790, and 0.777. Furthermore, in the dimension of land use planning, systematic evaluation of effective factors, the balanced geographical distribution of all missions, targeted planning, spatial development of the land, constructive interaction between society and nature, and location-allocation based on the traffic volume and accident hot spots were 0.673, 0.582, 0.812, 0.733, 0.816, 0.878 for senior accident experts. These values were calculated at 0.769, 0.785, 0.816, 0.754, 0.879, and 0.861 for RCS and EMS experts.

According to the values above 0.7, all the components are suitable and acceptable. In addition, in order to check the convergence validity of the measurement model of the main categories related to each variable, the extracted average variance was used, and its value was greater than 0.5 for the effect of rescue and relief services on the severity of traffic accidents in all dimensions according to the acceptable value for this index. Moreover, for the components of database development in the dimension of equipment and continuous identification of specialized needs in the dimension of expertise, it is less than 0.5. Nonetheless, since other indicators, such as composite validity and Cronbach's test, for these components have higher degree of validity, these two components were used.

Table 5. Validity and convergence of the research measurement model

Dimension	Component	Composite validity of senior accident experts	Average variance of senior accident experts	Composite validity of RCS experts	Average variance of RCS & EMS experts
Equipment	Strengthening and developing equipment to help the injured and secure the operation scene	0.809	0.908	0.812	0.726
	Standardization of specialized equipment	0.726	0.659	0.819	0.684
	Provision of specialized rescue facilities and equipment	0.578	0.536	0.721	0.613
	Development of road rescue bases	0.692	0.651	0.763	0.275
	Having access to air rescue facilities	0.704	0.802	0.822	0.593
	Logistics and support equipment	0.599	0.737	0.740	0.825
Expertise	Continuous identification of specialized needs of employees according to environmental changes	0.823	0.840	0.851	0.491
	Technical knowledge continuity according to the conditions	0.709	0.741	0.784	0.545
	Diversity of specialized programs with the aim of better learning scientific content	0.786	0.831	0.940	0.757
	Using new developments in specialized training	0.776	0.679	0.941	0.793
Education	Determining the educational needs of the organization	0.754	0.566	0.819	0.782
	Having a vision for the implementation of educational programs	0.861	0.672	0.790	0.841
	Using new tools and smart equipment in education	0.820	0.616	0.777	0.830
	Diversity in educational programs with the aim of better learning scientific content	0.848	0.812	0.707	0.683
Land use planning	Systematic assessment of natural, social, economic, and cultural factors	0.673	0.791	0.769	0.898
	Balanced and coordinated geographic distribution of all missions	0.582	0.519	0.785	0.798
	Targeted planning in the distribution of facilities and equipment	0.812	0.724	0.816	0.628
	Spatial development of the land, taking into account the capabilities, opportunities, and limitations	0.733	0.632	0.754	0.754
		0.816	0.594	0.879	0.669
		0.878	0.847	0.861	0.609

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Table 6. Coefficients and t-statistics of model variables

Dimensions	Senior accident experts			RCS & EMS experts		
	Main coefficient (beta)	T	Significance level	Main coefficient (beta)	T	Significance level
Dimension of equipment	0.903	42.009	0.000	0.912	31.077	0.000
Land use	0.909	39.419	0.000	0.869	25.610	0.000
Education	0.898	33.770	0.000	0.765	8.243	0.000
expertise	0.685	8.951	0.000	0.821	23.598	0.000
Enhancement and development of equipment	0.802	16.304	0.000	0.897	21.558	0.000
Logistics and support equipment	0.609	5.578	0.000	0.822	2.654	0.000
Development of road rescue bases	0.713	10.681	0.000	0.869	12.938	0.000
Provision of specialized facilities and equipment	0.594	5.896	0.000	0.781	10.700	0.000
Standardization of specialized equipment	0.747	15.060	0.000	0.911	22.665	0.000
Having access to air rescue facilities	0.727	16.503	0.000	0.924	21.988	0.000
Systematic evaluation of effective factors	0.689	13.115	0.000	0.816	10.060	0.000
location-allocation based on traffic volume and accident hot spots	0.881	31.070	0.000	0.856	15.383	0.000
constructive interaction between society and nature	0.822	21.154	0.000	0.879	35.086	0.000
Spatial development of the land	0.737	11.681	0.000	0.762	13.641	0.000
balanced geographical distribution of all missions	0.609	8.362	0.000	0.832	11.784	0.000
targeted planning	0.814	18/725	0.000	0.841	15.769	0.000
Diversity in educational programs	0.860	30/418	0.000	0.721	15.625	0.000
use of new tools	0.813	14/077	0.000	0.763	18.933	0.000
Having an educational perspective	0.857	19.743	0.000	0/786	16.455	0.000
Determination of training needs	0.774	17.889	0.000	0.681	11.693	0.000
continuous identification of specialized needs	0.820	16.482	0.000	0.738	17.008	0.000
Use of new developments	0.780	15.498	0.000	0.821	60.824	0.000
Continuity of technical knowledge	0.714	12.790	0.000	0.654	13.754	0.000
Diversity of specialized programs	0.792	19.487	0.000	0.863	53.086	0.000

