Influence of Police Authorities and Units on Transport Safety in the European Union Countries

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Summary
The article is devoted to analyzing the police influence on road safety formation. The globalization processes confirm the study's relevance, provoking population mobility and the need to increase freight traffic. The study aims to identify the factors that affect road safety and the activities of the police and the EU transport safety units. An empirical analysis using factor analysis, correlation analysis, and general scientific methods of cognition were carried out to achieve the goal. The analysis results found that the number of police officers affects road safety, but not in all countries, which confirms the importance of other factors. Based on the analysis results of the scientific literature, the factors affecting transport safety are legislative regulation, the use of innovative technologies, transport infrastructure, geography, and psycho-physical and emotional drivers factors. It has been proved that the police authorities and units cannot fully ensure transport safety in the European Union because the safety is formed by a complex of actions by the state and road users.

Keywords:
Road safety, traffic accident, vehicle (vehicle), law enforcement agencies, accident, road traffic.

1. Introduction

The development of civilization in recent decades has been paralleled by the rapid growth of the transport complex and the automotive industry. In such conditions, the problem of transport safety becomes more and more urgent for the whole world and Europe in particular. Every year the number of accidents, which lead to the loss of human lives, is growing. The increase in traffic also increases the cost of repairs, vehicle and pavement service, treatment, and insurance for the injured (Gamero N., Silla I., Sainz-González R., Sora B., 2018). The adverse effects of increased traffic also affect the environment, particularly the amount of CO_2 air emissions, increased vibrations, and noise pollution in populated places.

Statistics from 2017 show that 1.3 million people die each year in car accidents. Losses from accidents in the European Union only amount to 200 billion euros. Such figures require increased attention to the problem by the authorities, which should take measures to improve transport safety (Żukowska J., Mikusova M., Michalski L., 2017). Looking for the reasons for this statistic, we can assume that the main one is the traffic increase. But this factor, even though it is influential, is not the only factor. To ensure safety on the road, government agencies try to implement regulatory and control systems. One of the responsible authorities for ensuring road safety is the police. The function of the police is not only controlling and stimulating. The police, as a public service, is an essential part of the administration. It identifies factors that have a negative impact on traffic safety and, conversely, identifies factors that improve safety on the roads.

2. Literature review

The article is based on statistical research presented in the EU Road Safety Action Plan (European Commission, 2018). The collected data confirms the appropriateness of the actions applied to solve the problem. In order to determine the safety level, several indicators are used, which include: speeding on the roads, drivers' use of seat belts and child protection, use of safety equipment, drunk driving, driver distraction level to different devices and objects inside the car, the safety level of new vehicles, the safety of road infrastructure, the effectiveness of assistance following an accident (European Transport Safety Council, 2020).

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To control the safety level on the roads, police officers use monitoring, tracking, and punishment for safety violations (Salmon P. M., Read G. J. M., Stevens N. J., 2016). But police functions include more than just these three responsibilities. The spectrum of police functions is much higher, and many functions are handled only with the use of modern police technology. Practice shows that the higher the level of modern police equipment, the faster, more effective road safety monitoring becomes. For example, the improvement of technologies for fixing violations of traffic rules makes monitoring permanent without the direct involvement of police officers. In turn, road users, having information about automated monitoring, act more carefully on the roads, following the basic rules of the road (Kristie L. Y., Regan M. A., 2007).

Today, almost all European Union countries have unified standards for road safety. The safety program concerns the technical and technological capabilities of monitoring and the specialist's professional training. In order to ensure that police officer can work with modern equipment and effectively perform their tasks, they must receive education and special skills for its use. To organize such training programs, the state organizes special training courses, as well as special units that aim to ensure traffic safety on the roads (Kuczyńska E., Nowicka I., Grześkowiak A., 2018).

The issues of the importance of the transport system and traffic are quite widely researched in the scientific literature. For example, Łukasik Z., Kuśmińska-Fijałkowska A., and Kozyra J. (2017) show the importance of transport for the national economy and its impact on socio-economic development. The authors underline that the transport complex development increases the risk level of road accidents. Transport, regardless of its purpose, is quite dangerous not only for drivers and passengers but also for the environment because it provokes the emission of pollution (Łukasik Z., Kuśmińska-Fijałkowska A., Kozyra J., 2017).

