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DANGEROUS BEHAVIOR OF PEDESTRIANS AND THEIR KNOWLEDGE OF ROAD TRAFFIC RISKS IN POLAND

Summary. This article presents the results of a survey with 3061 respondents conducted to investigate the propensity for risky behavior among pedestrian road users and their knowledge of the potential risks they face from passenger car drivers. The study shows that there is a correlation between gender and risk propensity (p=0.000, c=0.1245). Men are more likely to be risk-averse than women, despite their greater knowledge of the possible dangers of passenger car drivers. A similar relationship can be identified when taking into account where pedestrians live. Residents of large cities (over 150,000 inhabitants) show the highest propensity for risky behavior compared to residents of smaller towns and villages. At the same time, residents of these cities have greater knowledge than the other groups surveyed regarding the reaction of the driver and the possibility of stopping the car. In the case of the age of pedestrians, it is not possible to identify one particular age group characterized by a higher propensity for risky behavior. At the same time, for the age of pedestrians and their risky behavior, there is a significant correlation relating to the use of headphones when crossing pedestrian crossings without traffic lights (p=0.000, c=0.4810). Headphones were frequently used when crossing crosswalks by those aged 18-29 years (44.2%), while never by those aged

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over 65 years. The results of the study indicate the need for educational efforts among pedestrians, taking into account demographic variables and aspects related to limited trust in passenger car drivers.

Keywords: pedestrian, behavior, road safety, pedestrian crossing, hazard, risk

1. INTRODUCTION

One of the problems facing the world today is road accidents. Every day, more than 3 500 people are killed on roads around the world, representing almost 1.3 million preventable deaths and around 50 million injuries per year [1]. Road accidents are unpredictable events that can happen to any road user. Although most road users are aware of the basic rules and regulations to be observed, failure to comply with some of them leads to disasters. Speeding, distracted drivers and pedestrians, drunk driving, and breaking traffic laws can be cited as the main causes of this situation [2].

Many dangerous traffic situations occur involving pedestrians. Walking is the most common form of travel. According to a study in an Indian city, about 64.7% of journeys are made on foot, compared to 15.8% by bicycle, 14.2% by public transport, 4.2% by private transport and only 1.1% by other forms of transport (rickshaw, taxi) [3]. Worldwide, pedestrians account for 23% of fatalities. In Europe, pedestrian road fatalities account for 19% [4]. In Poland, pedestrians account for 18.3% of all road accident victims. Measures are being taken to improve pedestrian safety, and the type and scope of these measures are included in programs to improve road safety in Poland [5,6].

It is worth noting that pedestrians are the group of road users who, on the one hand, are most exposed to the serious consequences of road accidents and, on the other hand, their knowledge of safe road travel is not verified in any way. In addition, like any group of road users, they show a propensity for risky behavior. Risk propensity can be defined as an individual's tendency to seek out or take risks [7]. Commonly, the term 'risky behavior' is most often associated with the expression of a balance of gain and loss. Psychological theories focus primarily on the assessment of loss, indicating that a risk is any factor that has the capacity to cause an undesirable outcome or loss of valued or expected loss (risk according to Fishburn) [8,9]. A juxtaposition of the two groups of risk theories was made by Zaleśkiewicz [10]. He distinguishes between two types of risk behavior: the first one results from the desire to make a broadly understood profit or avoid possible losses (instrumental risk), while the second refers to a specific form of satisfying the need to experience pleasure (stimulus risk). Both of these forms of behavior are observed among pedestrian road users [9].

One of the places where accidents involving pedestrians most often occur is pedestrian crossings [11]. Aiming to improve safety at pedestrian crossings without traffic lights in Poland, the law was amended in 2021 according to which: "a pedestrian at a pedestrian crossing has priority over a vehicle. A pedestrian entering a pedestrian crossing shall have priority over a vehicle, with the exception of a tram" [12]. As a result of the introduced amendment broadening the rights of pedestrians, there was an increase in the number of road accidents involving pedestrians by the end of 2022 [13]. Some of the accidents were the result of inappropriate behavior on the part of pedestrians, who often believed that priority at pedestrian crossings relieved them of their duty to check the traffic situation. In addition, some pedestrians became accustomed to being a privileged group of road users at pedestrian crossings and therefore stopped being cautious by crossing without checking for oncoming vehicles, regardless of the prevailing weather conditions and time of day.

