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ACTUAL SAFETY OF THE YOUNGEST ROAD USERS AT PEDESTRIAN CROSSINGS

Abstract

Objectives: The article analyses the impact of legal regulations increasing pedestrian rights at crossings (introduced in the amended Road Traffic Law on June 1, 2021) on the actual safety of the youngest road users at pedestrian crossings. In accordance with the law, the scope of the pedestrian protection in the area of pedestrian crossings was increased. It was happened mainly because of imposing additional obligations on the vehicle driver.

Material and methods: In our study we used the method of quantitative and qualitative analysis of the content contained in scientific publications, programs and reports, normative acts related to the thematic area and statistical data. Police statistical data for the last quarter of 2023 collected in the Accident and Collision Registration System (SEWIK in Polish) were of particular importance for us.

Results: It might seem that over time, drivers will get used to the new regulations, and pedestrians, the youngest ones, will enter into some kind of synergy with them. The presented data show that the number of children aged 7-16 involved in road accidents at pedestrian crossings has significantly increased. The number of injured children has also increased.

Conclusions: We proved that the changes to the road traffic law introduced on June 1, 2021 (increasing the scope of pedestrian protection in the pedestrian crossing area by imposing additional obligations on the vehicle driver) have not had the expected (positive) impact on the actual safety of the youngest road users using pedestrian crossings. At the same time, the opposite tendency was demonstrated, i.e. the changing safety of the youngest people at pedestrian crossings, unfortunately with a downward trend.

Keywords: *safety; pedestrian; road incident; pedestrian crossing; youngest road users*

Introduction

According to published data, among others, in the National Road Safety Programme 2021-2030, the level of road traffic safety in Poland has been systematically improving over recent years. Between 2010 and 2020, the number of road accident fatalities was reduced by over 36% and the number of seriously injured persons by over 23%. However, the cited results are lower than those assumed in the previous program (for 2013-2020), which indicates difficulties in implementing the actions from previous years and the specificity of the challenge itself. In terms of numbers: in 2009, 4,572 people died on Polish roads, and in 2019 it was 2,909 people. The high risk of death in road accidents

is one of the biggest problems, the effects of which are clearly felt by the society and place Poland in the three European countries with the highest level of risk in road traffic (alongside Romania and Bulgaria). The plans included in the National Road Safety Programme 2021-2030 assume that by 2030 the number of fatalities is not to exceed 1,455 (National Road Safety Programme 2021-2030, 2020, pp. 7, 13, 44, 45). This effect is to be achieved through the systematic implementation of the mechanisms proposed by the European Union (EU) in the document EU Road Safety Policy Framework 2021 - 2030. Next steps towards 'Vision Zero' (European Commission, 2020). According to data for 2020, Poland has something to work on, as we rank 4th among the 27 EU Member States in terms of the highest number of fatalities per million inhabitants (National Road Safety Programme 2021-2030, 2020, p. 12).

Safety of children and young people in road traffic

One of the most at-risk groups of road victims (alongside passengers and drivers of passenger cars) includes vulnerable road users, i.e. pedestrians, cyclists, moped drivers and motorcyclists (Namatovu et al., 2022, p. 1). Despite solutions proposed to improve their safety, in 2019 these groups of road victims accounted for 48.6% of fatalities and 49.2% of seriously injured people in Poland (National Road Safety Council, 2020; Skoczyński, 2021, pp. 1-2). In the case of pedestrians themselves, the significant improvement in their safety should be emphasized. However, Poland still has a high rate of fatalities compared to the EU average - in 2019, pedestrians accounted for 27% of all road fatalities here, while the EU average was 21%. Moreover, in the context of age groups, fatalities in Polish road accidents are most often seniors (people over 60 years of age), and young people aged 18 to 24 have the greatest risk of becoming a victim (136 victims per 1 million population; data from 2019). In the case of children and adolescents, the risk is lower, although still disturbing - in the age group from 7 to 14 years, the fatality rate was 14 per 1 million of the population, and for the group of 15-17 years old it was 47 (data for 2019). In relation to EU Member States, Poland's statistics

regarding fatalities among people under 18 years of age are the same as the EU average, i.e. 4% of all victims (data from 2020). It is worth emphasizing that over the last 10 years, the number of fatalities among the youngest road users has decreased significantly, and has increased dramatically among the oldest people (age 85+) – this is a result of the aging population and it is a trend clearly visible throughout the EU (European Road Safety Observatory, 2023).

