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THE VEHICLE INSURANCE AND THE RISK OF ROAD ACCIDENTS IN POLAND

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Abstract

Vehicle third-party liability insurance, or civil liability insurance, is not only the most important but above all mandatory insurance for every vehicle owner. Third-party liability insurance covers the costs of repairing damage caused by the insured to other road users. Therefore, vehicle third-party liability insurance protects not so much the insured themselves, but rather third parties who receive financial compensation for damages incurred and compensation for bodily injury. This study analyzed the relationships between vehicle insurance policyholders and individuals involved in road accidents. To achieve this, the age structure of individuals purchasing private car policies and the age structure of individuals involved in road accidents were analyzed. Insurance companies calculate the premium amount taking into account many factors related to both the driver and the vehicle. The age of the owner, years of driving experience, claims history, place of residence, and marital status are important factors. The age and brand of the car, as well as the engine capacity, are also significant. The study also presents the average amounts of vehicle third-party liability insurance in selected European countries along with the number of road accidents. The results confirm that accidents caused by young drivers are more tragic in their consequences, so young and inexperienced drivers must expect significantly higher costs when purchasing mandatory third-party liability insurance.

Keywords: vehicle insurance; safety; traffic accidents; fatalities

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1. Introduction

The third-party liability insurance (OC) market in Poland, covering mandatory liability insurance for vehicle owners, is a key component of the country's insurance sector. The purpose of this insurance is to protect individuals injured in road accidents, ensuring they are compensated for claims against the responsible parties. The obligation to hold OC insurance has existed in Poland since 2003, leading to almost full market penetration among vehicle owners [2, 20].

The market structure is dominated by several large insurance companies, such as PZU, Warta, and Ergo Hestia, which compete not only on price but also on the quality of services offered. The market is also experiencing consolidation, as evidenced by mergers and acquisitions like those of AXA and Aviva. The fluctuating OC insurance premiums result from various factors, including the place of residence, driver's age, engine capacity, and claims history. Modern solutions, such as telematics, allow for monitoring driving behavior and better tailoring premiums to individual risk [2, 19]. Market trends indicate a growing interest in advanced technologies, such as Usage-Based Insurance (UBI). These changes are also related to the increasing number of electric vehicles and the need to adapt insurance offers to new conditions. Insurers also face rising compensation costs, driven by higher repair and medical care expenses [3, 19].

The literature also points to the role of supervisory institutions like the Insurance Guarantee Fund (UFG), which ensures protection for victims in cases where the at-fault party did not have valid OC insurance [3, 20]. It is expected that the market will evolve toward greater personalization of offers and optimization of processes using new technologies. Between 2019 and 2023, the Polish insurance market experienced steady growth and dynamic changes. The value of assets held by domestic insurance companies increased from €43.6 billion (193.9 billion PLN) in 2019 to €49.0 billion (218.1 billion PLN) in 2023. Despite slight declines in 2020 and 2021, the value of assets grew gradually, indicating the sector's stability and continued development. Insurance companies play a vital role in the economy, acting as significant long-term investors in Polish enterprises and as economic stabilizers [5, 12].

The value of gross written premiums also increased, from €14.2 billion (63.3 billion PLN) in 2019 to €17.7 billion (78.9 billion PLN) in 2023. A large portion of this amount comes from property insurance, which accounted for 71% of total premiums in 2023, reflecting a growing demand for these insurance products. This growth reflects increased customer awareness of the need to protect their property, including vehicles and real estate [5, 12]. Motor insurance continues to dominate the market, with the value of gross written premiums rising from €5.3 billion (23.5 billion PLN) in 2019 to €6.4 billion (28.3 billion PLN) in 2023. Mandatory motor third-party liability insurance accounted for a significant portion of this, reaching €3.5 billion (15.7 billion PLN) in 2023. The value of comprehensive coverage (Autocasco) also

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rose, from €2.1 billion (9.5 billion PLN) in 2019 to €2.8 billion (12.6 billion PLN) in 2023, indicating a growing need to protect vehicles against various risks. The value of claims and benefits paid increased during the analyzed period, from €8.7 billion (38.5 billion PLN) in 2019 to €9.9 billion (44.2 billion PLN) in 2023. The increased payout amounts reflect a higher number of claims and the growing value of damages in both motor and property insurance. Insurers have had to meet rising obligations to customers, which has affected their cost structures [5, 12, 21].

The financial performance of property insurance companies grew significantly between 2019 and 2023, reaching €1.4 billion (6.2 billion PLN) in 2023, the highest figure during this period. The results of life insurance companies also improved, reaching €741 million (3.3 billion PLN) in 2023. These outcomes demonstrate the good financial health of the insurance industry in Poland, despite challenges related to rising compensation costs [5, 12]. The number of active OC insurance policies for vehicle owners rose from 27.1 million in 2019 to 28.1 million in 2023, indicating a high market penetration. Similarly, the number of active Autocasco policies increased from 6.6 million to 7.4 million during the same period. The growth in the number of insurance policies reflects the growing awareness among consumers about the benefits of insurance coverage and the increased demand for property protection [21, 28].

The Polish insurance market between 2019 and 2023 developed steadily, with an increasing value of premiums, assets, and compensation payouts. The motor insurance sector plays a key role, and the financial results of insurance companies indicate the entire industry's good condition. Between 2019 and 2023, the European Union (EU) vehicle insurance market underwent significant changes, driven by technological advancements, the growing popularity of Advanced Driver Assistance Systems (ADAS), and the rapidly increasing interest in Usage-Based Insurance (UBI). Changing consumer preferences and rising repair costs were crucial factors shaping the market during this period [1, 16, 18].

The value of the European motor insurance market grew at a Compound Annual Growth Rate (CAGR) of 2.36%. In 2019, the market was worth $105 billion, reaching $118 billion in 2023. This growth was driven by the increasing number of vehicles on the road and rising costs related to compensation and repairs for technologically advanced vehicles. The growing demand for more advanced vehicle protection technologies also translated into higher insurance premiums [21, 28].

Advanced Driver Assistance Systems (ADAS), such as automatic emergency braking and lane-keeping assistance, became increasingly common in new vehicles. The annual growth rate in the popularity of these systems averaged 14.87%. In 2019, about 40% of new vehicles were equipped with ADAS, and by 2023, this percentage had risen to 80%. While these systems improve road safety, they also increase vehicle repair costs, which had a direct impact on the rising cost of insurance premiums [14, 24, 29].

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Usage-Based Insurance (UBI), which uses telematics to monitor a driver's behavior, saw massive growth in popularity. Between 2019 and 2023, the number of active UBI policies grew at an annual rate of 35.99%. In 2019, 5% of drivers used this type of insurance, and by 2023, this percentage had risen to 20%. UBI growth was particularly dynamic in Italy and the UK, where telematics became a key element in monitoring driver behavior and calculating premiums [6, 17, 30].

The rise of inflation in Europe, especially between 2021 and 2023, further contributed to the increase in insurance premiums. Rising vehicle repair costs, especially those equipped with advanced ADAS technologies and electric vehicles, forced insurers to raise premiums. Repair costs rose by an average of 5–12% annually, depending on the region and the type of technology in the vehicles. The years 2019–2023 were a period of dynamic development in the EU vehicle insurance market [14, 17]. The popularity of ADAS and UBI significantly impacted premium growth, and rising repair costs further fueled this trend. Despite inflation-related challenges, the market value grew steadily, demonstrating that insurers successfully adapted their offers to the changing needs of the market [17, 30].

The risk analysis associated with accidents during waste incineration processes on ships, as described in study [15], employs the FMEA technique. This risk assessment approach is also useful in third-party liability insurance, where identifying potential hazards and managing risks can help reduce damages and optimize premiums. Study [25] focuses on multivariate modeling of insurance claims, which is crucial for predicting losses and adjusting premiums to individual driver risk levels. Such modeling supports the personalization of insurance offerings in an increasingly competitive third-party liability market. The authors of study [10] addressed the issue of adverse selection in motor insurance, indicating that drivers opting for more comprehensive insurance often carry a higher accident risk. This phenomenon highlights the importance of the bonus-malus system and solutions like Usage-Based Insurance (UBI), which better align premiums with individual driver risk levels. Forecasting the number of road accidents in Poland depending on the day of the week was discussed in study [9]. Using neural networks to analyze this data can aid in predicting OC market needs and future trends in road safety, directly influencing risk calculations.

The impact of driver training quality on road safety is the topic of study [11], which examines the link between driver preparation levels and accident risk. In the context of third-party liability insurance, proper driver training can help reduce the number of damages, leading to lower insurance costs. The analysis of the technical condition of road infrastructure and its impact on road safety, presented in study [8], underscores the importance of road quality in risk assessment by insurers. Investments in infrastructure can reduce the number of accidents, positively affecting the number of claims and the stability of the OC market. Study [13] describes the impact of maintaining a safe distance between vehicles on road safety. Distance-monitoring technology, such as ADAS systems, can help reduce the number of accidents, which translates into fewer claims and more competitive insurance premiums.

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Road traffic safety management systems, such as the ISO 39001 standard, are discussed in publication [26]. Implementing such standards can result in improved road safety and reduced claims, benefiting the third-party liability insurance market.

Study [4] presents a comparative analysis of road safety conditions in Poland, Slovakia, and the Czech Republic, providing an international perspective that can help OC insurers adapt their strategies to different regional conditions and safety standards. The final analyzed publication [31] focuses on establishing emergency sections on roads to enhance safety and reduce accident numbers. Such infrastructure investments influence the number of insurance claims and can help insurers manage risks in high-accident areas.

2. Methodology

This study employs a quantitative research approach, focusing on analyzing statistical data to explore the relationship between third-party liability (OC) insurance and road accidents in Poland. The methodology encompasses data collection, data preparation, and analytical procedures, including correlation analysis, regression analysis, and clustering.

2.1. Data Collection

Data for this study were collected from various secondary sources, including internal reports from Generali Insurance and publicly available national statistics from sources such as the Polish Police and Statistics Poland (GUS). These sources provided information on:

- The number of OC insurance policies by age group.
- OC insurance premium amounts across different age groups, vehicle types, and driver profiles.
- Accident statistics, including the number of accidents, fatalities, and injuries by age group.
- Vehicle registration data in Poland for recent years.

2.2. Data Preparation

Data preparation involved standardizing information from different sources to enable accurate comparison and integration. Data points related to insurance policies and road accidents were organized by age group, time period, and geographic location to ensure consistency across datasets. Missing or inconsistent values were verified using national averages where possible. Additionally, all monetary data was converted from Polish Zloty (PLN) to Euro (€) using the exchange rate of 1 € = 4.45 PLN, for easier international comparison.