The article presents the results of research, following the 2021 amendments to the Traffic Law, on:

- risky behavior among pedestrian road users in Poland, mainly at pedestrian crossings,
- knowledge of the risks to which pedestrians are exposed by car drivers resulting from the sudden appearance of a pedestrian on the road and the driver's reaction time and ability to stop the vehicle.

2. LITERATURE REVIEW

Another aspect that should be considered by pedestrians when crossing a pedestrian crossing without traffic lights is the awareness of the driver's reaction time to the appearance of an obstacle. This is assumed to be between 0.7 and 1 second on average [14]. At the same time, according to studies, the driver's reaction time to the appearance of an obstacle can vary according to gender, age, speed, distance, lighting, attention focus, fatigue, driver experience, seat position, brake light location, or mobile phone use [15-17]. Another aspect that should be considered by pedestrians when crossing a crosswalk without traffic lights is awareness of the driver's reaction time to the appearance of an obstacle. It is generally accepted that it averages 0.7 to 1 second [14]. At the same time, according to studies, the driver's reaction time to the appearance of an obstacle can vary depending on gender, age, speed, distance, lighting, concentration of attention, fatigue, driver experience, seat position, location of brake lights, or use of a cell phone [15,17].

The driver's reaction time is one factor affecting accident-free driving. The second factor, in the case of a pedestrian suddenly appearing on the road, is the braking distance of the vehicle. The distance the vehicle travels when perceiving and reacting to a situation and reacting to a dangerous situation is proportional to the reaction time. This time accounts for a large proportion (25-50%) of the total stopping distance. The longer the reaction time, the greater the stopping distance. Braking distance is a function of human and mechanical processes related to perception, reaction and stopping time [18,19]. Stopping distances, according to research, depend on a number of factors, driver-dependent and non-driver-dependent. However, studies show that weather and lighting conditions, such as snow, rain, fog, high winds and night and day driving, affect braking distance by affecting vehicle performance, traffic flow and driver visibility [18,20-22]. This means that suddenly stepping into a pedestrian crossing in front of a moving vehicle, or crossing the road in an unauthorized place in adverse weather conditions or poor lighting, makes an accident more likely.

Braking speed is significantly influenced by visibility. It is, in the case of the pedestrian, largely dependent on it. According to a study by Doza et al. [23], the response process of drivers is highly dependent on the relationship between the time a pedestrian becomes visible and the speed of the pedestrian, suggesting that the response of drivers may depend more on the pedestrian's field of safety than on themselves. Most people travelling at night do not realize how much visibility a driver has after dark. If road conditions force the driver to travel with dipped headlights on, the headlights can illuminate the road in front of the vehicle for as little as 40m. A pedestrian, on the other hand, is visible from an even shorter distance, as the light beam must illuminate him or her for approximately 25-30 cm (measured from the road surface) to be visible to the driver. This essentially means that the distance to spot a pedestrian is much shorter (approximately 20-25 m) [24,25]. According to a study by Benea et al. [26], pedestrian clothing and adaptive headlights significantly affect the likelihood that a driver will recognize the presence of a pedestrian on the road and correctly perceive the distance the pedestrian is at.

Pedestrians' clothing has a huge impact on their visibility. When the pedestrian was dressed in a black coat, he or she was barely noticed from a distance of 10 m. For the other subjects, the distance of the pedestrian in black was confused with the background (i.e. it was invisible). The moment of visibility of a pedestrian wearing black may prevent drivers from stopping in time. Pedestrian visibility is improved by wearing light-colored clothing (which provides greater contrast with the surroundings) [25,27,28].

A study by Gauld et al. [29] found that pedestrians who were dependent on their mobile phones were more likely to use them when crossing the road. Teenagers in particular have become dependent on their phones, which affects their decisions to cross the carriageway, increasing the likelihood of a collision or accident. In addition to chatting, texting or using various chat rooms is dangerous when crossing the road. This influences slower walking speed and holding the head in a bent position to view the device screen while walking [30-33]. People who are busy with their devices are more likely to cross the road in front of oncoming traffic [34,35,30] Equally dangerous is the use of headphones. A study by Lee et al. [36] shows that pedestrians are actually unable to detect the warning sound of a vehicle coming from behind, even from a short distance (1 m) if they are listening to music from headphones at the time. Wearing headphones is associated with an increase in walking speed [37]. According to a number of studies, both mobile phone and headphone use by pedestrians contributes to reduced road safety [38-41].