Regulatory and technical frameworks for the transport use are explored by Gamero N., Silla I., Sainz-González R., Sora B. (2018). These authors emphasize that regulation at the state level is the main factor that contributes to road safety. But in addition to state regulators, organizational factors are also necessary to maintain a high road safety level. Such factors include forming road safety standards and regulations (European Parliament, 2003). In addition to road safety standards, it is important to organize the financial component of regulation, and the institutional component, to establish road and service infrastructure, produce and operate vehicles that meet international requirements, and minimize the negative impact on the environment and human health. It is also necessary to timely respond to technical and innovative developments in transport and services and produce and operate vehicles that meet international requirements and minimize the negative impact on the environment and human beings. It is also necessary to timely respond to technical and innovative changes, regularly update safety standards for cars, and improve law enforcement to control road risks (Shah S. A. R., Ahmad N., Shen Y., Pirdavani A., Basheer M. A., Brijs T., 2018).

As Shinar D., Treat J. R., and McDonald S. T. (1983) show in their study, the main sources for analytical information are police accident reports, which summarize statistics and information used in the trial process. In addition, data from findings on law enforcement program development to improve transportation safety are also taken as a source of information. But even though these reports are almost a single source of information, we cannot take their data as complete and objective because they show only a fraction of the traffic accidents that occur on the roads.

The purpose of the study is to identify the factors that affect safety on the road, as well as the activities of the police and the EU transport safety units.

It is necessary to carry out the tasks presented below in order to achieve the goals:

1) to identify the factors that affect transport safety in the EU member states.
2) to analyze and evaluate statistical data in the European Union on the EU regulatory authorities, the number of transport and traffic accidents, and victims in their aftermath.
3) to examine the relationship between road accidents and the number of police officers; the number of victims of road accidents and the number of police officers; the number of vehicles, and the number of road accidents.
4) identify and summarize the impact of the police on transport safety in the EU.

3. Research Methods and Sources

Statistical analysis is used for the empirical study to collect and compare data on the police number and traffic accidents on the roads, the number of victims in accidents, and the number of vehicles on the roads in different European Union countries.

The correlation analysis allows establishing the relationship between the studied indicators from 2015 to 2018 for the following countries: Cyprus, Greece, Germany, Sweden, Belgium, and Finland. Furthermore, the analysis is carried out for the same period on the number of accidents in Cyprus, Greece, Belgium, Germany, Finland, and Sweden.

In order to summarize the data and make an analogy, the method of factor analysis is used, which allows for determining the factors of influence on traffic and transport safety.

To summarize the theoretical knowledge, scientific papers published from 1980 to 2021 were also analyzed.

According to the results of statistical analysis, the following indicators were established:

– the number of police officers per 100,000 inhabitants by EU countries, by period 2015–2018, as reflected in Pordata.
– the level of deaths on the roads for the period 2015–2019 by EU countries;
– number of passenger vehicles in Europe for the period 2015 to 2018, as collected by Eurostat;
– number of road accidents for Cyprus from 2015 to 2019 can be found in Findicator, Statbel, Statistics Finland, Hellenic Statistical Authority, and Bundesanstalt für Straßenwesen.

4. Study results

European countries differ in income and spending on administration and police, so the number of police officers varies from one European country to another. Therefore, in order to determine the relationship between the number of traffic accidents and the number of police officers, it is necessary to identify the countries with the highest number of police officers and the countries with the lowest.

Table 1: Number of police officers per 100 thousand inhabitants in the EU countries

Country	Years			
	2015	2016	2017	2018
Cyprus	580,7	570,7	581,8	566,3
Greece	486,6	490,1	494,6	495,3
Belgium	335,0	332,6	360,8	362,0
Germany	299,9	296,7	298,4	295,3
Sweden	203,1	201,8	196,3	196,9
Finland	140,4	137,2	136,4	139,3

Source: Pordata, 2020.

According to Table 1, it is clear that Cyprus is the country with the most number of police officers among the studied EU countries. According to 2015–2018 statistics, Cyprus has about 566 police officers per 100,000 population. Greece holds second place; the number of police officers here is 495 per 1,000 thousand population. Significantly lower is the indicator in Belgium, which ranks third in the rating. The lowest index has Finland, which has 139 police officers per 100 thousand people. The number of hired policemen tends to decrease every year. In particular, the number of policemen in Cyprus, Germany, and Sweden is falling. In its turn, Finland annually feels the lack of police officers on the roads, so it increases its staff.

Table 2 shows that while Cyprus has the most significant number of police officers, Germany has the largest number of traffic accidents. Belgium takes second place, and Sweden the third. At the same time, Sweden has almost half the traffic accident rate as Germany. Greece has a positive trend in the level of road accidents. The same positive direction is found in Finland and Cyprus.