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2.3. Analytical Procedures

The analytical procedures conducted in this study included three main techniques: Pearson correlation analysis, regression analysis, and K-means clustering. Each of these methods allowed for examining different aspects of insurance data, providing a broad insight into the relationships between the number of OC policies, the age of insured individuals, their occupational group, and risk indicators such as the number of accidents, injuries, and fatalities.

The first step was to perform Pearson correlation analysis to determine the strength and direction of the relationship between the number of active OC policies and accident indicators across various age groups. Pearson correlation helps identify the extent to which variables are related – in this case, whether a higher number of OC policies in a particular age group corresponds to a higher occurrence of accidents, injuries, or fatalities. Pearson correlation coefficients range from –1 to 1, where values close to 1 indicate a strong positive relationship, values close to –1 indicate a strong negative relationship, and values near 0 show no relationship. In this study, high correlation coefficients suggested that in age groups with a greater number of active drivers and OC policies, the risk of accidents, as well as related injuries and fatalities, also increased.

The next step was regression analysis, aimed at examining trends in OC insurance costs for different occupational and age groups over the years 2020–2022. Regression analysis allows for predicting changes in one variable (e.g., OC premium costs) based on changes in another variable (e.g., age or occupational group). This study focused on estimating slope coefficients, which indicate an increase or decrease in OC premium costs for each occupational group. Results from the regression analysis revealed that OC costs consistently declined across most occupational groups in the analyzed period, with the largest decreases observed in professions such as athletes, IT employees, and unemployed individuals. High determination coefficient (R^2) values above 0.97 for most occupational groups reflect a strong fit of the regression model to the data. A high model fit means that changes in insurance costs for specific occupational groups can be predicted with great accuracy based on previous years' trends.

To assess the statistical significance of differences in insurance costs across the years 2020, 2021, and 2022, Analysis of Variance (ANOVA) was conducted. The ANOVA result showed that differences in insurance costs across the years were not statistically significant ($p > 0.05$), suggesting that changes in OC costs during the studied period were relatively uniform and gradual. The lack of significant differences between annual premium costs indicates that no sharp increases or decreases in OC costs were observed, which could indicate market stability.

The final analytical step involved K-means clustering, which grouped occupational groups based on similarities in insurance costs from 2020 to 2022. K-means clustering is a data grouping technique that allows for the creation of clusters containing objects with similar

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characteristics. In this study, three main occupational clusters were identified based on OC premium levels:

- Group 0: Contains professions with relatively higher OC insurance costs, such as athletes, unemployed individuals, and IT employees. Higher insurance costs for these groups may result from the perceived higher risk associated with their professional profiles or lifestyles.
- Group 1: Consists solely of students, suggesting that individuals in this age and occupational group have a completely different risk profile, which affects their OC premium rates.
- Group 2: Includes most professions, such as lawyers, office workers, manual workers, and management staff. Insurance costs in this group are stable, indicating lower risk and more predictable driving behavior.

Clustering results allowed for identifying occupational groups with similar risk profiles, which can be useful for further research on OC insurance market segmentation and the development of more accurate, tailored insurance offers.

3. Motor vehicle statistics

Between 2014 and 2023, the number of motor vehicles in Poland steadily increased, achieving an impressive growth from 26.47 million to 35.91 million, which represents a 35.7% rise. The highest growth was recorded in 2018, when the number of vehicles increased by 4.57%, representing an addition of more than 1.35 million vehicles. The growth rate slowed somewhat in subsequent years, with 2021 showing an increase of only 2.44%. This suggests some market saturation; however, the number of vehicles still grew by over 1 million annually in recent years. Figure 1 illustrates the characteristics of registered vehicles in Poland from 2014 to 2023.

The number of passenger cars increased by 36%, from 20.00 million in 2014 to 27.23 million in 2023. The largest percentage growth in passenger cars occurred in 2016, with a rise of 4.59%. In later years, particularly in 2022, this growth rate slowed, reaching only 1.63%. Despite this, passenger cars remain the dominant mode of transport, with the largest share of the total number of vehicles. Trucks also saw growth, though at a slightly slower pace. The number of trucks rose by 25.2%, from 3.04 million in 2014 to 3.80 million in 2023. The largest increase in the number of trucks occurred in 2019, with a growth rate of 3.66%, while in the last year (2023), the growth was more moderate at 1.99%. This indicates that the number of commercial vehicles grew at a stable but slower pace than passenger cars. Motorcycles gained in popularity, with their number rising from 1.19 million in 2014 to 1.92 million in 2023, an increase of 61.6%. This growth was particularly pronounced in 2023, when the number of motorcycles increased by 5.64%, indicating the growing popularity of motorcycles as a means of transport [7, 15]. Characteristics of selected groups of registered motor vehicles in Poland in 2014–2023 are presented in Figure 2.

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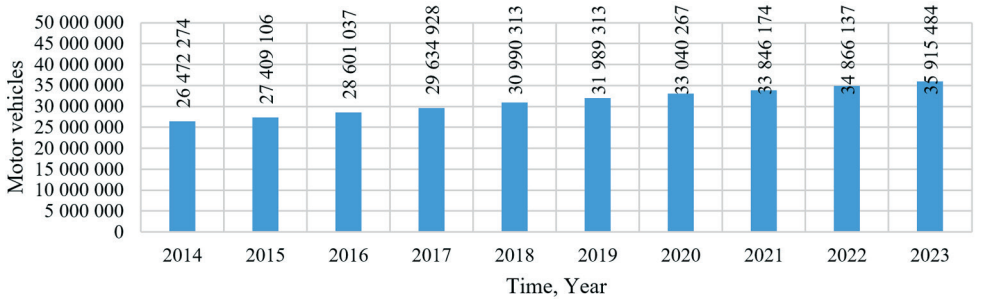

Fig. 1. Number of registered vehicles in Poland in 2014–2023 [23]

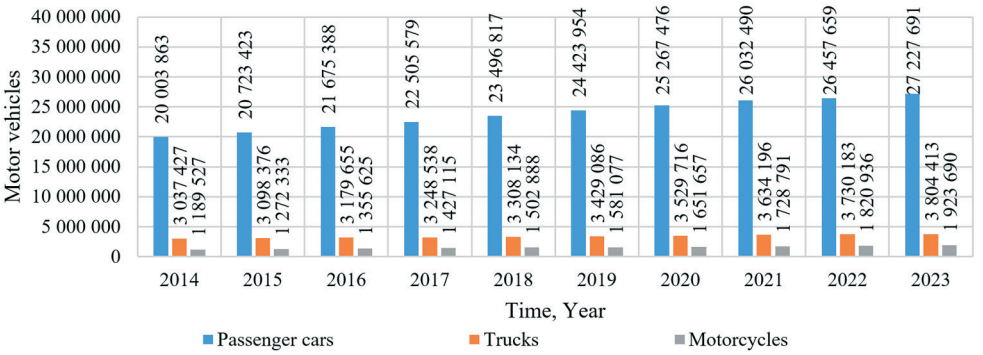

Fig. 2. Characteristics of selected groups of registered motor vehicles in Poland in 2014–2023 [23]

Correlation Pherson analysis has shown very strong relationships between the overall number of motor vehicles and specific types of vehicles. The correlation between the number of motor vehicles and passenger cars is 0.999, and with trucks, it is 0.993. For motorcycles, the correlation is 0.997. This means that the increase in the number of motor vehicles in Poland was driven primarily by the growth in the number of passenger cars, and to a lesser extent, by motorcycles and trucks. Passenger cars, which dominate Polish roads, had the strongest influence on the total number of vehicles. Given the growth rate so far, it is projected that the number of motor vehicles in Poland will continue to rise until 2030, although the growth rate may gradually slow due to market saturation. Assuming an average annual growth rate of 3%, the number of motor vehicles could reach around 44–46 million by 2030. The number of passenger cars, at a similar growth rate, could approach 33–35 million. For trucks, this number could be around 4.5 million, while the number of motorcycles could exceed 2.5 million, indicating their continued rise in popularity.

However, several key factors could influence these forecasts. Climate policies and environmental regulations, such as emission restrictions and the promotion of electric vehicles, may

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significantly impact the automotive market structure. Government support programs for electric vehicles and the development of charging infrastructure could accelerate the adoption of electric cars while reducing the demand for traditional combustion-engine vehicles. Demographic changes, such as an aging population and migration to cities, could lower the demand for new vehicles, particularly in the passenger car segment. Additionally, fuel prices and the availability of electricity could affect consumer preferences. High fuel prices might accelerate the transition to more fuel-efficient vehicles, while the stability of electricity supplies will be critical for the growth of the electric car market. The sharing economy and the development of autonomous vehicle technology could also alter transportation usage, potentially limiting the number of new vehicles registered. Economic conditions will also play a significant role—during periods of economic growth, increased purchasing power tends to boost new vehicle sales, while financial crises may delay purchasing decisions and stimulate the used vehicle market. Consumer behavior and growing environmental awareness may also influence transportation choices, promoting more sustainable means of travel, which in turn could reduce demand for private cars.

Between 2016 and 2023, the number of new vehicle registrations in Poland across various categories (passenger cars, trucks, buses, motorcycles, and scooters) exhibited fluctuating trends, which can be attributed to both economic conditions and changing consumer preferences (Figure 3). In the new passenger car segment, the number of registrations increased from 61,858 in 2016 to a peak of 70,812 in 2021, representing a 14.5% rise compared to 2016. In 2022, this number dropped to 69,831, and in 2023, it sharply declined to 64,522, marking a 7.6% decrease compared to 2022. The 2023 decline could be the result of market saturation and global supply chain disruptions that affected the availability of new cars.

New truck registrations showed steady growth over the analyzed period, from 26,532 in 2016 to 35,502 in 2023. This is a 33.8% increase compared to 2016, with particularly dynamic growth observed between 2019 and 2021. Stability in the last two years (2022 and 2023) indicates sustained high economic activity and demand for freight transport, which supports the demand for new trucks. The number of new buses increased from 2,255 in 2016 to 4,550 in 2022, doubling the number of new registrations over six years. However, 2023 saw a sharp decline to just 1,160 registrations, a drop of more than 74% compared to 2022. Such a dramatic change could be due to reduced demand for public transport as a result of the COVID-19 pandemic, decreased public budgets, and shifting investment priorities.