The factors outlined as potential pedestrian safety hazards also depend on the pedestrian's age [42-45], gender [44-48], or place of residence [49-51].

3. MATERIAL AND METHODS

The study used a survey questionnaire. It was designed using Microsoft Forms tools and was distributed via email and social media channels; Facebook, Linkedln and Instagram. A pilot study was conducted to test the readability of the worded questions and responses.

The questionnaire consisted of questions about the respondents' unsafe behavior and their knowledge of selected car driver behaviors that could pose a significant risk to pedestrians. The questions related to:

- the types of crossings most frequently used by pedestrians and the frequency of use of crossings without traffic lights,
- dangerous behavior of pedestrians including crossing the road in an unauthorized place, use of telephones and headphones when crossing a pedestrian crossing without traffic lights, use of reflective elements after dark,
- awareness of pedestrians regarding their visibility after dark without the use of reflective elements, awareness of the reaction time of a driver to the sudden appearance of an obstacle or a living person on the road, knowledge of the braking distance of a passenger vehicle at 50 km/h, knowledge of the distance covered by a passenger car travelling at 50 km/h in 1 s,
- demographic data (gender, age, education, place of residence).

The survey was conducted between 20.12.2022 and 01.06.2023. Two methods were used in the data collection process:

- PAPI - to collect data among a proportion of people over 65 who do not use social media (e.g. due to lack of internet access) and a proportion of rural residents who had no other means of completing the survey;
- CAWI - to collect data from the remaining respondents.

In determining the sample size, a confidence level of α =95%, p= 0.5 and a maximum error of 2% were assumed. The minimum sample size for this survey was N=2401. In total, responses were obtained from 3251 respondents. 190 paper questionnaires were rejected due to incorrect completion. 3061 questionnaires were used for further analysis, representing 94.2% of all completed questionnaires. In order to answer the research questions, statistical analyses were carried out using an Excel spreadsheet and the Statistica 13.3 program, which was used to calculate basic descriptive statistics, the $\chi 2$ test and Pearson's c- contingency coefficient. The significance level in the article was taken as $\alpha = 0.05$.

4. RESULTS

4.1. Participant

The characteristics of the respondents are summarized in Table 1. More than half of the respondents were women - 1,840 people (60.1%). The largest group were respondents aged 18-29 years - 889 people (29.0%). Most of the respondents had higher education - 1622 persons (53.0%) and secondary education - 978 persons (32.0%), and the least with vocational education - 168 persons (5.5%). In terms of occupational status, most respondents were employed - 1,765 persons (57.7%), while the least were unemployed - 67 persons (2.2%). Among the respondents, people residing in cities predominated - 1,883 persons (59.9%), including those in urban centers with more than 150,000 inhabitants - 870 persons (28.4%).

Tab. 1

Characteristics of respondents

Variable	Specification	Number	%
gender	woman	1840	60,1
	man	1221	39,9
age	under 18*	268	8,8
	18-29	889	29,0
	30-41	526	17,2
	42-53	692	22,6
	54-65	329	10,7
	over 65	357	11,7
education	primary	293	9,6
	vocational	168	5,5
	secondary	978	32,0
	higher	1622	53,0
residence	village	1228	40,1
	city of up to 50 thousand inhabitants	564	18,4
	city from 51 thousand - 100 thousand inhabitants	289	9,4
	city from 101 thousand - 150 thousand inhabitants	110	3,6
	above 150,000 inhabitants	870	28,4

*the survey included people who were 14 years of age or older (persons who have completed elementary school).

4.2. Dangerous behavior and risk awareness - by gender

Considering the unsafe behavior among men and women, it can be seen that men were more likely to exhibit unsafe behavior than women, but this is not a significant difference (Tab. 2). Men were more likely to cross the road in an unauthorized place (79.0% of men and 67.6% of women). Men were also more likely to use phones and headphones when crossing a pedestrian crossing without a traffic light. When it came to the use of reflective elements after dark, men were also more likely to indicate that they did not use them at all. In the area of unsafe behavior, there was a weak correlation only between gender and crossing the road in an unauthorized place (p=0.000, c=0.1245). Although men were more likely to exhibit unsafe behavior, they have greater knowledge of the dangers of car drivers. Considering the knowledge of the distance from which a pedestrian walking at dusk without reflective elements is visible, a weak correlation relationship can be indicated (p=0.000, c = 0.1798). Similar results and a weak correlation relationship were also obtained for:

- knowledge of the driver's reaction time to the sudden appearance of an obstacle or living creature on the road (p=0.000, c = 0.2627),
- knowledge of the braking distance of a passenger car at 50 km/h (p=0.000, c = 0.1548),
- knowledge of the distance covered by a passenger car in one second travelling at 50 km/h (p=0.000, c = 0.1851).