In Table 6, the components related to the effect of rescue and relief services on the severity of traffic accidents are correlated in the results of the questionnaire, and the results of the questionnaire of senior accident and technical experts of Tehran Traffic Police revealed that the dimension of equipment (0.930) had the highest correlation, followed by land use planning (0.909), education (0.898), and expertise (0.685). The results of the same questionnaire for Red Crescent and Tehran emergency experts also showed that the dimension of equipment (0.912) had the highest correlation, followed by land use planning (0.869), expertise (0.821), and education (0.765). The components related to the dimension of the equipment were correlated in the results of the questionnaire of both groups of senior accident experts and RCS and EMS experts, and in the results of the questionnaire of senior accident experts, it was determined that the component of strengthening and developing equipment (0.802) had the highest correlation, followed by standardization (0.747), having access to air relief facilities (0.727), the development of rescue bases (0.713), logistic and support equipment (0.609), and the provision of facilities (0.594).

The results of the same questionnaire for Red Crescent Society and Emergency Medical experts illustrated that the component of having access to air rescue facilities (0.924) displayed the highest correlation, followed by standardization (0.911), strengthening and developing equipment (0.897), development of rescue bases (0.869), logistics and support equipment (0.822), and provision of facilities (0.781). The components related to the dimension of land use planning were correlated in the results of the questionnaire of both groups of top accident experts and experts of RCS and EMS in the results of the questionnaire of top accident experts, it was determined that the location-allocation component based on traffic volume and accident hot spots (0.881) had the highest correlation, followed by constructive interaction between society and nature (0.822), targeted planning (0.814), land spatial development (0.737), the systematic evaluation of effective factors (0.689), and the balanced geographical

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distribution of the of all missions 0.609.

The results of the same questionnaire for RCS and EMS experts pinpointed that the constructive interaction between society and nature had the highest correlation (0.879), followed by location-allocation based on traffic volume and accident hot spots (0.856), targeted planning (0.841), balanced geographical distribution of the of all missions (0.832), systematic evaluation of effective factors (0.816), and land spatial development (0.762). The components related to the dimension of education were correlated in the results of the questionnaire of both groups of senior accident experts and RCS and EMS experts, and in the results of the questionnaire of the senior accident experts, it was determined that diversity in educational programs had the highest correlation (0.860), followed by having an educational perspective (0.857), the use of modern tools (0.813), and determining educational needs (0.774).

The results of the same questionnaire for RCS and EMS experts pointed out that the component of having an educational perspective had the highest correlation (0.786), followed by the use of modern tools (0.763), diversity in educational programs (0.721), and determination of educational needs (0.681). The components related to the dimension of expertise were correlated in the results of the questionnaire of both groups of accident experts and RCS and EMS experts. In the results of the questionnaire of accident experts, it was found that the component of continuous identification of specialized needs had the highest correlation (0.820), followed by diversity in specialized programs (0.792), using new developments (0.780), and continuity of technical knowledge (0.714).

The results of the same questionnaire for RCS and EMS experts demonstrated that the component of diversity in specialized programs (0.863) had the highest value, followed by the use of new developments (0.821), continuous identification of specialized needs (0.738), and continuity of technical knowledge (0.654). The factor analysis of the effect of Emergency Medical Services on the severity of traffic accidents is presented in Table 6.