New motorcycles enjoyed steady registration growth, from 22,745 in 2016 to 30,491 in 2021, representing a 33.9% increase. However, growth slowed, and in 2023, only 7,591 new motorcycles were registered, a drastic 75.4% drop compared to 2022 (30,901). This decline may be explained by changes in consumer preferences or issues related to vehicle availability. Similar trends can be observed with new scooters, where registrations grew from 14,211 in 2016 to 20,168 in 2022, a 41.9% increase. However, in 2023, registrations sharply fell to 4,577, a 77.3% decrease compared to 2022. The decline in the scooter segment may be related

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to seasonal trends, consumer preferences, and the growing share of electric transportation in cities.

Overall, the market for new vehicle registrations exhibits varying trends. The truck market remains stable and is growing, likely linked to the demand for freight transport. The decline in new passenger cars, buses, motorcycles, and scooters in 2023 could be attributed to a combination of factors, including supply chain issues, market saturation, changing consumer preferences, and shifts in public transport budgets.

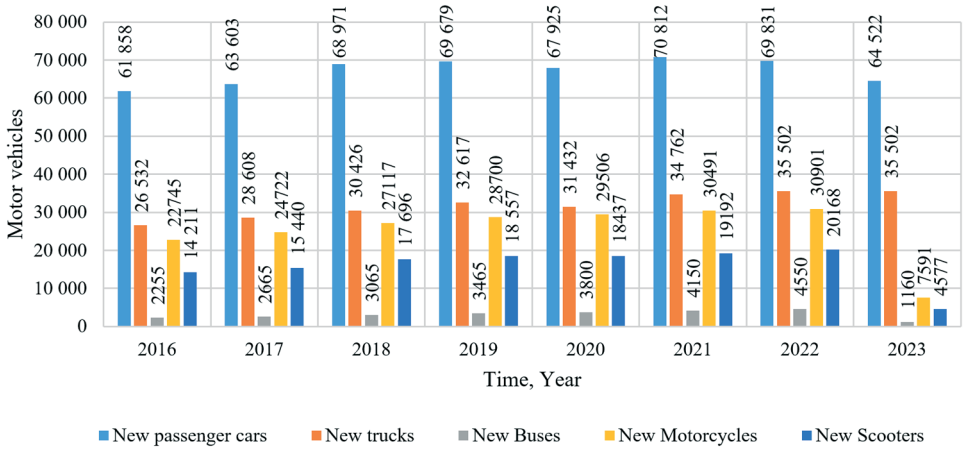

Fig. 3. Characteristics of new vehicles registered in Poland in 2014–2023 [23]

The correlation analysis between new vehicle registrations and the total number of registered vehicles show that new trucks have a very strong correlation with the total number of trucks (0.95) and the total number of all motor vehicles (0.96). This high level of correlation suggests that the increase in new truck registrations is closely linked to the growth in the total number of trucks and vehicles in Poland. This indicates stable growth in this segment, reflecting the demand for freight transport.

New passenger cars show a moderate correlation with the total number of passenger cars (0.53) and motor vehicles (0.49). This means that the increase in new passenger car registrations does not have as strong impact on the overall number of registered vehicles, which may be due to a more saturated market and the stability of this segment. Demand for new passenger cars changes gradually and has a lesser effect on the total number of vehicles.

In contrast, new motorcycles have a negative correlation with the total number of motorcycles (–0.30) and motor vehicles (–0.23). This suggests that in recent years, the number of new motorcycle registrations has not grown in parallel with the overall increase in the number of

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motorcycles. This may be due to the seasonality of this market, changing consumer preferences, and specific factors influencing demand in this segment.

Thus, new truck registrations are strongly correlated with the total number of registered vehicles, indicating stable growth. On the other hand, new registrations of passenger cars and motorcycles have a lesser impact on the total number of vehicles, likely due to changing demand and the unique characteristics of these vehicle markets.

4. Statistics on motor vehicles

Between 2014 and 2023, a systematic decline in the number of road accidents in Poland has been observed, which can be attributed to improvements in road safety. In 2014, 34,970 accidents were recorded, whereas in 2023, this number dropped to 20,936, representing a 40.2% reduction. At the same time, the number of fatalities decreased from 3,202 in 2014 to 1,893 in 2023, a decline of 40.9% [7, 23]. The number of injured individuals also fell—from 42,545 in 2014 to 24,125 in 2023—reflecting a 43.3% reduction. The most significant decrease in accidents, fatalities, and injuries occurred between 2020 and 2023, possibly linked to restrictions from the COVID-19 pandemic and a reduction in traffic volume [7, 27]. In 2020, the number of accidents dropped by 32.7% compared to 2014, and fatalities decreased by 22.2%. The reduction in the number of injured reached 37.8%. In the following years (2021–2022), the downward trend in accidents, fatalities, and injuries continued. In 2022, the number of accidents was 61% lower than in 2014, and the number of fatalities dropped by 40.8%.

Correlation analysis between the number of accidents, fatalities, and injuries shows strong relationships between these variables. The correlation between the number of accidents and fatalities is 0.96, while the correlation between accidents and injuries is 0.998. This indicates that a reduction in the number of accidents directly translates to fewer fatalities and injuries. The effectiveness of preventive measures, such as improving road infrastructure, implementing modern vehicle safety systems, and enhancing the efficiency of rescue services, likely contributes significantly to this trend.

It is worth noting the changes in mortality rates from accidents. In 2014, for every 10 accidents, there was 1 fatality, giving a ratio of 9.16 accidents per fatality. By 2023, this ratio had improved to 11.06 accidents per fatality, suggesting that accidents are becoming less deadly, likely due to technological advancements and improvements in road safety measures. On average, between 2014 and 2023, there were 28,494 accidents per year, resulting in about 2,629 deaths and 33,714 injuries annually. Characteristics of the number of road accidents and their consequences in Poland in 2014–2023 are presented in Figure 4.

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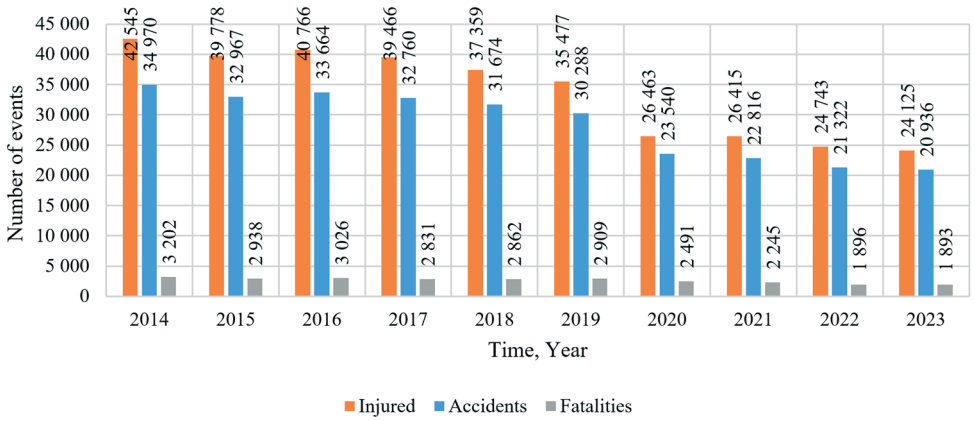

Fig. 4. Characteristics of the number of road accidents and their consequences in Poland in 2014–2023 [23]

Future forecasts suggest that if current trends continue, by 2030 there could be a further reduction in the number of accidents, fatalities, and injuries. Assuming the downward trend persists at a similar rate, the number of accidents in 2030 may reach around 15,000. The number of fatalities could fall to around 1,200, while the number of injuries may drop to below 17,000. These projections will be influenced by factors such as advancements in vehicle safety technology, investments in road infrastructure, and government and local policies supporting road safety improvements.

Based on an analysis of data on road accident perpetrators by age group in 2022 and 2023, significant differences can be observed in the number of accidents, fatalities, and injuries per 10,000 people in each group. The group of children aged 0–6 had the lowest accident rate per 10,000 people. In 2023, this rate was 0.05, and the number of injuries was at a similar level—0.05—indicating a very low risk of involvement in accidents for this age group. In 2023, no fatalities were recorded, while in 2022, the fatality rate was 0.013 per 10,000 people. The low number of accidents and the absence of fatalities are likely due to the care provided for children and their limited independent mobility. Accident perpetrators by age group in 2023 and 2022 are shown in Figure 5. Perpetrators of fatalities in road accidents in 2023 and 2022 by age group are shown in Figure 6. Perpetrators of injuries in road accidents in 2023 and 2022 by age group are shown in Figure 7.

In the 7–14 age group, the accident rate in 2023 was 0.76 per 10,000 people, and the injury rate was 0.02. This represents a decrease compared to 2022, where the accident rate was 0.83 and the injury rate was 0.85. However, in 2023, no fatalities were recorded, which may be related to better education and caution among children in this age group.

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For the 15–17 age group, the accident rate per 10,000 people remained steady at 1.97 in both years, which is one of the highest rates among the younger age groups. However, in 2023, the injury rate increased to 2.13, up from 1.85 in 2022. The fatality rate in 2023 was 0.11, which is also notably higher than in 2022 (0.068), indicating a higher risk of serious accidents in this age group.

The 18–24 age group shows the highest rates of accidents, injuries, and fatalities. In 2023, the accident rate was 11.54 per 10,000 people, the injury rate was 14.60, and the fatality rate was 1.10. Despite a decrease in the number of accidents compared to 2022, when the accident rate was 12.19, this age group remains the most vulnerable to road accidents. This is mainly due to a lack of experience and a higher propensity for risky behavior.

In the 25–39 age group, the accident rate per 10,000 people was 7.14 in 2023, a slight decline compared to 2022 (7.51). The injury rate also decreased from 8.85 in 2022 to 8.51 in 2023. Although the number of accidents is decreasing, the fatality rate remains relatively high—0.66 in 2023—indicating that accidents in this age group often have severe consequences.

The 40–59 age group had a stable accident rate in 2023 (5.30) compared to 2022 (5.26). The injury rate was 6.17 per 10,000 people, a slight decline from 2022 (6.21). However, an increase in the fatality rate is noticeable—the fatality rate rose from 0.42 in 2022 to 0.46 in 2023, suggesting a higher risk of death in accidents in this group.