Tab. 2

Dangerous behavior and risk awareness

Gender		Woman		Men		Test results	c-Pearson coefficient
		Number	%	Number	%		
Crossing the road in a forbidden place	yes	1243	67,6	965	79,0	χ^2=48,114 p=0,000	c = 0,1245
	no	597	32,4	256	21,0		
Crossing a pedestrian crossing without a traffic light using a cell phone	never	1059	57,6	655	53,6	χ^2 = 8,597 p=0,0136	c = 0,0529
	rarely	635	34,5	435	35,7		
	often	146	7,9	131	10,7		
Crossing a crosswalk without a traffic light using headphones	never	1158	62,9	679	55,6	χ^2=17,180 p=0,000	c = 0,0747
	rarely	319	17,3	267	21,9		
	often	363	19,7	275	22,5		
Use of reflective elements after darkness falls	yes	368	20,0	197	16,1	χ^2 =7,760 p =0,021	c = 0,0503
	sometimes	686	37,3	463	37,9		
	no	786	42,7	561	46,0		
Knowledge of the distance from which a pedestrian walking at dusk without reflective elements is visible	good	232	12,6	319	26,1	χ^2=102,299 p =0,000	c = 0,1798
	wrong	1410	76,6	831	68,1		
	no opinion	198	10,8	71	5,8		

Knowledge of the driver's reaction time to the sudden appearance of an obstacle or living being on the road	good	433	23,5	599	49,1	χ^2=226,848 p =0,000	c = 0,2627
	wrong	1157	62,9	553	45,3		
	no opinion	250	13,6	69	5,7		
Knowledge of the braking distance of a passenger vehicle at 50 km/h	good	427	23,2	401	32,8	χ^2=75,899 p =0,000	c = 0,1548
	wrong	1118	60,8	737	60,4		
	no opinion	295	16,0	83	6,8		
Knowledge of the distance covered by a passenger car in one second traveling at 50 km/h	good	685	37,2	654	53,6	χ^2=108,539 p =0,000	c = 0,1851
	wrong	763	41,5	449	36,8		
	no opinion	392	21,3	118	9,7		

4.3 Dangerous behavior and risk awareness - by age

When analyzing the dangerous behavior of pedestrians and their knowledge of traffic hazards, it is possible to indicate the existence of a correlation relationship for each study area (Tab. 3). People between the ages of 18 and 29 were most likely to cross the road in an unauthorized place (80.5%), and those over 65 were least likely to do so (57.1%). There is a weak correlation between age and crossing the road in a prohibited place (p=0.000, c=0.1687). At the same time, it can be noted that although under-18s are most likely not to cross in a prohibited place, they show dangerous behavior at crossings without traffic lights, using mobile phones and headphones. The largest proportion of under-18s, among all respondents considering the age criterion, frequently use mobile phones (19.8%), as do those aged 18 - 29 (15.1%). The largest group of people who never use mobile phones when crossing a pedestrian crossing are those aged 54-65 (79.0%) and those over 65 (79%). There is a moderate correlation between the variables (p=0.000, c=0.3057).

There is a similar trend for headphones. Those aged under 18 (32.2%) and 18 - 29 (44.2%) use headphones frequently when crossing crossings without traffic lights. The highest proportion of pedestrians who do not use headphones when crossing pedestrian crossings without traffic lights includes those aged 54 - 65 (91.5%) and over 65 (95.2%). There is a strong correlation between age and crossing pedestrian crossings without traffic lights (p=0.000, c = 0.4810).

The situation is slightly different when it comes to using reflective elements after dark. The elderly (over 65 - 51.5 %) are the ones who do not wear such items. In each of the groups surveyed, less than 25% wear reflective elements. Those aged under 18 (41.4%) and 30-41 (41.4%) were the most likely to indicate these elements as being worn 'sometimes'.