In addition to the indicated statistical data related to pedestrian safety, it is important to determine the causes of accidents in which pedestrians become victims. Many studies indicate that the most important factors influencing the number of road accidents are driver behaviours such as speeding, lack of concentration and fatigue (Ashraf et al., 2019), what is confirmed by the data presented by the European Transport Safety Council (Road Safety Performance Index, 2018). In the case of motorcycles and mopeds, inexperience should be added to the above-mentioned list (Szumska et al., 2020, pp. 76-77). In Poland itself, one of the three leading factors is failure to give way to pedestrians at a pedestrian crossing. In 2019 alone, there were 2,924 road accidents. Referring to pedestrians, road accidents are most often caused by: 1) careless entering the road, 2) crossing the road in an unauthorized place, 3) entering the road when the light is red; therefore, the dominant causes are related to careless or inappropriate behaviour of pedestrians in road traffic. Moreover, the mentioned behaviours are also the leading causes of fatal road accidents caused by pedestrians (National Road Safety Programme 2021-2030, p. 48).

Actual research shows that many activities can improve pedestrian safety. These may include proactive activities aimed at risk factors diagnosed among drivers, such as speed and sobriety checks, social campaigns and changes in infrastructure (Fisa et al., 2022, pp. 5-13). It may also include changes in law regulations. Such actions were taken in Poland, where a number of changes in legal regulations have been introduced in recent years (Poland: Road Safety Country Profile, 2021, pp. 3-4). The amendment to the Road Traffic Law of February 2021, which strengthened the position of pedestrians, is of crucial importance here (Road Traffic Act 2021). From June 1, 2021, pedestrians have priority not only when they are on a pedestrian crossing, but also when entering it. Significant changes were also introduced by reducing the speed limit in built-up areas at night to 50 km/h and by prohibiting pedestrians from using mobile phones and other

electronic devices in a way that limits the possibility of observing the situation on a road, tracks or pedestrian crossings. The focus on pedestrians results directly from the analysis of statistics - as indicated above, this is one of the most at-risk groups of victims on Polish roads. Children and adolescents constitute a significant part of pedestrians, which is also visible in European data (European Road Safety Observatory, Facts and Figures – Pedestrians, 2020, p. 3). Hence the above-mentioned regulations were also intended to increase the safety of these road users. Generally, legal challenges related to safe road crossing, including pedestrian crossings, focus on reducing the number of fatal pedestrian collisions by eliminating the cause of failure to give way to pedestrian. Therefore, the new law in Poland is intended to improve the situation of pedestrians. Children and young people may become the greatest beneficiaries of this solution. Similarly to what is expected from regulations related to the ban on the use of telephones and other electronic devices - according to research results, teenagers and young people seem to be particularly vulnerable. It is worth acting on them preventively thus (Mikusova et al., 2021, p. 17). In addition to the above, several changes have been introduced recently, i.e. from January 1, 2022, to the current law: increased, among others, penalties for failure to comply with pedestrian protection regulations. These include failure to give way to a pedestrian, overtaking at a pedestrian crossing or failure to stop the vehicle before a pedestrian crossing to allow a disabled person to cross. Penalties for pedestrians have also been tightened, including using a mobile phone while entering and crossing a road or tracks (Dąbrowska-Loranc, Sicińska, 2021, p. 69). In the near future, EU solutions may become another complement to Polish regulations, especially those proposed in the Vision ZERO, which aims to achieve zero fatalities on European roads. In the program document for the vision entitled "EU Road Safety Policy Framework 2021 - 2030. Next steps towards 'Vision Zero'" its authors did not introduce direct, extensive references to the safety of pedestrians, including children and adolescents. However, the proposed directions of changes may also bring tangible benefits in terms of increasing children's safety, mainly thanks to systematic risk mapping and assessment of road and roadside safety. Moreover, great importance is attached to combating drivers' distractions (mainly related to the use of smartphones and electronic systems integrated with vehicles) and driving under

the influence of alcohol and psychoactive substances (EU Road Safety Policy Framework 2021 – 2030. Next steps towards 'Vision Zero', 2020, p. 20).