Table 2: Number of traffic accidents by EU countries

Country	Years				
	2015	2016	2017	2018	2019
Cyprus	958	942	876	741	727
Greece	11 440	11 318	10 848	10 737	10 712
Belgium	40 303	40 096	38 020	38 453	376 99
Germany	305 659	308 145	302 656	308 721	300 143
Sweden	14 703	14 086	14 951	–	–
Finland	5 185	4 752	4 432	4 312	4 002

Source: Cyprus Police, 2020; Findicator, 2021; Statistics Finland, 2020; Hellenic Statistical Authority, 2020; Statbel, 2020; Bundesanstalt für Straßenwesen, 2020

Let us conduct a correlation analysis to establish the relationship between the number of accidents and police officers. To analyze the indicators given in Table 1, 2, the following formula is used:

$$r = \frac{\sum (x_{1_i} - \bar{x}_1) \cdot (x_{2_i} - \bar{x}_2)}{\sqrt{\sum (x_{1_i} - \bar{x}_1)^2} \cdot \sqrt{\sum (x_{2_i} - \bar{x}_2)^2}}$$

where x1 is the number of police officers per 100 thousand inhabitants of the country;
x2 – number of traffic accidents by country;
r – linear correlation coefficient.

For the period from 2015 to 2018, the linear correlation coefficient between the number of accidents and the number of police officers is quite different:

– Cyprus: 0.60;
– Greece: -0.98;
– Belgium:-0.97;
– Germany:-0.70;
– Sweden:-0.58;
– Finland:0.50.

At the same time, the inverse relationship (negative correlation coefficient) is observed for the countries: Greece, Belgium, Germany, and Switzerland. This means that the higher is the number of police officers on the roads, the lower is the accident rate. On the other hand, the statistics for Cyprus and Finland show the opposite data, i.e., the decrease in the level of accidents is partly related to the reduction in the number of police officers on the roads.

First and foremost, the police are responsible for ensuring traffic safety and reducing the number of accidents on the roads. According to statistics for 2015–2019, the most significant number of people who died due to accidents was recorded in Germany – 3,459 people per year. In Greece, for example, the rate is more than three times lower. It is necessary to point out the decrease in mortality by country. In 2015, the mortality rate in almost all countries was higher than in 2019.

Table 3: Road death rate and its dynamics

Country	Years				
	2015	2016	2017	2018	2019
Cyprus	57	46	53	49	52
Greece	793	824	731	700	699
Belgium	762	670	609	604	620
Germany	3 459	3 206	3 177	3 275	3 059
Sweden	259	270	253	324	221
Finland	270	258	238	239	209

Source: European Transport Safety Council, 2020.

After analyzing the relationship between the number of police officers and the road death rate, also the relative change in the road death rate, it is determined that the indicator in Cyprus is r = 0.796. A fairly high reversible relationship is observed in Greece r = -0.823, Belgium r = -0.826. A moderate level of dependence is observed in Germany r = 0.535, Finland r = 0.521.

To determine the impact of police work on the number of road accidents in general, it is necessary to establish the number of vehicles used by the population in the countries included in the sample.

Table 4: Number of vehicles per 1,000 inhabitants

Country	Years			
	2015	2016	2017	2018
Cyprus	575	595	609	629
Greece	474	479	487	–
Belgium	497	503	508	511
Germany	548	555	561	567
Sweden	474	477	479	476
Finland	590	604	617	629

Source: Eurostat, 2020.

From 2015 to 2018, an increase in the number of vehicles was observed in all the studied countries. Specifically, there were 575–629 vehicles per 1,000 inhabitants, in Greece 474–487 vehicles, in Belgium 497–511, in Germany 548–567, and in Finland 590–629. However, a slightly different trend is shown by the statistics of Sweden, where in 2015–2018, the number of vehicles decreased from 479 to 476 per 1,000 inhabitants.

Let us calculate the correlation index between the number of traffic accidents and the number of vehicles per 1,000 inhabitants. According to the analysis, the correlation index is: Cyprus r = -0.936, Greece r = -0.981, Belgium r = -0.880, Germany r = 0.173, Sweden r = 0.166, Finland r = -0.979.

Thus, a weak correlation was found in Sweden and Germany, and a high negative correlation was found in Cyprus, Greece, Belgium, and Finland, which shows a high level of inverse correlation: the more transport – the lower the level of traffic accidents.