Analyzing the knowledge of pedestrians about possible dangerous situations related to road traffic and their dangerous behavior, it can be seen that more than half of the respondents did not know the correct answer to most of the questions. In the case of knowledge of the distance from which a pedestrian is visible when walking at dusk without reflective elements, the most common correct answer was indicated by those aged 54 - 65 (22.5%), those over 65 (22.4%) and those under 18 (21.6%). When analyzing the question concerning the wearing of reflective elements after darkness falls, it can be seen that the people who most often knew the positive answer were the least likely to wear such elements. The most frequent correct answers to the question on knowledge of the reaction time of a driver to the sudden appearance of an obstacle

or living creature on the road were given by people aged 18 - 29 (36.7%) and 42 - 53 (37.3%). At the same time, one of the higher percentages of incorrect answers was recorded in both groups. When asked about the braking distance of a vehicle travelling at 50 km/h, the most common incorrect answers were given by those aged 18 - 29 (66.3%) and 30 - 41 (61.2%). Incorrect answers were indicated least frequently by people over 65 years of age (51.0%), while at the same time marking the answer "I have no opinion" most frequently (20.2%). There is a weak correlation between the variables (p=0.000, c = 0.2234). In the case of the question about the distance covered by a passenger car in 1 s, travelling at 50 km/h, the most frequent incorrect answer was given by those aged 30 - 41 years (43.7%) and the correct one by those aged 18 - 29 years (49.3%).

Tab. 3

Dangerous behavior and risk awareness - by age

age		under 18	18-29	30-41	42-53	54-65	over 65	test results	c-Pearson coefficient
		%	%	%	%	%	%		
Crossing the road in a forbidden place	yes	69,0	80,5	77,6	69,1	66,0	57,1	χ^2=89,636 p=0,000	c=0,1687
	no	31,0	19,5	22,4	30,9	34,0	42,9		
Crossing a pedestrian crossing without a traffic light using a cell phone	never	39,6	42,0	50,6	61,7	79,0	79,0	χ^2=315,508 p=0,000	c=0,3057
	rarely	40,7	42,9	40,9	34,0	19,1	18,8		
	often	19,8	15,1	8,5	4,3	1,8	2,2		
Crossing a crosswalk without a traffic light using headphones	never	32,1	29,2	61,8	75,9	91,5	95,2	χ^2=921,807 p=0,000	c=0,4810
	rarely	28,7	26,6	24,3	16,6	6,4	2,5		
	often	39,2	44,2	13,9	7,5	2,1	2,2		
Use of reflective elements after darkness falls	never	13,1	13,2	20,3	22,8	24,6	18,8	χ^2=61,690 p= 0,000	c=0,1406
	rarely	41,4	37,7	41,4	38,3	34,7	29,7		
	often	45,5	49,2	38,2	38,9	40,7	51,5		
Knowledge of the distance from which a pedestrian walking at dusk without reflective elements is visible	good	21,6	17,8	13,9	15,6	22,5	22,4	χ^2=172,591 p=0,000	c=0,2310
	wrong	54,5	76,7	82,5	77,5	68,7	60,8		
	no opinion	23,9	5,5	3,6	6,9	8,8	16,8		
Knowledge of the driver's reaction time to the sudden appearance of an obstacle or living being on the road	good	29,9	36,7	34,0	37,3	34,7	21,0	χ^2=130,361 p=0,000	c=0,2021
	wrong	50,7	58,5	58,9	53,8	50,5	57,7		
	no opinion	19,4	4,8	7,0	9,0	14,9	21,3		

Knowledge of the braking distance of a passenger vehicle at 50 km/h	good	12,7	27,4	30,8	29,2	25,2	28,9	χ^2=160,809 p=0,000	c=0,2234
	wrong	57,8	66,3	61,2	60,4	57,5	51,0		
	no opinion	29,5	6,3	8,0	10,4	17,3	20,2		
Knowledge of the distance covered by a passenger car in one second traveling at 50 km/h	good	28,4	49,3	43,7	43,6	41,0	44,3	χ^2=94,121 p=0,000	c=0,1727
	wrong	41,0	38,9	43,7	41,2	38,9	31,7		
	no opinion	30,6	11,8	12,5	15,2	20,1	24,1		