Regarding the safety of children and adolescents as pedestrians crossing the street, interesting studies were conducted in the context of 1) peer influence and 2) children's perception of the best (the safest) moment to enter the street. The first research was aimed at verifying how children perceive the norms of behaviour of their peers when crossing the street in relation to their personal norms in this area. Then, it was checked how children's self-reports about crossing the road relate to the actual crossing in a virtual road situation. The research was part of the considerations related to the importance of using social norms in preventive programs reducing health-threatening behaviours. Its results indicated that children's perception of peers' behavioural norms has a strong relationship with their behaviour at crossings and may be one of the important factors increasing the risk of injury (Morrongiello et al., 2019, pp. 197-201). The second mentioned study analysed the way children cross the street: what places they choose, how they estimate the gaps between moving vehicles, and finally how they assess the speed of the vehicle and the time left to cross a street. According to the results, when deciding on the convenient moment to cross the street, children relied primarily on the subjective perception of the distance of the vehicle. The risk increased with larger distances between vehicles: children started crossing too late, did not monitor traffic or adjust their walking speed while crossing. Even with smaller vehicle distances and a comparable risk, children were not able to sufficiently adjust their speed and their time to enter the road. The subjective perception of the distance of the moving vehicle was therefore misleading for them and increased the risk of injury in various road situations (Morrongiello et al., 2016, pp. 272-273).

In addition to the above, it should be emphasized that changes in pedestrian rights regarding priority and the method of entering a pedestrian crossing may result in the development of routine behaviour. This type of behaviour could be extremely harmful to road users (Lisheng et al., 2021, pp. 1-3) and result in the disappearance of typical elements of pedestrian behaviour that have so far been interpreted by drivers as signalling their intention to enter a pedestrian crossing. These elements include changes in pedestrians' head orientation, such as looking or glancing at traffic (Rasouli et al., 2018, pp. 61-70). One of the effects here is an environment in which pedestrians' intentions are increasingly

difficult for drivers to recognize. Additionally, errors made by drivers during the recognition are not compensated by the caution of pedestrians.

Research methods and assumptions.

The aim of our research was to obtain knowledge about the impact of regulations increasing pedestrian rights at crossings (introduced in the amended Road Traffic Law, June 1, 2021) on the actual safety of the youngest road users at pedestrian crossings. Pursuant to the mentioned regulations, the scope of pedestrian protection in the analysed area was increased by imposing additional obligations on the vehicle driver. The driver was obliged to carefully observe the pedestrian crossing and its surroundings and allow the pedestrian to cross safely. In practice, this means that pedestrians always have the right of way when crossing and entering a pedestrian crossing. The change in regulations was therefore aimed at protecting pedestrians, including the youngest ones, who received the main attention in our study.

The main research problem was defined in the question: what impact do the provisions increasing the rights of pedestrians at crossings (included in the amended Road Traffic Law, introduced from June 1, 2021) have on the actual safety of the youngest road users using pedestrian crossings? Solving the indicated research problem was possible by designating a research area for all road incidents that occurred at pedestrian crossings in Poland in 2019-2023. The specificity of data from 2020 was also taken into account, when changes related to the Covid-2019 pandemic had a drastic impact on the functioning of European societies, including Polish society. The key changes included here movement of residents, remote work and learning; and they had an impact on statistics related to road traffic incidents. Therefore, the most important information validating the conducted research concerns the years 2019, 2021, 2022 and the first three quarters of 2023.

To achieve the assumed goal and clarify the research problem, we used the method of quantitative and qualitative analysis of scientific publications, programs and reports, normative acts and statistical data. The leading influence on the research process had statistical data collected in the Accident and Collision

Registration System (hereafter SEWIK). We received the data from the Police in the last quarter of 2023, organized and interpreted it in terms of the research goal. The SEWIK database, which is the main source of information on road incidents in Poland, is administered by the Road Traffic Office of the National Police Headquarters. The purpose of processing personal data in SEWIK is to fulfil the statutory tasks imposed on the Police, i.e. the obligation to create statistics on road incidents (including the age of perpetrators, gender) and to provide information on road incidents to the Insurance Guarantee Fund, insurance companies and other insurance institutions authorized by law.

Results

The conducted research required taking into account many variables which are collected by the Police in road incident cards in the SEWIK system. These variables are: type of road incident, type of participant, road surface condition, lighting, weather conditions, area, consequences for pedestrians, whether the driver is under the influence of alcohol or other substances, age and gender of the injured person, and the characteristics of the incident site. Among them, in terms of the research goal, we considered the most important to be: weather conditions, lighting and surface condition.