Table 6 demonstrates factor loadings between dimensions and components related to the effect of rescue and relief services on the severity of traffic accidents. Regarding the coefficient R^2, the value of this coefficient should be more than 0.05 at the significance level of 0.95. According to the presented general model, it can be observed that at the level of 0.95, there are relatively strong relationships between the dimensions and components investigated with the effect of rescue and relief services on the severity of traffic accidents, and the relationships are significant. In addition, the highest impact of rescue and relief services on the severity of traffic accidents from the perspective of senior accident experts was related to the dimension of equipment (42.009), followed by land use planning (39.419), education (33.77), and expertise (8.951).

Moreover, from the perspective of RCS and EMS experts, the greatest effect of rescue and relief services on the severity of traffic accidents pertained to equipment (31.077), followed by land use planning (25.610), expertise (23.598), and education (8.243). On the other hand, it can be observed that the factor loadings of all aspects of the impact of rescue and relief services on the severity of traffic accidents, including equipment, land use planning, education and expertise are more than 0.5, and all the factor loadings are significant at the 0.95 level. Furthermore, according to the factor analysis table, the value of the t-test obtained from the mentioned test is higher than 1.96, demonstrating that the test is significant and all the obtained dimensions and components showed a strong relationship with the effect of rescue and relief services on the severity of traffic accidents. In order to check the adequacy of the presented model, the fit indices according to Table 7 were used, and the results are as follows.

Table 7. Results of the adequacy test of the dimensions of the impact of rescue and relief services on the severity of traffic accidents

Dimensions	Mean Squared Error	Root Mean Square Error	Q^2
Equipment	0/096	0/082	0/636
Land use planning	0/112	0/091	0/463
Expertise	0/167	0/127	0/357
Education	0/185	0/165	0/319

One of the best fit indices of structural equation models in SmartPLS3 software is the Root Mean Squared Error (RMSE). This index shows to what extent the experimental model matches the assumed theoretical model. The second structural model fit index, the Q2 index, is

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the Aston-Geiser index. This index specifies the prediction power of the model in endogenous structures. The negative value of this index is suggestive of a very weak estimate of the latent variable, while the positive value indicates that the model has a good fit and high predictive power. The Q2 index is positive in the effectiveness of rescue and relief services in the severity of traffic accidents for all dimensions and components. In addition, the values obtained for the dimension of equipment and land use planning had stronger validity and predictive power for model prediction than other dimensions.

Discussion and Conclusion

The present study aimed to assess the effect of rescue and relief services on the severity of traffic accidents. The qualitative interview results demonstrated that rescue and relief services' dimensions in the severity of traffic accidents include equipment, land use planning, expertise, and education. Moreover, the effect of each of the dimensions in the statistical population was also evaluated in the quantitative section, and the results pinpointed that these dimensions are closely related to each other. It is worth mentioning that in the analysis of the results of the qualitative and quantitative sections of the research, it was found that all the extracted dimensions, including equipment, land use planning, expertise, and education which were the output of interviews with specialists and experts, in the same order of priority, were confirmed by the statistical community of the quantitative section, including senior accident experts and the RCS and EMS experts. The only difference was that senior accident experts considered education more important than expertise, while RCS and EMS experts attached more importance to expertise.

In confirmation of these results, we can refer to the research by Zamani (1401), which suggested that the most important criterion in the location-allocation and land use planning of relief and rescue centers is easy access to the road and rail transportation network. This finding is, to some extent, in line with the results obtained in this research, including spatial development of the land, taking into account the capabilities, opportunities, and limitations in the dimension of land use planning. In a similar vein, the findings of the study by Farokhimanesh et al. (2020) entitled The components and indicators of improving the quality of public education of Rescue & Relief in Red Crescent Society are in agreement with the components of determining the needs and educational resources of the organization and the use of modern tools and smart equipment in education dimension.

Along the same lines, the findings of the study by Abid and et al. (2021) revealed that the integration of geographic information system and remote sensing of disaster management, planning, systematic evaluation of natural, social, economic, and cultural factors, situational awareness and recovery and return to the first state made it possible to rescue traffic accident victims.

In addition, the findings of the study by Asarian-Nejad and Mehri (2015) illustrated that the systematization of the rescue system and the use of the golden time to help the victims of traffic accidents can help reduce the severity of traffic accidents and prevent accidents. They are aligned with the component of strengthening and development of equipment and standardization of specialized equipment in terms of equipment and the component of spatial development of the land, taking into account the capabilities, opportunities, and limitations, and location-allocation based on traffic volume, accident hot spots, and proximity to medical centers in land use planning dimension in this research. In explaining these findings, it can be stated that it is necessary to consider the impact of rescue and relief services on the severity of traffic accidents and all four dimensions of equipment, land preparation, education, and expertise and their components in order to witness a reduction in traffic-related death rate.