4.4 Dangerous behavior and risk awareness - by residence

The place of residence and unsafe behavior and knowledge of traffic hazards is very important due to the different types of roads that run through rural and urban areas. The results of the survey indicate that pedestrians living in rural areas (76.7%) and residents of cities with up to 50,000 inhabitants (72.0%) are most likely to cross the road in unauthorized places (Tab. 4). In each case, the percentage of responses indicating negative behavior was over 60%. There is a weak correlation between the variables (p=0.000, c=0.1126). Pedestrians living in large cities (more than 150,000 inhabitants) are more likely to use a mobile phone and headphones when crossing a crosswalk without traffic lights. The correlation relationship between the variables is very weak for mobile phone use (p=0.000, c = 0.1114) and weak for headphone use (p=0.000, c=0.2163).

In the case of wearing reflective elements after dark, respondents' answers were specific to their place of residence. Pedestrians living in rural areas are most likely to wear reflective elements - 24.3% of indications "always", and residents of cities with more than 150,000 inhabitants were least likely to wear reflective elements - 12.8% of indications "always". At the same time, pedestrians living in the countryside most often indicated the wrong answer regarding the distance from which a pedestrian moving after dusk without reflective elements is visible.

Wearing reflective elements in the countryside is defined by law. In undeveloped areas, pedestrians are obliged to wear them. This requirement does not correspond to the respondents' knowledge of reflective elements. In both the question on pedestrian visibility and the other questions, the percentage of incorrect answers is more than 50%. Residents of cities with more than 150,000 inhabitants (36.5%) indicated the highest number of correct answers regarding the reaction time of a driver to the sudden appearance of an obstacle or living being on the road, while the lowest number of correct answers was indicated by pedestrians living in cities with 101,000 to 150,000 inhabitants (24.5%). Residents of cities with 101,000 to 150,000 inhabitants also indicated the incorrect answer most often (65.5%). Also, for the other questions, residents of cities with more than 150,000 inhabitants most often indicated a positive answer.

In the case of the question concerning knowledge of the braking distance of a passenger car at 50 km/h, the correct answer was given by 30.6% of pedestrians from cities with a population of 150,000, and in the case of the question concerning knowledge of the distance covered by a passenger car in 1 second travelling at 50 km/h, the correct answer was given by 48.9% of residents of the largest cities in Poland. Taking into account the answers of pedestrians living in rural areas, where sometimes moving on the road requires more attention from them, the percentage of incorrect answers is higher for most questions than for pedestrians living in cities.

Tab. 4

Dangerous behavior and risk awareness - by residence

Residence		Village	city of up to 50 thou. inhabitants	city from 51 thou.- 100 thou. inhabitants	city from 101 thou. - 150 thou. inhabitants	above 150,000 inhabitants	test results	c-Pearson coefficient
		%	%	%	%	%		
Crossing the road in a forbidden place	yes	76,7	72,0	60,2	63,6	70,8	χ^2=39,294 p=0,000	c=0,1126
	no	23,3	28,0	39,8	36,4	29,2		
Crossing a pedestrian crossing without a traffic light using a cell phone	never	60,8	54,8	60,9	55,3	48,4	χ^2=38,474 p=0,000	c=0,1114
	rarely	31,4	35,1	32,9	37,7	40,3		
	often	7,8	10,1	6,2	7,0	11,3		
Crossing a crosswalk without a traffic light using headphones	never	69,5	58,9	65,1	67,3	45,0	χ^2=150,249 p=0,000	c=0,2163
	rarely	17,3	19,1	16,6	14,5	23,0		
	often	13,2	22,0	18,3	12,7	32,0		
Use of reflective elements after darkness falls	never	24,3	16,5	14,5	18,2	12,8	χ^2=100,876 p=0,000	c=0,1812
	rarely	41,5	33,9	30,1	32,7	37,4		
	often	34,1	49,6	55,4	49,1	49,9		
Knowledge of the distance from which a pedestrian walking at dusk without reflective elements is visible	good	16,7	16,5	19,7	18,2	20,2	χ^2=20,280 p=0,000	c=0,0811
	wrong	76,4	72,2	68,5	71,8	71,1		
	no opinion	6,9	11,3	11,8	10,0	8,6		
Knowledge of the driver's reaction time to	good	32,7	35,1	32,2	24,5	36,0	χ^2=13,945 p=0,083	-
	wrong	57,7	52,1	55,0	65,5	54,8		
	no opinion	9,7	12,8	12,8	10,0	9,2		