According to data analysis, good weather conditions occurred in more than half of all road incidents recorded in SEWIK. The summary is presented in the table below. The data only concerned road incidents at pedestrian crossings.

Research conducted so far often presents divergent results. Some of them showed that increases in air temperature and snowfall have a positive impact on the number of road fatalities, while an increase in rainfall and relative humidity has a negative impact (Zou et al., 2021, pp. 2, 8, 12). Others suggested that the number of road incidents increases on rainy days (Lobo et al., 2019, pp. 8-9; Bijleveld, Churchill. 2009, pp. 17-20). As data from SEWIK indicated, weather conditions did not have a significant impact in the case of road incidents at pedestrian crossings in the years 2019-2023 in Poland.

Table 1. *Road incidents at pedestrian crossings by type of weather conditions*

	2019	2020	2021	2022	2023
Good conditions	56,82%	51,28%	52,19%	52,98%	57,60%
Others	43,18%	48,72%	47,81%	47,02%	42,40%

Source: own study based on SEWIK data

Another variable important for our research was pedestrian crossing lighting. And here, according to the SEWIK data, it turned out that most road incidents take place on illuminated crossings or in daylight.

Table 2. *Road incidents at pedestrian crossings divided by pedestrian crossing lighting*

	2019	2020	2021	2022	2023
Night – lit road	29,88%	32,87%	30,06%	28,58%	24,25%
Night - unlit road	1,16%	1,56%	2,05%	1,74%	1,55%
Daylight	58,48%	54,31%	59,45%	60,40%	66,92%
Dawn, dusk	10,48%	11,26%	8,45%	9,28%	7,28%

Source: own study based on SEWIK data

Road incidents at illuminated crossings and during the day accounted for approximately 90% of all incidents in particular years. From this point of view, it can be concluded that the lack of crossing lighting and poor visibility conditions were not a significant cause of road incidents at pedestrian crossings in the analysed period. It should be noted, however, that scientific literature presents various approaches to issues related to the lighting of pedestrian crossings. For example, improperly designed and unlit pedestrian crossings may cause effects that are counterproductive and consequently reduce the level of pedestrian safety (Tomczuk et al., 2021, pp. 21-39). The analysis results also indicate that lighting directed from above can illuminate a crossing in a way that creates a false impression of safety for both pedestrians and drivers, while at the same time not illuminating pedestrians in dark clothes. Vertical lighting may be the solution here (Llinares, et al., 2020, pp. 1-2, 16-17).

The final variable we took into account was the condition of the road surface which does not seem to be the most important, especially if speed limits are most

often applied at pedestrian crossings. Surprisingly, it turned out that most road incidents occur on dry (in about 60% of cases) and then wet (approximately 40% of cases) surfaces. Icy surfaces occurred in less than 3% of incidents.

Table 3. *Road incidents at pedestrian crossings divided by surface condition*

	2019	2020	2021	2022	2023
Dry	61,54%	56,39%	56,01%	61,03%	65,01%
Wet	36,18%	42,79%	39,04%	36,08%	33,65%
Atmospheric icing, snow	1,93%	0,50%	1,08%	2,70%	1,06%
Other	0,35%	0,32%	3,87%	0,18%	0,27%

Source: own study based on SEWIK data

The number of road incidents that occurred on wet surfaces was slightly lower than the average number of days with precipitation in Poland, which, according to the Institute of Meteorology and Water Management, has averaged 162 days (44.32%) over the last decade. Hence, it can be assumed that the type of surface did not have a significant impact on the number of road incidents at pedestrian crossings in the analysed period. Meta-analyses indicate that the impact of road surface condition on the occurrence of road incidents is insignificant compared to other factors such as vehicle speed, road geometry, wet surface, road edge, etc. (Deme, 2020, pp. 1-11).

Therefore, for the purposes of the research, only incidents that occurred during good weather conditions on dry surfaces and only events involving hitting a pedestrian at pedestrian crossings were taken into account. All incidents in which drivers were under the influence of alcohol or a similar substance were rejected. Thus, our research included incidents that may only be influenced by the participants' behaviour. This made it possible to limit the influence of more or less important external variables.