5. Discussion

A sufficiently large number of scientists, as well as state authorities regulating transport security, form their opinions, policy and propose development strategies according to the transport policy of the European Union. Special attention is paid to security – as a new concept of transport system (Żukowska J., Mikusova M., Michalski L., 2017). According to the transport policy, the responsibility for transport safety lies with the police authorities, which have a unique opportunity to assess safety directly on the ground, record possible violations, and investigate the causes of violations. All of this data is captured by analysts to shape more effective regulatory policies that aim to reduce the risks of transporting people and goods (Gössling S., 2017). Within a systems approach (Haddon W., 1980), law enforcement agencies use tools to regulate and improve safety and gather data sources to form regulations and legislation on transportation safety (European Commission). However, the study found that there is no direct influence of the police authorities on the level of security in all countries. In some countries, such dependence is observed, in some countries, it is insignificant, so it is not reasonable to generalize data. At the same time, the main factors that indirectly influence road safety have been established. According to the structural model highlighted by Archer J. (2005), road safety depends on the use of technology, the behavior of drivers, and sociology in general. Security is shaped by many aspects, as shown by Alonso F., Esteban C., Montoro L., Useche S. A., and Crowther-Dowey C. (2017). The authors of this study share the same opinion: it is not possible to influence road safety by influencing one factor because there is always a large influence from others. For example, despite innovative technologies for monitoring or significant investments in road construction, the human factor always occupies an essential component in shaping safety on the road. Thus, to show the whole set of factors, it is necessary to consider the attitudes, opinions, and people's perception of traffic rules, the presence of police supervision, and the implementation of a penalty system for traffic violations (Alonso F., Esteban C., Montoro L., Useche S. A., Crowther-Dowey C., 2017). Bąk J. and Bąk-Gajda D. (2008) also confirm this statement and show that

traffic cannot be generalized by general trends since each situation has unique conditions for a crash. At the same time, scientists show that the level of traffic accidents can be influenced by: the level of physical activity (determined by medical examination), psychological state (determined by psychological tests), and driving skills (determined by experience).

If we investigate the driver's attitude to safety on the road, they are mainly characterized by external factors, in particular, such as road quality, traffic regulation, and the presence of police control. But in addition to external, drivers also highlight internal aspects, which include psychological and emotional state, social adaptation, skills to solve complex problems, and self-discipline (Kuczyńska E., Nowicka I., Grześkowiak A., 2018). But at the same time, we should also highlight innovative factors, which should include innovative technologies that are used to automate the recording of traffic violations and digitalization of transport infrastructure. Especially nowadays, drivers appreciate the use of gadgets, and guides, which provide a more comfortable driving environment and allow the driver to reduce the risks on the road independently. Furthermore, such systems make an additional alert in case of traffic violations, allow to choose the right route, and reduce the number of errors on the road, which improves the psychological and emotional component of safety (Marusin A., Marusin A., Ablyazov T., 2019).

The Covid-19 situation has shown that the socio-medical aspect should be added to the already established and highlighted earlier factors of safety on the road. The number of deaths on the roads has increased not only for the reasons shown above but also through the increase in the overall mortality in the population, which comes with the time spent on the road also. In particular, Italy has the most road deaths in Italy (84 %), followed by Belgium, Spain, France, and Greece, with a decrease of over 59% (European Transport Safety Council, 2020). The number of accidents on the roads could be much lower if people who feel ill stayed home instead of being in their vehicles. The author's team agrees with Budd L. and Ison S. (2020), who state the importance of federal restrictions to prevent the spread of the virus. Another fact to add to this is the possibility of contracting the virus through being in an enclosed transport space with an infected person. Not all drivers and passengers are responsible to the public, and controlling authorities, particularly the police, cannot control the process of transporting people, so transport is one of the most common places where the disease is spread.

6. Conclusion

Analysis of the scientific literature has shown that the police bodies and units are separate elements in the transport safety system, which is formed by many items. The main function of the police is to control and fix legal responsibility for violations of traffic safety rules.

Statistical analysis using correlation analysis has shown that in many countries, there is a high level of correlation between the number of police officers and traffic accidents. The correlation is inverse: the more police – the lower the number of casualties. But among European countries, some do not show such a correlation because other factors have a more substantial influence on the level of safety on the road than police control. Analysis of the dynamics of deaths on the road and its comparison with the dynamics of the number of police officers does not show a clear correlation. But the overall trend of road deaths from 2015 to 2019 is positive, which is due to better control, as well as the ability to use innovative technology to make travel arrangements. The analysis proves a weak correlation between the number of cars and the number of accidents in Sweden and Germany. It reveals a negative correlation in Cyprus, Greece, Belgium, and Finland, which shows that, in general, the number of accidents is not related to an increase in the number of cars.

Consequently, in order to ensure road safety, it is necessary to: improve the regulatory framework, increase the level of innovation and technology, develop transport infrastructure, improve road quality, and have a positive impact on the level of the psychological and emotional state of the drivers. That is why it is not enough to improve the police units' work to reduce the risks on the roads significantly. To achieve this result, it is necessary to take comprehensive measures and form strategies to reduce road risk.

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