For the 60+ age group, the accident rate per 10,000 people in 2023 was 4.06, an increase compared to 2022 (3.61). The injury rate was 4.07, remaining stable. The fatality rate was 0.32, similar to the 2022 level (0.32). Despite a lower number of accidents, older individuals are more prone to serious injuries and fatalities in road accidents, due to the decline in physical condition with age.

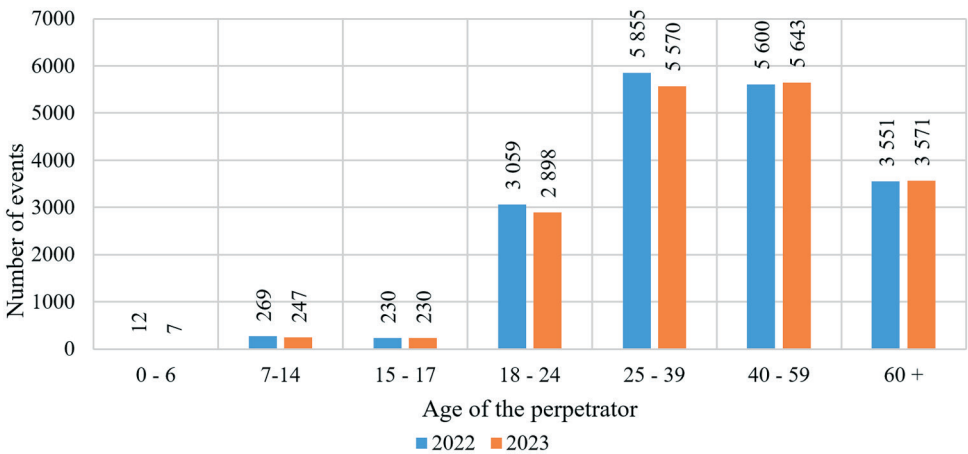

Fig. 5. Perpetrators of road accidents in 2023 and 2022 by age [23]

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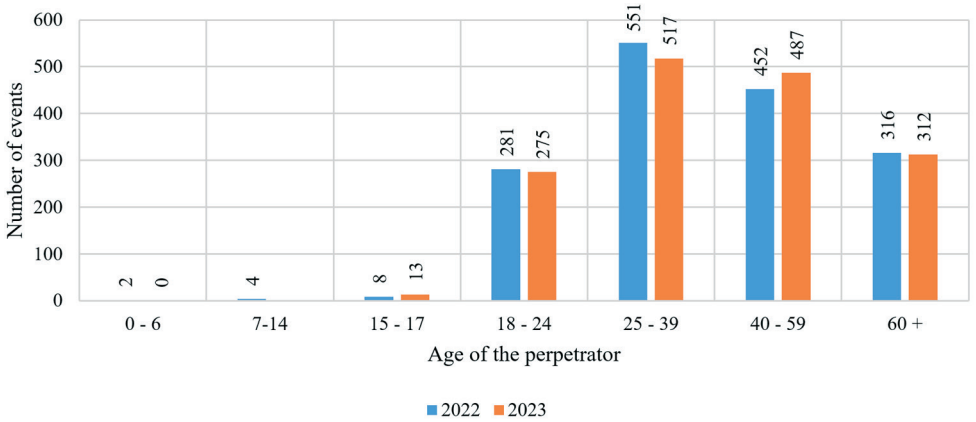

Fig. 6. Perpetrators of fatalities in road accidents in 2023 and 2022 by age [23]

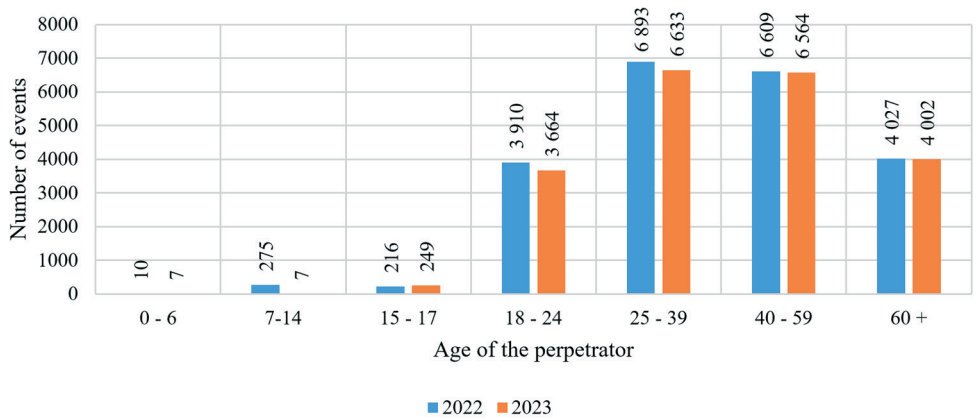

Fig. 7. Perpetrators of victims injured in road accidents in 2023 and 2022 by age [23]

It is important to note that the 18–24 age group is the most vulnerable to road accidents, as reflected by the highest rates of accidents, injuries, and fatalities. Despite a lower number of accidents, older individuals (60+) are more susceptible to severe consequences in accidents, highlighting the need for targeted preventive measures for this group. Characteristics of road accident victims by age group are presented in Figure 8.

Based on an analysis of data regarding road accident victims by age group in 2022 and 2023, differences in the number of fatalities and injuries, as well as the rates of victims per 1 million population, can be observed.

In the 0–6 age group, the number of fatalities decreased from 22 in 2022 to 11 in 2023, resulting in a rate of 7.3 fatalities per 1 million population in 2023. The number of injuries

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remained stable at 492 in 2023, translating to a rate of 327.1 injuries per 1 million population. The low number of fatalities and injuries may be attributed to adult supervision and limited independent mobility of children on roads.

In the 7–14 age group, an increase in fatalities was recorded, rising from 31 in 2022 to 37 in 2023, with a rate of 11.4 fatalities per 1 million population. The number of injuries slightly decreased to 1,340 in 2023, yielding a rate of 413.4 injuries per 1 million population. The higher number of fatalities in this group may result from older children moving more independently, which increases the risk of serious accidents.

Among teenagers aged 15–17, the number of fatalities decreased from 18 in 2022 to 13 in 2023, translating to a rate of 35.1 fatalities per 1 million population. However, the number of injuries rose from 1,045 in 2022 to 1,133 in 2023, giving a rate of 971.3 injuries per 1 million population. Despite the drop in fatalities, this group remains at high risk of serious injuries, likely due to greater road activity and a propensity for risky behavior.

In the 18–24 age group, the number of fatalities increased from 211 in 2022 to 232 in 2023, resulting in the highest fatality rate of all age groups at 92.5 per 1 million population. The number of injuries, however, decreased from 3,163 in 2022 to 2,976 in 2023, with a rate of 1,186 injuries per 1 million population. This age group faces the highest risk of accidents, primarily due to inexperience and a greater likelihood of engaging in risky driving behavior.

In the 25–39 age group, the number of fatalities decreased from 371 in 2022 to 347 in 2023, with a fatality rate of 57.9 per 1 million population. Injuries also declined from 6,467 in 2022 to 6,039 in 2023, giving a rate of 775 injuries per 1 million population. Although fatalities and injuries are decreasing, this age group remains heavily involved in road accidents, possibly due to high professional activity and frequent use of cars.

For adults aged 40–59, the number of fatalities remained stable, with 515 in 2023 compared to 521 in 2022, resulting in a rate of 48.9 fatalities per 1 million population. The number of injuries also remained steady, with 6,492 in 2023, corresponding to a rate of 650.3 injuries per 1 million population. Despite stable rates, this group is involved in a significant number of accidents, possibly due to regular use of roads for work and family-related travel.

In the 60+ age group, fatalities increased from 590 in 2022 to 608 in 2023, giving a fatality rate of 61.8 per 1 million population. The number of injuries decreased from 5,365 in 2022 to 5,219 in 2023, resulting in a rate of 530.4 injuries per 1 million population. Despite a lower number of injuries, older individuals are more vulnerable to fatal accidents, likely due to a decline in physical condition and slower reactions with age. Characteristics of the number of people injured in road accidents by age group are presented in Figure 9.

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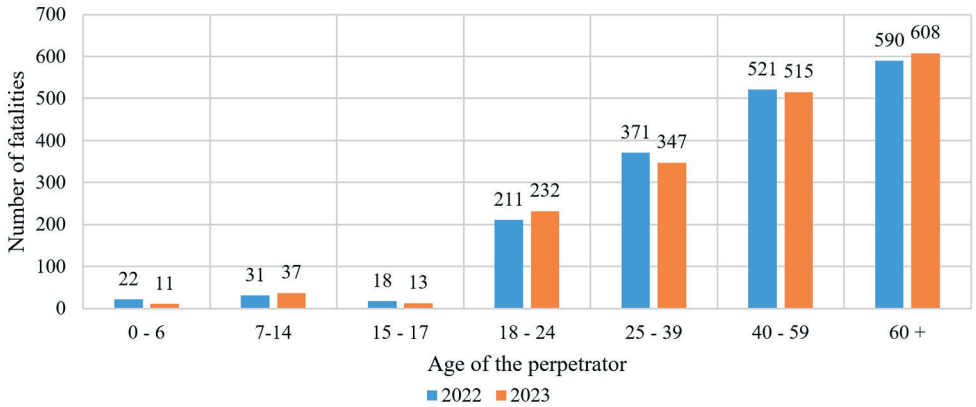

Fig. 8. Characteristics of road accident victims by age group [23]

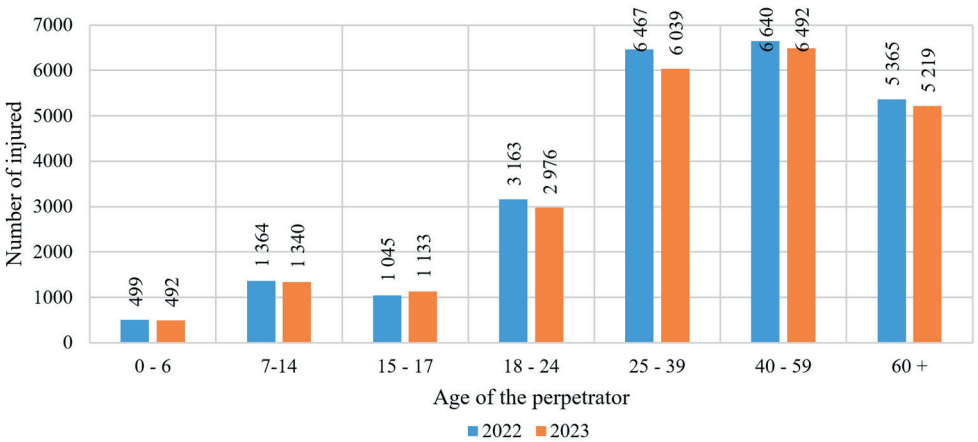

Fig. 9. Characteristics of the number of people injured in road accidents by age group [23]

It should be noted that the 18–24 age group is the most vulnerable to fatal road traffic accidents, reflecting the highest rate of fatalities per 1 million population. In older groups (60+), despite the lower number of injured people, a high rate of fatalities is observed, which indicates a higher risk of serious injuries and death in road accidents.