Table 4 presents data including collisions with pedestrians at pedestrian crossings, during good weather conditions, on dry surfaces, and when the participants were sober. In 2019 and 2020 there was a decrease in the number of incidents, but from 2021 their number has been increasing. It should be remembered that the act increasing pedestrians' rights at pedestrian crossings came into force in June 2021 and the numbers for 2023 are incomplete because they cover 3

quarters. Assuming that in the fourth quarter of the year the number of incidents could be the arithmetic average of the previous quarters, the total number of events will be 2,578. This means that the number of incidents is increasing.

Table 4. *Number of pedestrians involved in road incidents at pedestrian crossings*

2019	2020	2021	2022	2023
3370	2368	2154	2577	2062

Source: own study based on SEWIK data

The division of the number of road incidents according to the age of pedestrians was also interesting for the research. The first category included children aged 7-16; most of them were primary school students.

Table 5. *Number of children aged 7-16 involved in road incidents at pedestrian crossings*

2019	2020	2021	2022	2023
237	152	234	291	427

Source: own study based on SEWIK data

Equally disturbing were the data on the number of children aged 7-16 who were seriously injured or died as a result of incidents at pedestrian crossings. The data is presented in the table below. For 2023, data until the end of September 2023 (3 quarters of 2023) are presented, and extrapolated data for the last quarter are given in brackets.

Table 6. *Number of children aged 7-16 injured in road incidents at pedestrian crossings*

	2019	2020	2021	2022	2023
Dead	4	1	3	6	3 (4)
Seriously injured	64	55	64	73	61 (81)
Total	68	56	67	79	64 (85)

Source: own study based on SEWIK data

It is clearly visible that the number of children who died or were seriously injured in road incidents at pedestrian crossings is increasing in the years 2020-2023.

The data presented above should be assessed in the appropriate context, taking into account the key variables for the conducted research. These variables

include the number of people covered by the statistics. In Poland, in the years 2019-2022, the number of children aged 0-14 in the population decreased significantly, as can be seen in the table below.

Table 7. *Number of children aged 1-14 (in thousands)*

2019	2020	2021	2022
5872,5	5941,8	5913,6	5816.01

Source: own compilation based on Statistics Poland data, Macroeconomic Data Bank: https://bdm.stat.gov.pl

A short-term growth in the number of children can be seen in 2019-2020, but this is not unusual. Birth rate trends in Poland and Europe are clearly downward, and the recent decline may be influenced by many factors, including the Covid-19 pandemic (Stout et al., 2021, p. 8; Pomar, et al., 2022). However, these long-term trends can be seen in the basic effect, which is the aging of European populations (Eurostat, 2023).

Table 8. *Number of live births (in thousands)*

2017	2018	2019	2020	2021	2022
402	388,2	375	355,3	331,5	305,1

Source: own compilation based on Statistics Poland data, Macroeconomic Data Bank: https://bdm.stat.gov.pl

As can be seen in table no. 7, the number of children in Poland is gradually decreasing, and this regression has an increasing dynamic of 3 to 5% year to year. To conclude, the number of children involved in road traffic is decreasing, while the number of road incidents is increasing.

Another variable we took into account was the number of vehicles on the road in each year. The number of passenger cars registered in Poland is presented in the table below.

Table 9. *Number of passenger cars in Poland*

Year	Number of passenger cars
2019	22,327,000
2020	22,491,000
2021	22,660,000
2022	22,830,000
2023	22,999,000

Source: own compilation based on CEPIK data, http://www.cepik.gov.pl/statystyki

The maximum difference in the number of registered passenger cars from year to year is 0.75%. These differences are very small and do not mean real changes in the number of vehicles in traffic. Overall, it is influenced by many other factors, and the real number of vehicles can be estimated based on changes in the number of kilometres of individual vehicles recorded in the Central Register of Vehicles and Drivers (hereafter CEPIK) during the annual mandatory inspections.

Findings indicate that the road safety system for children aged 7-16 is more deteriorated than would result from the number of road incidents alone. With clearly decreasing trends regarding: the number of children - road users, a similar number of vehicles, the lack of significant influence of factors such as road condition, weather conditions or lighting, the number of road incidents is increasing. Therefore, the changes to the road traffic law introduced on June 1, 2021, which were intended to increase pedestrian safety in the area of pedestrian crossings (by imposing additional obligations on the vehicle driver), are not justified by the presented statistical data.