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Conflict of Interests

Authors have no conflict of interests.

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References

1. Amiri M. Model of traffic accident management in Iran, first edition, Tehran: Rahvar FARAJA Police Research Center Publications. 2014 (In Persian)
2. Amiri M, Souri H, Khankeh H, Momeni A, Aeini A. The factors affecting accident scene management: a grounded theory study in the Islamic Republic of Iran. Rahvar Scientific Quarterly, 2014, Vol 11, pp.30-11. http://talar.jrl.police.ir/article_11593.html (In Persian)
3. Murray CGL, Lopez AD. The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020, Boston, Harvard University Press. 2020
4. Parhizkar A. Presenting Model and criteria Site Selection Station of Fire, Departments, Research Center of Urban and rural. 2014 (In Persian)
5. Ebrahimi M, Alavi E A, Meshkini, A. Spatial distribution pattern and organizing of crisis management supportive bases using MCDM and GIS (Case study: zone 18 of Tehran). Urban Structure and Function Studies, 2017; Vol.4, No.13, pp. 44-69. DOI :10.22080/shahr.2017; pp. 15-17 (In Persian)
6. Esmaili A, Azizi H, Zahiri M. Investigating the role of the traffic police in the management of road accident scenes (case study: Ardabil province), Traffic Management Studies Quarterly, 2009; Vol.5, No.17, pp.1-23. (In Persian)
7. Zamani M. Locating rescue centers using AHP and GIS combined model. Research Journal of Transportation, 1401, http://www.trijournal.ir/article_162070.html?lang=fa (In Persian)
8. Farokhimanesh M, Jahed H, Sarikhani N. The components and indicators of improving the quality of public education of Rescue & Relief in Red Crescent Society. Journal of Psychological Sciences. 2020; Vol.19, No.91, pp.883-891(In Persian)
9. Assarian Nejad H, Mehri T. Investigating the role of intelligent systems in reducing human casualties on the highways of Tehran. Rahvar Scientific Quarterly, 2015; No. 18, pp. 37-73. http://talar.jrl.police.ir/article_11646.
10. Azani M, Moradipour M, Jahangir E. Investigating the extent of the Red Crescent Society's road bases with specialized and mandatory rescue and rescue facilities and equipment, Rescue and Rescue Journal, 2015; Vol.7, Iss.1, pp. 61-69. (In Persian)
11. Chaharsoughi Amin H, Rezania K, Nouri H, Tardest H, Shiri SH, Soleimani Mehri M. Rescue and Relief stations in reducing the number of injuries resulting in death. Rescue and Rescue Journal, 2014; Vol 6, No.4, pp.92-107. https://www.sid.ir/paper/190907/fa (In Persian)
12. Abid SK, Sulaiman N, Chan SW, Nazir U, Abid M, Han H et al. Toward an integrated disaster management approach: How artificial intelligence can boost disaster management. Sustainability (Switzerland). 2021; Vol.13, No.22 https://doi.org/10.3390/su132212560
13. Vafaeinejad A, Bolouri S, Alesheikh AA, Panahi M, Chang-Wook L. The Capacitated Location-Allocation Problem Using the VAOMP (Vector Assignment Ordered Median Problem) Unified Approach in GIS (Geospatial Information System). Machine Learning Techniques Applied to Geospatial Big Data. Appl. Sci. 2020,Vol.10, No.23 https://doi.org/10.3390/app10238505 (In Persian)
14. Heydari M, Aryankhesal A, Khorasani-Zavareh D. Laypeople roles at road traffic crash scenes: a systematic review. International Journal of injury control & safety promotion. 2019; 82-91 DOI:10.1080/17457300.2018.1481869(In Persian)
15. Agha Mohammadi A, Moradi M. Land preparation in regional development. Journal of Geography and Human Relations, 2017; Vol.1, No.2, pp. 957-968. (In Persian)
16. Sarvar R. Land use planning in regional civil development plans, Ganj e Honar Publications. 2008 (In Persian)
17. Khanifar H. An introduction to the concept of land preparation and its application, Land Preparation Magazine, 2010; Vol.2, No.2, pp. 2-26 https://jtcp.ut.ac.ir/article_21766.html (In Persian)

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