5. Vehicle Third Party Liability Insurance Statistics

Data on the average third-party liability insurance (OC) prices from 2015 to 2023 indicate significant fluctuations. In 2015, the average OC price was €98 (434 PLN), and in 2016 it increased by 45% to €141 (629 PLN). This sharp rise could have been caused by regulatory

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changes or increased compensation payout costs. In 2017, OC prices rose by another 24%, reaching €175 (779 PLN), continuing the upward trend from previous years. However, starting in 2018, a downward trend in OC prices began. In 2018, the average price decreased by 5% to €167 (741 PLN), and this downward trend continued in the following years. In 2019, prices dropped by 7% to €155 (689 PLN), and in 2020, they decreased by 2%, reaching €151 (672 PLN).

The largest decrease occurred in 2021, when the average OC price fell to €135 (602 PLN), representing a 10% drop compared to the previous year. The decline in prices became even more pronounced in 2022, with a 16% reduction, leading to the lowest average OC price in the analyzed period, at €113 (505 PLN). This drop could have been due to increased competition in the insurance market, cost optimization by insurers, or a decrease in accidents resulting from the pandemic, which lowered compensation costs.

In 2023, the downward trend was interrupted, with the average OC price rising by 3% to €117 (520 PLN). This increase may have been driven by inflation, rising operating costs for insurers, or an increase in compensation payouts. In summary, from 2015 to 2023, the OC market in Poland experienced a sharp price increase from 2015 to 2017, followed by a gradual decline from 2018 to 2022, before a slight price increase was recorded in 2023. The changes in the average OC insurance value from 2015 to 2023 are illustrated in Figure 10. Changes in average OC prices across voivodeships in 2017 are shown in Figure 11, and for 2023 in Figure 12.

In 2017, the highest OC insurance prices were observed in Wrocław (€256, 1,140 PLN) and Gdańsk (€238, 1,060 PLN), with Warsaw also having a high average price of €231 (1,030 PLN). On the other hand, the lowest OC insurance prices were seen in southern and eastern cities such as Rzeszów (€181, 807 PLN), Katowice (€186, 829 PLN), and Kielce (€175, 780 PLN). Overall, OC prices in western cities were higher than in eastern cities.

By 2023, a general downward trend or price stabilization was observed in many regions. For example, in Wrocław, the price dropped to €139 (619 PLN), and in Gdańsk, it decreased to €130 (578 PLN). Warsaw also saw a significant reduction, from €231 (1,030 PLN) in 2017 to €120 (532 PLN) in 2023. OC prices in southern and eastern Poland remained relatively lower, as seen in Rzeszów (€102, 452 PLN) and Katowice (€102, 454 PLN). A comparison of both years' data shows that OC insurance prices significantly decreased between 2017 and 2023. This may be attributed to factors such as improved road safety, a lower number of accidents, and increased competition in the OC insurance market in Poland.

Between 2017 and 2023, a significant decline in average OC insurance prices was observed across most Polish regions. The largest percentage decrease was seen in the Podlaskie and Mazowieckie regions. In Podlaskie, OC prices dropped by approximately 44.7%, while Mazowieckie experienced a decrease of 43.7%. Similarly, Warmińsko-Mazurskie saw a notable reduction of 41.1%, followed by Lubuskie and Pomorskie, with declines of 41% and 40.8%, respectively. These results indicate an overall trend of decreasing OC insurance prices

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in Poland, which may be attributed to improved road safety, a reduction in accident rates, and increased competition in the insurance market. The decrease in OC premiums reflects market stabilization and improved risk management efficiency among insurance providers.

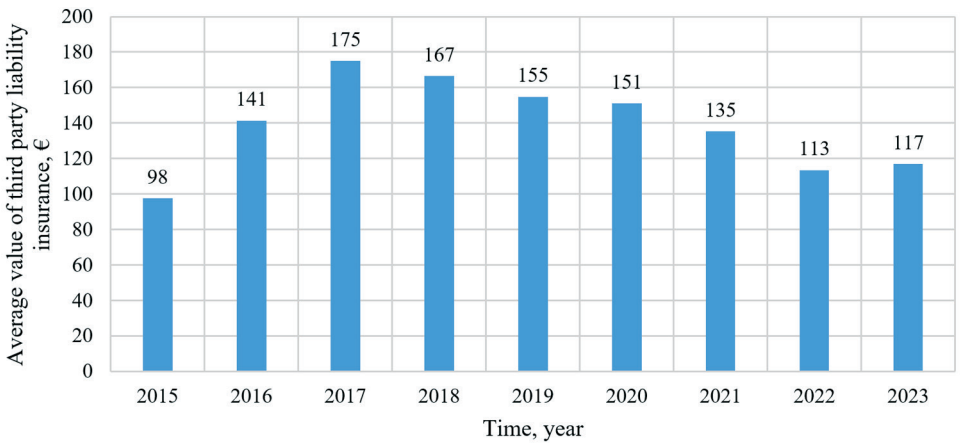

Fig. 10. Characteristics of changes in the average value of third-party liability insurance in 2025–2023 [22]

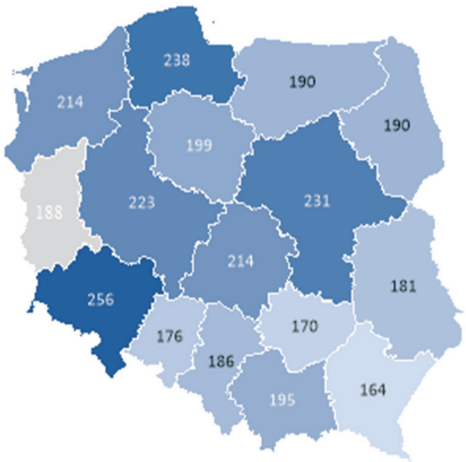

Fig. 11. Changes in average prices of third-party liability insurance in voivodships in 2017 (third party liability insurance premium amounts in €) [22]

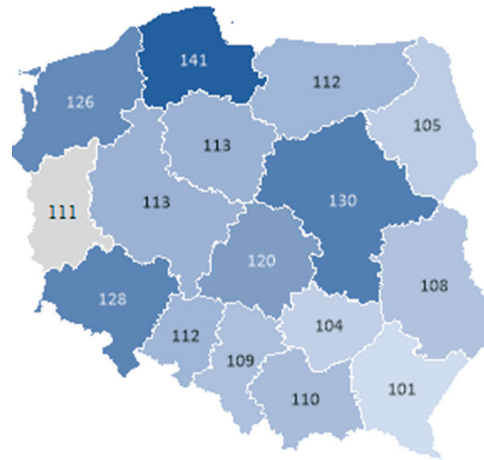

Fig. 12. Changes in average prices of third-party liability insurance in voivodships in 2023 (third party liability insurance premium amounts in €) [22]

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Data on the median prices of third-party liability insurance (OC) by driver age from 2019 to 2023 show that insurance premiums are closely tied to the driver's age, with younger individuals paying significantly higher premiums than older drivers. The general trend indicates that OC prices for younger drivers are much higher than for older age groups, but as drivers age, prices gradually decrease until they reach a certain point, after which premiums begin to rise again for older age groups.

Compared to 2019, OC premiums for young drivers aged 18 increased by 2.7%, from €442 (1,965 PLN) in 2019 to €453 (2,018 PLN) in 2023. Despite this increase, OC prices for this group slightly decreased compared to 2022 (€462, 2,056 PLN). Drivers aged 18–24 continue to pay significantly more, likely due to the higher insurance risk associated with a lack of experience and more frequent accidents. For example, for 24-year-olds, the premium was €314 (1,400 PLN) in 2023, a 7% increase compared to €319 (1,420 PLN) in 2019, but a systematic decrease of several hundred PLN has been observed over the past few years.

Starting from age 25, OC insurance prices begin to significantly decline. For 25-year-olds in 2023, the median price was €294 (1,310 PLN), noticeably lower than the cost for younger drivers. In 2019, the median for this age group was €301 (1,340 PLN), indicating a 2.2% decrease over these four years. The downward trend in OC prices continues with each additional year of age. For drivers aged 30, the average OC price in 2023 was €213 (950 PLN), a significant improvement compared to €236 (1,050 PLN) in both 2022 and 2019 – a 9.5% decrease over four years.

The lowest OC insurance prices are observed for drivers aged 50–60. In 2023, the median price for 50-year-olds was €97 (430 PLN), reflecting stable prices compared to 2019, when it was €126 (560 PLN), a 23.2% decrease over this period. These are the lowest prices in the entire analysis, likely due to the extensive driving experience and lower accident risk in this age group.

After reaching 60 years of age, OC prices start to rise again, likely due to insurers' concerns about the health and reaction abilities of older drivers. For 60-year-olds, the median premium was €89 (396 PLN) in 2023, a 29.4% drop compared to €126 (561 PLN) in 2019. For 70-year-olds, the median premium was €110 (490 PLN) in 2023, showing that premiums rise again with age and increased risk.

Older drivers paid significantly less for OC insurance than younger drivers. In 2023, older drivers (60 years old) paid 80.38% less than young drivers aged 18, while middle-aged drivers (40 years old) paid 72.25% less. These differences result from greater driving experience and lower risk attributed by insurers to older drivers compared to younger, less experienced individuals.

The median OC prices in 2023 show a clear trend: the youngest drivers pay the highest premiums, which decrease with age and driving experience, reaching the lowest levels in the

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50–60 age group. Compared to 2019, prices for most age groups have decreased, suggesting market stabilization. After age 60, premiums start to rise again, reflecting the increased risk associated with age. The median OC prices by driver age in 2019 and 2023 are illustrated in Figure 13.