Conclusions

The presented research attempts to answer the question bothering many drivers and road safety experts: What impact do the regulations included in the amended Road Traffic Law have had on the actual safety of the youngest road users using pedestrian crossings? The aforementioned amendment, as indicated in earlier sections of the article, refers to provisions increasing the rights of pedestrians at crossings, introduced in Poland from 1 June 2021. With reference to the changes, the Minister of Infrastructure in office in 2021, emphasised that the new law introduces a number of solutions to improve the safety of road users, including, above all, pedestrians, who stand no chance in a collision with a speeding vehicle. He also added that the Polish governments' priority is to improve road safety, especially the safety of vulnerable road users (National Road Safety Council, 2021).

In connection with the introduced legal changes, many doubts have arisen, including the driver's recognition of the intentions of a pedestrian entering a pedestrian crossing. It might seem that over time, drivers will get used to the new regulations, and pedestrians, the youngest ones, will enter into some kind of synergy with them. However, it turns out that the reality is completely different. The presented data show that the number of children aged 7-16 involved in road accidents at pedestrian crossings has significantly increased. The number of injured children has also increased. Could one of the reasons be a reduction in the level of caution that children were accustomed to, taught and paid attention to both at school and at home? Perhaps the answer to this question is yes, but such a thesis would need to be scientifically confirmed, which may be another research challenge.

The research achieved its goal, which was particularly helped by the road incident data from SEWIK. We proved that the changes to the road traffic law introduced on June 1, 2021 (increasing the scope of pedestrian protection in the pedestrian crossing area by imposing additional obligations on the vehicle driver) have not had the expected (positive) impact on the actual safety of the youngest road users using pedestrian crossings. At the same time, the opposite tendency was demonstrated, i.e. the changing safety of the youngest people at pedestrian crossings, unfortunately with a downward trend.

References

Ashraf, I., Hur, S., Shafiq, M., Park, Y. (2019). *Catastrophic factors involved in road accidents: Underlying causes and descriptive analysis.* PLoS ONE 14(10): e0223473. https://doi.org/10.1371/journal.pone.0223473.

Bijleveld, F., Churchill, T. (2009). *The influence of weather conditions on road safety*. Leidschendam: SWOV Institute for Road Safety- Research, pp. 17-20.

Dąbrowska-Loranc, M., Sicińska, K. (2021). *Survey of pedestrians and car drivers' attitudes at the area of pedestrian crossings over period of time*, Transport Problems, 16(2), p. 69.

Deme, D. (2020). *Review on Effect of Pavement Surface Failure on Road Traffic Accident*. American International Journal of Sciences and Engineering Research, 3(1), pp. 1-11.

European Commission. (2020). *EU road safety policy framework 2021-2030: next steps towards 'Vision Zero'*, Commission Staff Working Document, SWD (2019) 283 final, p. 20.

European Road Safety Observatory. (2020). *Facts and Figures - Pedestrians*. (https://road-safety.transport.ec.europa.eu/system/files/2021-07/facts_figures_pedestrians_final_20210323. pdf), access: 28 December 2023, p. 3.

European Transport Safety Council. (2018). *Road Safety Performance Index (PIN) Annual Report 2018*. (https://etsc.eu/wp-content/uploads/PIN-ANNUAL-REPORT-2018.pdf), access: 28 December 2023.

Eurostat. (2023). *Statistics Explained*. (https://ec.europa.eu/eurostat/statistics-explained/index.php/ Main_Page), access: 26 December 2023.

Fisa ,R., Musukuma, M., Sampa, M., Musonda, P., Young, T. (2022). *Effects of interventions for preventing road traffic crashes: an overview of systematic reviews*. BMC Public Health, 22(1), 513, pp. 5-13.

International Transport Forum. (2021). *Poland: Road Safety Country Profile,* (https://www.itf-oecd.org/sites/default/files/poland-road-safety.pdf), access: 28 December 2023, pp. 3-4.

Lisheng, Jin., Baicang, Guo., Yuying, J., Qiang, H. (2021). *Analysis on the Influencing Factors of Driving Behaviours Based on Theory of Planned Behaviour*. Advances in Civil Engineering, Volume 2021, pp. 1-3.

Llinares, C., Higuera-Trujillo, J. L., Montañana, A., Castilla, N. (2020) *Improving the Pedestrian's Perceptions of Safety on Street Crossings. Psychological and Neurophysiological Effects of Traffic Lanes, Artificial Lighting, and Vegetation*. Int. J. Environ. Res. Public Health, pp. 1-2, 16-17.