the sudden appearance of an obstacle or living being on the road								
Knowledge of the braking distance of a passenger vehicle at 50 km/h	good	26,2	25,9	21,5	29,1	30,6	χ^2=37,025 p=0,000	c=0,1093
	wrong	62,8	56,0	62,6	60,0	59,9		
	no opinion	11,0	18,1	15,9	10,9	9,5		
Knowledge of the distance covered by a passenger car in one second traveling at 50 km/h	good	42,7	40,8	39,4	41,8	48,9	χ^2=21,686 p=0,006	c=0,0839
	wrong	40,1	41,1	39,1	39,1	38,2		
	no opinion	17,3	18,1	21,5	19,1	13,0		

5. DISCUSSION

With reference to the results of the analyses presented, it can be seen that the majority of pedestrians are prone to jaywalking. Taking into account the demographic variable of gender, it can be indicated that men were more likely to be prone to crossing in a prohibited place than women. The findings are confirmed by studies [47,44,52]. Those aged 18 - 29 years had the highest propensity to cross in a forbidden place, while those aged over 65 years had the lowest propensity. For those over 65 years of age, this behavior is influenced by their psychophysical fitness or lower propensity to engage in risky behavior [43,44,45]. Considering the place of residence, despite slight differences, the predominant group among respondents prone to dangerous behavior were rural residents. This behavior may be a result of the low number of marked pedestrian crossings found in rural areas.

Another risky behavior among pedestrians is the use of mobile phones and headphones at pedestrian crossings without traffic lights. Although there is no significant difference in the number of responses, men are more likely to use phones and headphones at crossings than women. They are mainly young and living in the largest cities with more than 150,000 inhabitants. Some of the observations are consistent with previous ones [41,38,39].

The final type of unsafe behavior among pedestrians that was the focus of the study was the use of reflective elements by pedestrians after dark. When comparing the gender data, it can be indicated that, despite a slight difference, it is more often women who wear these types of elements than men. Taking into account the age criterion, it was mainly people aged 54-64, while the least frequent were those aged over 65. Pedestrians living in rural areas are most likely to use reflective elements after dark, while those living in cities with more than 150 000 inhabitants are least likely to do so. This distribution of responses may be due to two reasons.

Rural residents, are more likely to walk in an undeveloped area, where it is legally obligatory to wear reflective elements. For residents of large cities, the use of reflectors is not necessarily necessary, as most pedestrian crossings or streets are well lit.

At the same time, the majority of pedestrians are not aware of the distance from which a pedestrian moving after dark is visible. In each of the surveyed groups (taking into account the criteria of gender, age and place of residence), the percentage of incorrect answers was more than 54%.

From the analysis of the respondents' answers concerning their knowledge of the driver's reaction time and the possibility of stopping the vehicle, it can be clearly seen that knowledge among pedestrians is very low, which is certainly reflected in the number of accidents. At the same time, some correlations can be identified. Considering the gender of pedestrians, men are more knowledgeable about driver behavior than women, while at the same time they show a greater tendency towards dangerous behavior than women. In the case of the age of pedestrians and their knowledge of drivers' reaction times and braking distances, it is not possible to distinguish a single group giving mostly correct answers. What is apparent, however, is the correlation between place of residence and the correct answers given. Inhabitants of cities with more than 150,000 inhabitants gave the most correct answers.

The research carried out clearly shows that the vast majority of pedestrians surveyed have very low knowledge and awareness of the dangers of inappropriate road behavior and, on the other hand, a significant propensity to take risky actions. The lack of awareness concerning, among other things, the braking distance of a vehicle among pedestrians certainly has a negative impact on their safety. The above findings correspond with those of Olakulehin et al. [53] and Jothula & Sreeharshika [54].

6. RECOMMENDATIONS AND LIMITATIONS

The conducted research provides a lot of valuable knowledge about the behavior of pedestrian road users and indicates the need for their education. This research can be used to develop educational programs taking into account age, gender and place of residence. An important element of such programs should be raising awareness of the threats posed by drivers of motor vehicles, which are often influenced by pedestrians themselves.

However, these studies have certain limitations. Their significant limitation was conducting research in two forms: online and paper. It seems advisable to undertake further research on the knowledge of pedestrian road users, extending it to include legal aspects regarding safe road travel and identifying tools that would influence their behavior.

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