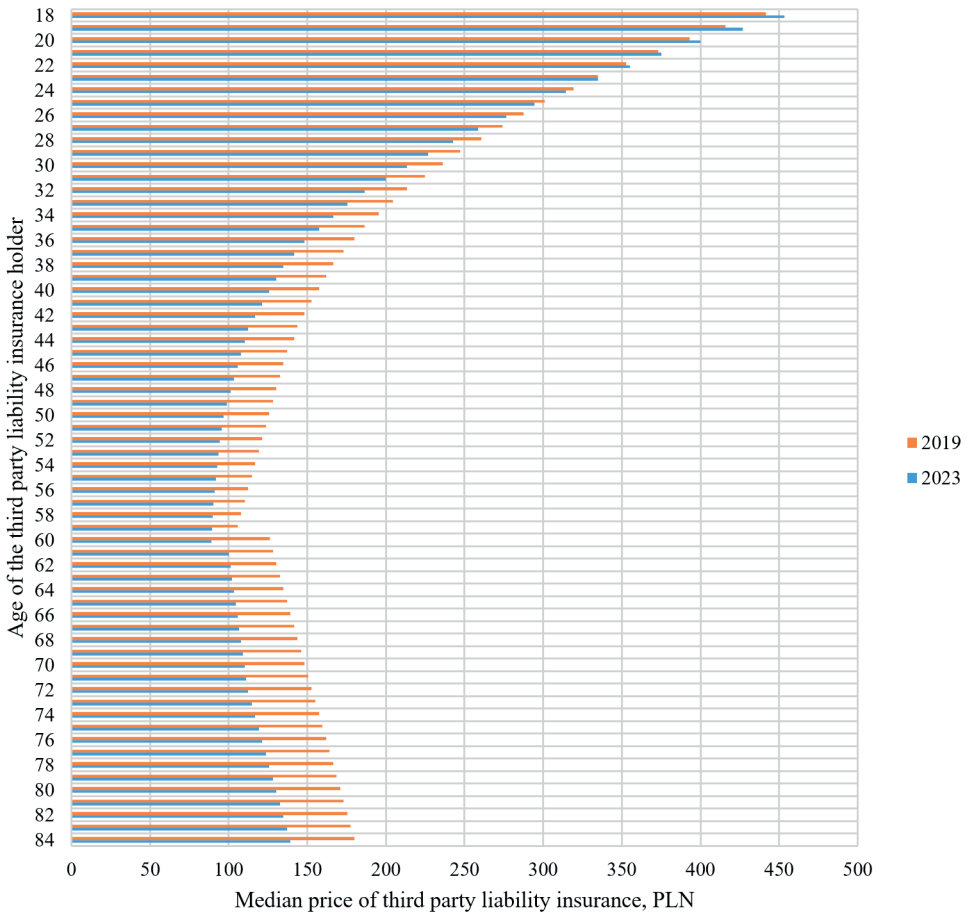

Fig. 13. Median prices of third-party liability insurance depending on the age of the driver in 2019 and 2023 [22]

Data on average third-party liability insurance (OC) prices based on engine capacity from 2020 to 2023 show a clear correlation between engine size and premium rates, with higher engine capacities leading to higher premiums. However, in recent years, there has been a downward trend for larger engine sizes, particularly in 2023.

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For cars with engines up to 1,000 cm³, OC prices remained stable in both 2022 and 2023, at €96 (427 PLN), indicating no changes compared to the previous year. Compared to 2020, when the average OC price for this group was €119 (529 PLN), this represents a decrease of about 19.3% over three years. This suggests that premiums for this group have been reduced, likely due to insurers attributing lower risk to drivers of smaller vehicles.

For cars with engines between 1,100 cm³ and 2,000 cm³, OC prices in 2023 were €115 (511 PLN), a 3.8% decrease compared to 2022 (€119, 531 PLN) and a 16.4% decrease compared to 2020, when prices were €137 (611 PLN). This is a significant cost reduction, which may be due to a lower accident rate in this category of cars or increased competition in the insurance market.

For cars with engines between 2,100 cm³ and 3,000 cm³, OC prices in 2023 were €137 (609 PLN), representing a 5.4% decrease compared to 2022 (€145, 644 PLN), but an increase compared to 2021, when the average was €133 (591 PLN). Compared to 2020, when prices were €148 (658 PLN), current premiums are 7.4% lower. These fluctuations suggest that insurers are adjusting their policies, but overall, prices for this group have also decreased.

Cars with engines between 3,100 cm³ and 4,000 cm³ saw smaller changes in recent years. In 2023, the average OC price was €142 (632 PLN), slightly lower than in 2022 (€146, 649 PLN), a 2.6% decrease. Compared to 2020, when OC was €160 (711 PLN), this is an 11.1% reduction, possibly due to reduced risk for this vehicle group.

For vehicles with engines between 4,100 cm³ and 5,000 cm³, the OC price in 2023 was €144 (640 PLN), a significant 7.9% drop compared to 2022 (€156, 695 PLN) and a 23.8% drop compared to 2020, when prices were €189 (840 PLN). This shows the largest decrease in this group, which may be due to lower demand for vehicles with such large engines or reduced risk in this category.

Vehicles with the largest engines, 5,100 cm³ or more, had OC prices of €151 (674 PLN) in 2023, a 3.6% decrease compared to 2022 (€157, 699 PLN) and a 21.4% decrease compared to 2020, when the OC price was €193 (858 PLN). Although premiums for this group remain high, the downward trend is evident, which may be due to fewer insured vehicles with large engines or competitive actions in the insurance market.

From 2020 to 2023, an overall downward trend in OC prices has been observed across all engine size categories, especially for cars with larger engines. The average OC insurance price by engine capacity from 2020 to 2023 is illustrated in Figure 14.

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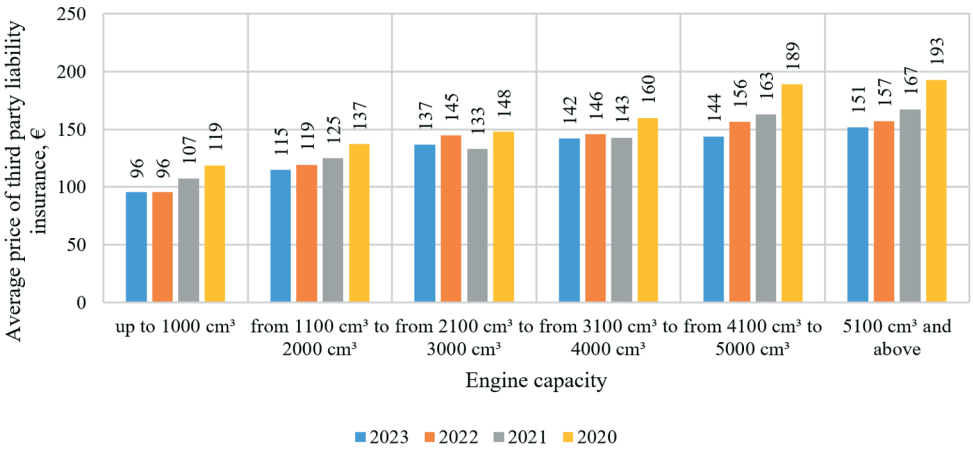

Fig. 14. Average price of third-party liability insurance depending on engine capacity in 2020–2023 [22]

Data on average third-party liability insurance (OC) prices by marital status from 2019 to 2023 indicate that marital status significantly impacts OC premium amounts. Generally, married individuals and widows/widowers pay lower OC premiums, while single individuals, such as bachelors and spinsters, pay noticeably more. In 2023, married individuals (both men and women) paid an average of €108 (482 PLN) for OC, which represents a slight increase of 3.7% compared to 2022 (€105, 465 PLN). However, compared to 2019, when the OC price was €135 (601 PLN), there has been a decrease of 19.8%. This suggests that insurers still perceive this group as more stable and less risky compared to single individuals.

Widows and widowers paid an average of €111 (495 PLN) in 2023, reflecting a slight decrease of 2.2% compared to 2022 (€114, 506 PLN). Compared to 2019, when the OC price was €141 (626 PLN), the decrease is more pronounced at 20.9%. This indicates that, like married individuals, widows and widowers benefit from lower premiums, likely due to their lower perceived insurance risk.

Divorced individuals paid an average of €112 (499 PLN) in 2023, representing a 1.6% decrease compared to 2022 (€114, 507 PLN) and a 23.4% decrease compared to 2020, when prices were at their highest (€146, 652 PLN). This shows a downward trend in this group, although OC prices remain slightly higher than for married individuals or widows/widowers.

The highest OC prices are for single individuals, such as bachelors and spinsters. In 2023, the average price was €155 (691 PLN), reflecting a minimal increase compared to 2022 (€155, 690 PLN), but a significant decrease of 27.8% compared to 2019, when the price was €215 (957 PLN). Although premiums for this group remain the highest, a downward trend has been observed

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in recent years. Higher OC premiums for bachelors and spinsters may result from their often lower driving experience and the greater perceived insurance risk associated with this group.

Between 2019 and 2023, OC prices decreased across all groups, but married individuals, widows, and widowers paid noticeably less than divorced or single individuals. The highest prices are for bachelors and spinsters, likely due to insurers viewing this group as more risky. The average OC prices by driver's marital status are illustrated in Figure 15.

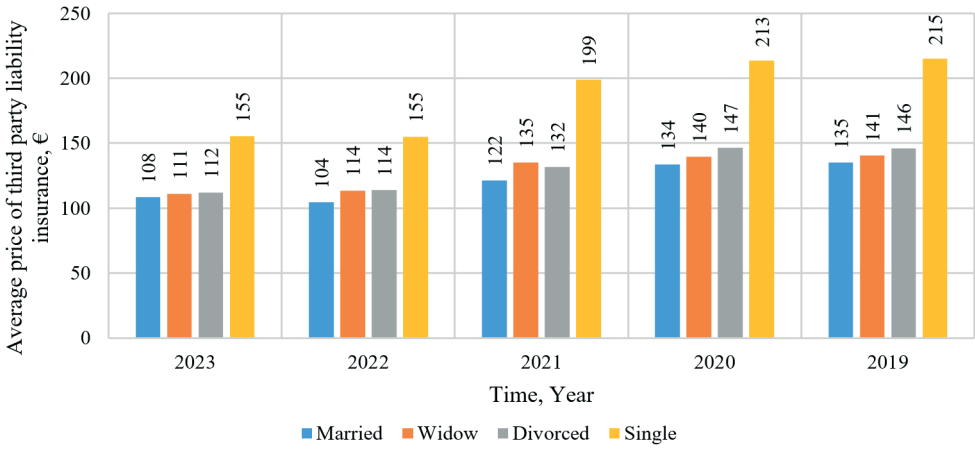

Fig. 15. Average prices of third–party liability insurance depending on the driver's marital status [22]

Between 2019 and 2023, third–party liability insurance (OC) prices for various car brands exhibited an overall downward trend, especially since 2020. Most brands saw significant reductions, which could indicate reduced insurance risk or increased competition in the insurance market.