Lobo, A., Ferreira, S., Iglesias, I., Couto, A. (2019) *Urban Road Crashes and Weather Conditions: Untangling the Effects*. Sustainability, 11(11), pp. 8-9.

Mikusova, M., Wachnicka, J., Zukowska J. (2021). *Research on the Use of Mobile Devices and Headphones on Pedestrian Crossings—Pilot Case Study from Slovakia*, Safety, 7(1), p.17.

Ministry of Infrastructure. (2020). *National Road Safety Programme 2021-2030*. (https://www.gov.pl/web/infrastruktura/narodowy-program-bezpieczenstwa-ruchu-drogowego-2021-2030), access: 28 December 2023.

Morrongiello, B. A, Corbett, M., Milanovic, M., Beer, J. (2016). *Using a Virtual Environment to Examine How Children Cross Streets: Advancing Our Understanding of How Injury Risk Arises*, Journal of Pediatric Psychology, 41(2), pp. 272-273.

Morrongiello, B.A., Seasons, M., McAuley, K., Koutsoulianos, S. (2019). *Child pedestrian behaviors: Influence of peer social norms and correspondence between self-reports and crossing behaviors*, Journal of Safety Research, 68, pp. 197-201.

Namatovu, S., Balugaba, B. E., Muni, K., Ningwa, A., Nsabagwa, L., Oporia, F., et al. (2022). *Interventions to reduce pedestrian road traffic injuries: A systematic review of randomized controlled trials, cluster randomized controlled trials, interrupted time-series, and controlled before-after studies*. PLoS ONE 17(1): e0262681. https://doi.org/10.1371/ journal.pone.0262681, p. 1.

National Road Safety Council. (2021). *National Road Safety Program 2021-2030*, (https://www.krbrd.gov.pl/aktualnosci/narodowy-program-brd-2021-2030, access: 26 December 2023, pp. 7-13, 44-48.

National Road Safety Council. (2021). *Changes to the Traffic Law from 1 June*, (https://www.krbrd.gov.pl/od-1-czerwca-zmiany-w-prawie-o-ruchu-drogowym/#.), access: 26 December 2023.

National Road Safety Council Secretariat. (2020), *Road Safety Status and Actions Taken in 2019*, Ministry of Infrastructure, Warsaw, (https://www.gov.pl/web/infrastruktura/stan-bezpieczenstwa-ruchu-drogowego-oraz-dzialania-realizowane-w-tym-zakresie-w-2019-r) access: 28 December 2023.

Pomar, L., Favre, G., de Labrusse, C., Contier, A., Boulvain, M., Baud, D. (2022). *Impact of the first wave of the COVID-19 pandemic on birth rates in Europe: a time series analysis in 24 countries*. Hum Reprod. Nov 24;37(12).

Rasouli, A., Kotseruba, I. i Tsotsos, J.K. (2018). *Understanding Pedestrian Behavior in Complex Traffic Scenes*, IEEE Transactions on Intelligent Vehicles, 3(1), pp. 61-70.

Road Traffic Act 2021. Act of 25 February 2021 amending the Act - Road Traffic Act. Journal of Laws 2021, item 54.

Skoczyński, P. (2021). *Analysis of Solutions Improving Safety of Cyclists in the Road Traffic. Applied Sciences*, 11(9), 3771, pp. 1-2.

Stout, M.J., Van De Ven C.J.M., Parekh, et al. (2021). *Use of Electronic Medical Records to Estimate Changes in Pregnancy and Birth Rates During the COVID-19 Pandemic*. JAMA Netw Open;4(6), p. 8.

Szumska, E., Frej, D., Grabski, P. (2020). *Analysis of the Causes of Vehicle Accidents in Poland in 2009-2019*. LOGI – Scientific Journal on Transport and Logistics, 11, 76-87. DOI: 10.2478/logi-2020-0017, pp. 76-77.

Tomczuk, P., Chrzanowicz, M., Mackun, T., Budzyński, M. (2021). *Analysis of lighting parameters audit at pedestrian crossings in Warsaw*. Archives of Transport, 59(3), pp. 21-39.

Zou, Y., Zhang, Y., Cheng, K. (2021). *Exploring the Impact of Climate and Extreme Weather on Fatal Traffic Accidents*. Sustainability 2021, 13, 390. https://doi.org/10.3390/su13010390, pp. 2, 8, 12.