For Fiat vehicles, the OC price in 2023 was 489 PLN, marking a 21.8% decrease compared to 2020, when the price was 625 PLN. Compared to 2021 (583 PLN), the drop is also substantial, suggesting that Fiat drivers are now perceived as less risky. Škoda saw a stabilization of OC prices, with a slight change between 2022 (470 PLN) and 2023 (471 PLN). Compared to 2020, when the price was 612 PLN, Škoda's OC decreased by 23%, indicating a significant drop in premiums for Škoda drivers over the past few years.

For Renault, the OC price in 2023 was 487 PLN, reflecting a 22.2% decrease compared to 2020 (626 PLN). A similar trend applies to Citroen vehicles, where the 2023 OC price was 493 PLN, a 21.2% drop from 2020. Opel's OC in 2023 was 495 PLN, a 23.3% decrease compared to 2020, when the price was 645 PLN. This demonstrates that, like other brands, Opel's insurance prices have systematically decreased.

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Overall, the decline in OC prices for most car brands between 2019 and 2023 could be due to improved driver behavior, increased competition in the insurance market, or better vehicle safety performance. The average OC prices by car brand are illustrated in Figure 16.

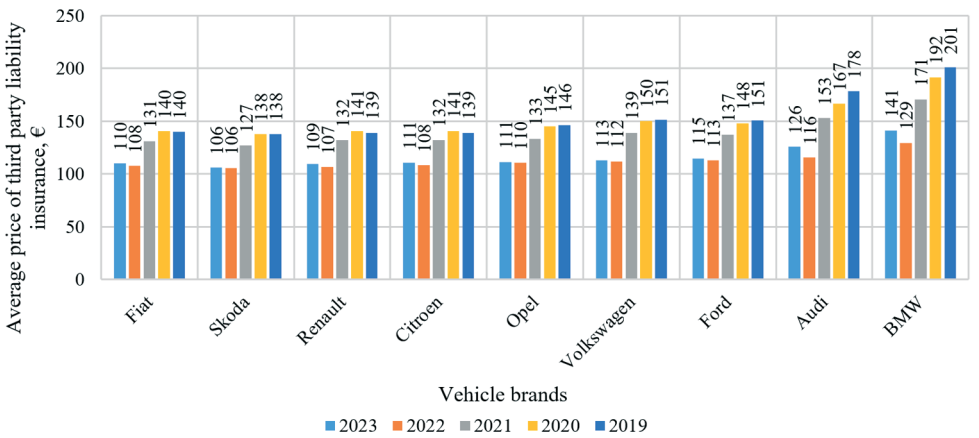

Fig. 16. Average prices of third-party liability insurance depending on the brand of the vehicle [22]

Data on third–party liability insurance (OC) prices by occupation from 2020 to 2022 show that OC premiums vary significantly based on occupational group (Table 1). The trends during these years reveal that certain professions are perceived by insurers as higher–risk, resulting in higher premiums, while other professions have seen significant OC price reductions.

In 2022, students paid the highest OC premiums, averaging 1,606 PLN, a slight decrease of 5.1% compared to 2021 (1,692 PLN). However, compared to 2020, when the premium was 1,695 PLN, there is a more noticeable decrease of 5.3%. Despite this, students continue to pay the highest premiums, likely due to the perceived risk associated with inexperience behind the wheel. Athletes also paid high OC premiums, with an average of 849 PLN in 2022, representing a 6.8% decrease from 2021 (911 PLN) and a 16.1% drop compared to 2020 (1,011 PLN). This clear downward trend suggests a reduced perceived risk for this occupational group.

Unemployed individuals saw a steady decline in OC prices, with premiums averaging 669 PLN in 2022, down 10.4% from 2021 (747 PLN) and 17.6% compared to 2020 (812 PLN). This decrease may be due to increased attention to responsible driving among the unemployed. In the tech sector, such as IT workers, the OC price in 2022 was 634 PLN, a 9.3% decrease compared to 2021 (699 PLN) and a 19.2% decrease compared to 2020 (785 PLN). This reduction could reflect insurers viewing this group as more responsible and lower risk on the road. Sales representatives paid 587 PLN for OC in 2022, a 7.3% decrease from 2021 (633 PLN) and a 16.6% drop from 2020 (704 PLN). Meanwhile, lawyers paid 561 PLN in 2022, a reduction of 11.8% compared to 2021 (636 PLN) and a 20% decrease from 2020 (701 PLN).

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The lowest OC premiums in 2022 were paid by farmers (432 PLN) and retirees (471 PLN). For farmers, this was an 11.7% decrease compared to 2021 (489 PLN) and a 22.4% decrease from 2020 (557 PLN). For retirees, the OC premium in 2022 decreased by 7.3% compared to 2021 (508 PLN) and by 17.9% from 2020 (574 PLN). Healthcare workers paid 547 PLN for OC in 2022, a 10.3% decrease from 2021 (610 PLN) and a 19.2% decrease compared to 2020 (677 PLN). This suggests a reduced perceived risk for this occupational group, despite being highly active on the roads.

The data show an overall downward trend in OC prices across most occupational groups between 2020 and 2022. The largest reductions are seen in occupations considered less risky, such as farmers, retirees, office workers, and IT professionals. Meanwhile, students, athletes, and young drivers continue to pay the highest premiums, despite noticeable reductions in recent years.

Tab. 1. Average prices of third-party liability insurance depending on the profession in 2020–2022 [22]

Profession	Average Third-Party Liability Insurance Prices in € for Selected Years		
	2022	2021	2020
Student	361	380	381
Athlete	191	205	227
Unemployed	150	168	182
IT employee	142	157	176
Sales representative	132	142	158
Lawyer	126	143	158
Office worker	126	139	154
Entrepreneur	126	139	150
Manual worker	123	138	156
Health care worker	123	137	152
Housewife	121	135	150
Professional driver	118	128	145
Engineer	118	131	149
Management staff	117	128	143
Teacher	110	121	134
Uniformed services	107	118	133
Retiree	106	114	129
Farmer	97	110	125

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The regression analysis allowed for the assessment of trends in insurance costs in 2020, 2021, and 2022 for different occupational groups. The slope coefficients indicate a decrease in insurance costs in most professions, meaning these costs are declining year by year. The largest decreases are observed in professions such as:

- athlete: a decrease of €18 (81 PLN) per year,
- IT employee: a decrease of €17 (75.5 PLN) per year,
- unemployed: a decrease of €16 (71.5 PLN) per year.

The determination coefficients (R^2) for most professions are above 0.97, indicating that the regression models fit the data very well. This means that changes in insurance costs for these professions can be predicted with high accuracy based on trends from previous years.

The result of the analysis of variance (ANOVA) does not indicate statistically significant differences in insurance costs between 2020, 2021, and 2022 (p–value is 0.366, well above the significance threshold of 0.05). This means that, despite the observed downward trends, changes in insurance costs do not differ significantly between the years. These changes may thus be more uniform over the years, without sudden jumps or drops.

The clustering analysis (KMeans) grouped professions based on similarities in insurance costs from 2020 to 2022. The results show three main groups (clusters):

- Group 0: includes professions such as Athlete, Unemployed, IT employee. This group shows relatively higher insurance costs, which may be due to riskier behaviors associated with these professions.
- Group 1: includes only the profession of Student, which may suggest that students have a completely different risk profile than other occupational groups, impacting their insurance costs.
- Group 2: includes most professions, including Lawyer, Office worker, Manual worker, Management staff. These professions have similar insurance costs, which are relatively stable and do not experience significant changes.

The conducted analyses indicate the stability of insurance costs in the studied years, although there are downward trends for some occupational groups. The lack of significant statistical differences between years suggests that these changes are gradual. The clustering analysis helped identify occupational groups with similar risk profiles, which could be useful for further research on insurance market segmentation.

6. Statistical analysis of the third party liability insurance market

Third–party liability insurance (OC) is mandatory for all vehicle owners in Poland. As of the end of the third quarter of 2023, more than 27.7 million Poles had an active OC policy. This

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insurance covers damages caused by the driver to others, including property damage and personal injury. In 2022, nearly 826,000 claims were paid out from OC policies, with the average claim amounting to approximately €2,135 (9,500 PLN). Over the past decade, the total payouts from this insurance reached €19.5 billion (86.6 billion PLN). The average annual OC premium in Poland is currently around €115 (510 PLN). The purpose of OC insurance is not only to protect victims of road accidents but also to promote safe driving. The Polish Insurance Association emphasizes that road safety largely depends on driver behavior, making it crucial to have adequate insurance coverage.

The data on the number of insurance contracts in the market for 2022–2023 comes from internal reports by one insurer, Generali. The analysis reveals significant differences based on age group. The total number of contracts in 2023 was 16,555,953, representing a 3.6% increase compared to 2022, when the number of contracts was 15,983,491. In the 0–20 age group, the number of contracts in 2023 was 28,275, a 12.5% increase compared to 2022 (25,154 contracts). While this is a relatively small group, the significant increase may result from more young people entering the insurance market. In the 21–25 age group, the number of contracts in 2023 was nearly identical to 2022–280,770 compared to 279,113, indicating a minimal increase of 0.6%. The stability in this group suggests that most young adults consistently insure their vehicles.

The 26–30 age group experienced a decline in contracts from 922,425 in 2022 to 893,983 in 2023, a 3.1% drop. A similar trend can be seen in the 31–35 age group, where the number of contracts remained stable with a slight decrease of 0.3% from 1,584,333 in 2022 to 1,588,807 in 2023. In the 36–40 age group, the number of contracts decreased by 0.9%, from 2,133,263 in 2022 to 2,140,753 in 2023. Subsequent age groups show slight increases, such as in the 41–45 age group, where the number of contracts in 2023 was 2,367,644, a 3.8% increase compared to 2022 (2,281,427 contracts).

In older age groups, such as 51–55 years, the number of contracts in 2023 increased by 6.4% compared to 2022, from 1,726,863 to 1,842,830. In the 56–60 age group, the number of contracts was 1,535,704 in 2023, a 3.7% increase compared to 2022 (1,481,388). The 61–65 age group saw a 1.7% increase in contracts, while for those aged 66–70, the number of contracts rose by 6.1% in 2023. In the 70+ age group, the number of contracts increased by 11.6%, from 988,176 in 2022 to 1,103,135 in 2023.

In 2023, the number of insurance contracts increased in most age groups, with noticeable growth in older groups (above 50 years old). In younger groups, particularly in the 26–40 age range, the number of contracts declined, which may result from demographic or economic factors such as fewer younger drivers or financial constraints. The age profile of individuals taking out OC insurance is illustrated in Figure 17.

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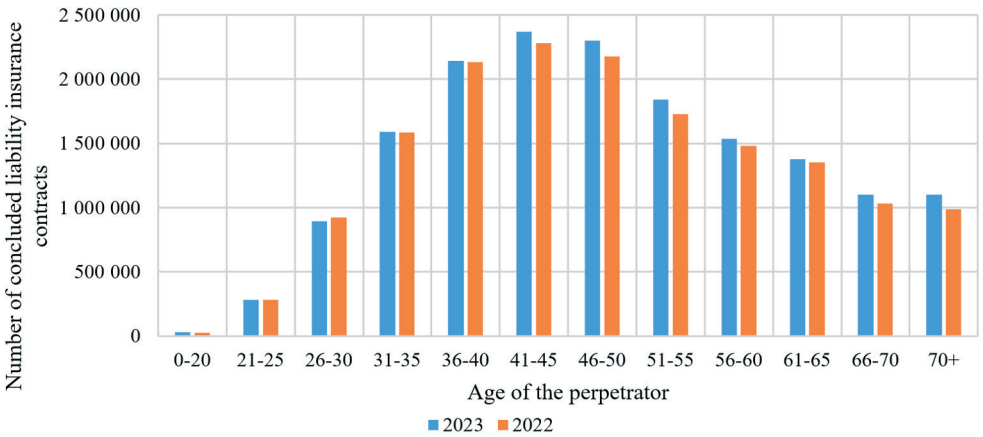

Fig. 17. Age characteristics of people taking out third-party liability insurance

The analysis of the correlation between the number of insurance contracts and the number of accidents, fatalities, and injuries in 2023 and 2022 shows very strong positive relationships. In 2023, the correlation between the number of insurance contracts and the number of accidents was 0.93, indicating that the more insurance contracts were signed in a given age group, the higher the number of accidents. This relationship suggests that age groups with a higher number of active drivers with insurance contracts are more frequently involved in road traffic, increasing the risk of accidents. In 2022, the correlation for this relationship was 0.83, which also indicates a strong connection, though slightly weaker than in 2023.

The correlation between the number of insurance contracts and the number of fatalities in 2023 was 0.92, again indicating a very strong positive relationship. A higher number of insurance contracts in a given age group was associated with a higher number of fatalities. This suggests that a greater number of drivers on the roads may lead to more risky situations resulting in fatalities. In 2022, the correlation for this relationship was 0.81, again showing a strong connection, but slightly weaker than in 2023.

Similarly, the correlation between the number of insurance contracts and the number of injuries in 2023 was 0.92, meaning that a higher number of insurance contracts was associated with a higher number of injuries in road accidents. In 2022, the correlation for this relationship was 0.82, indicating a weaker but still significant connection.

The 2023 data shows very strong positive correlations between the number of insurance contracts and the number of accidents, injuries, and fatalities. Compared to 2022, these correlations are slightly stronger, which may suggest that in 2023, these relationships intensified even further. Age groups with more insurance contracts were more frequently involved

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in accidents, leading to a higher number of victims. The correlation results are presented in Table 2.

Tab. 2. Pearson correlation results

Correlated variables	Correlation Persona	
	2023	2022
Number of insurance contracts with the number of road accidents	0.93	0.83
Number of insurance contracts with fatalities	0.92	0.81
Number of insurance contracts with the number of people injured in road accidents	0.92	0.82

The data from Generali regarding the number of insurance contracts signed in 2023 and 2022 show significant differences across various age groups. The fewest contracts are signed by young people, particularly in the 0–20 and 21–25 age groups. In 2023, the number of contracts for those aged 0–20 was 28,275, and for the 21–25 age group, it was 280,770. These numbers are much lower compared to older groups, especially individuals aged 41–50, where the number of signed contracts was the highest. In 2023, the 41–45 age group signed 2,367,644 contracts, and the 46–50 age group signed 2,298,083.

One of the key reasons younger individuals sign fewer insurance contracts is the high cost of OC insurance in these age groups. For young drivers, particularly those aged 18–25, OC prices can reach as high as €449 (2,000 PLN) or more, making insurance less affordable. In contrast, individuals in older age groups, such as those aged 50–60, pay much lower premiums, which can be around €97 (430 PLN). The largest number of contracts is signed by people aged 41–50, which may be partly due to parents purchasing OC insurance for their adult children to lower the premium. Registering a vehicle under a parent's name, who has more driving experience and lower OC premiums, allows younger drivers to benefit from lower insurance costs. This way, although younger drivers use the vehicle, the insurance is formally tied to the older, more experienced driver, reducing the costs.

Thus, the youngest age groups (0–25 years) sign the fewest insurance contracts, which can be linked to high OC costs, while the largest number of contracts falls within the 41–50 age group, where parents may register vehicles in their own names to lower the insurance costs for their adult children.

7. Conclusion

Motor insurance, particularly third-party liability insurance (OC), plays a crucial role in ensuring road safety by covering damages caused by drivers. The OC premium and the number of insurance contracts are influenced by various factors, including the driver's age, experience,

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and accident history. Analyzing data from Generali and other previously discussed information reveals clear correlations between the number of signed contracts and the risks associated with road participation, as well as differences in OC costs by age group.

In 2023, the insurance market in Poland achieved an impressive result, generating gross written premiums of €17.7 billion (78.9 billion PLN). Of this amount, 71% came from property insurance and 29% from life insurance, highlighting the dominance of property insurance in the market. One of the key sectors in this market is motor insurance, which in 2023 generated €6.4 billion (28.3 billion PLN) in premiums, with €3.5 billion (15.7 billion PLN) from mandatory OC insurance and €2.8 billion (12.6 billion PLN) from Autocasco. At the same time, insurers paid out a total of €9.9 billion (44.2 billion PLN) in claims and benefits, a significant portion of which concerned the motor insurance sector. In OC motor insurance, €2.4 billion (10.7 billion PLN) was paid out, while Autocasco claims amounted to €1.4 billion (6.3 billion PLN). At the end of the year, the number of active OC policies for vehicle owners was 28.06 million, and the number of Autocasco policies was 7.39 million. These figures reflect the importance of motor insurance in the Polish market and its key contribution to the overall performance of the insurance sector.

Younger individuals, especially those aged 18–25, sign relatively few insurance contracts, mainly due to the high cost of OC insurance for this age group. The average OC premium for young drivers can exceed €449 (2,000 PLN), making insurance less accessible. In contrast, individuals aged 41–50 sign the most insurance contracts, partly because parents often register vehicles in their own names to lower the OC premium for their adult children. This allows younger people to use vehicles insured under more experienced drivers, reducing the overall cost.

The number of insurance contracts is strongly correlated with the number of accidents and fatalities. Age groups with more contracts, such as those aged 41–50, are involved in more accidents due to the larger number of active drivers in this group. However, the number of fatalities in these groups is relatively low, likely due to the greater driving experience of these drivers. Conversely, younger age groups, such as 18–24, are more prone to serious accidents despite signing fewer insurance contracts, resulting in a higher number of fatalities.

The analysis of injuries shows a similar trend. Age groups with more insurance contracts, like 41–50, also have a higher number of injuries. However, among younger groups, despite having fewer contracts, the number of injuries is proportionally higher, indicating a greater risk of serious accidents among young drivers.

Comparing data from 2022 and 2023, the total number of insurance contracts has not changed drastically, although some age groups show more significant fluctuations. For instance, the number of contracts in the 41–50 age group decreased by around 100,000, while in older groups, such as 51–60, the number of contracts increased. Despite these changes, the trends

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in accidents and fatalities remain stable, suggesting that shifts in the number of contracts do not always directly impact road safety.

The structure of the OC insurance market is closely linked to drivers' age and experience. Younger people, due to the high cost of OC, are less likely to sign contracts, which increases their risk. Meanwhile, older drivers, especially those aged 41–50, sign the most contracts, often as a means to lower insurance costs for their children.

In summary, third-party liability insurance (OC) plays a vital role in protecting both drivers and victims of road accidents. Its widespread use among Polish drivers reflects an increasing awareness of road safety. Analyzing data from recent years shows that the number of accidents and associated claims remains high. OC insurance is an essential component of the safety net that minimizes the financial consequences for victims.

The value of third-party liability insurance (OC) is influenced by various factors related to both the vehicle and the driver. Key elements include the driver's age and experience—young drivers, especially those aged 18–24, often pay higher premiums due to a higher risk of accidents. Location also plays a significant role, with residents of larger cities, such as Warsaw or Wrocław, typically facing higher costs than those in smaller towns, due to increased traffic and higher collision risks. The technical condition and model of the vehicle also matter, as more expensive and heavily used cars present a greater risk. Additionally, the driver's insurance history, including the number of claims and accidents, directly affects the premium – the more incidents, the higher the cost of the policy.

Usage-Based Insurance (UBI) represents a significant advancement in the insurance industry by utilizing telematics to adjust premiums based on an individual's driving habits rather than traditional risk factors like age or driving history alone. This model provides a highly personalized approach, as the insurance costs are linked directly to the driver's actual behavior on the road, such as speed, braking patterns, and mileage. As a result, safer drivers are rewarded with lower premiums, creating an incentive for careful driving and fostering responsible behavior.

The UBI model relies on telematics devices that collect real-time data from the vehicle, which insurers analyze to develop detailed profiles of driving behaviors. This data-driven approach not only allows for fairer pricing for drivers but also supports advancements in telematics technologies, contributing to road safety improvements. By providing feedback to drivers about their habits, UBI systems empower them to make adjustments that can decrease their risk of accidents and further lower their insurance costs.

In upcoming research, the authors plan to delve into the relationship between road safety and driver age by comparing data on driving license pass rates across various age groups with the number of compulsory third-party liability (OC) and UBI insurance contracts. This analysis aims to uncover any correlations between driver age, road safety outcomes, and

insurance preferences, ultimately informing more tailored and optimized insurance solutions. Such insights may reveal how younger versus older drivers approach motor insurance, helping insurers design products that better meet the needs of specific demographics, enhance customer satisfaction, and contribute to broader safety goals on the road.

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