

# Homicide numbers, rates, and victims' characteristics in the Tri-City metropolitan area, Poland, between 2010 and 2019

## Liczby i wskaźniki zabójstw oraz charakterystyka ofiar na terenie aglomeracji Trójmiasta w latach 2010-2019

Karol Karnecki <sup>[1]</sup>, Adrian Wrocławski <sup>[2]</sup>, Dorota Pieśniak <sup>[1]</sup>, Wojciech Dalewski <sup>[1]</sup>, Tomasz Gos <sup>[1]</sup>, Michał Kaliszan <sup>[1]</sup>

[1] Katedra i Zakład Medycyny Sądowej, Wydział Lekarski, Gdański Uniwersytet Medyczny, Polska

[2] Katedra Prawa Karnego Materialnego i Kryminologii, Wydział Prawa i Administracji, Uniwersytet Gdański, Polska

### Abstract

Despite a clear global downward trend, homicides still account for a relatively high proportion of all violent deaths, making them a serious problem both in Poland and worldwide. The discrepancy in available data prompted the authors of the study to analyse the numbers and rates of homicides and the characteristics of the homicide victims in the Tri-City area of northern Poland. The study was based on data from autopsy reports, supplemented by information from prosecutor's files on all homicides in the Tri-City area between 2010 and 2019. A total of 107 homicides were statistically analysed for age, sex, blood alcohol concentration at the time of death, time and place of death. The annual homicide rate was 1.24 per 100,000 inhabitants, with a clear downward trend over the period analysed. The average age of victims was about 48 years, and the majority of victims were male (70.1%). 92.5% of homicides were committed in the Tri-City, with a clear predominance of Gdańsk (49.5%) over other, mostly rural, areas of the analysed agglomeration. The majority of victims (57.8%) whose blood alcohol concentration was measured were intoxicated, with a clear predominance of males in this group (70.9%). Victim characteristics and the homicide rates obtained from the analysed material were similar to other countries in Central and Eastern Europe, which may be related to historical, cultural, and demographic similarities. The study highlights the significant impact of alcohol abuse on the risk of homicide.

### Keywords

homicide, epidemiology, crime victims, data analysis, forensic medicine

## Streszczenie

Zabójstwa, pomimo globalnej tendencji spadkowej, nadal stanowią względnie duży odsetek zgonów gwałtownych, co czyni je istotnym problemem zarówno w Polsce, jak i na świecie. Rozbieżności w dostępnych danych dotyczących liczb i wskaźników zabójstw skłoniły autorów pracy do analizy statystycznej zabójstw na terenie aglomeracji Trójmiasta. Podstawą opracowania były dane zawarte w protokołach sekcyjnych, uzupełnione o informacje z akt prokuratorskich, dotyczące wszystkich przypadków zabójstw na terenie aglomeracji Trójmiasta w latach 2010-2019. Łącznie przeanalizowano 107 przypadków zabójstw, które opisano pod kątem wieku, płci, czasu i miejsca zgonu, a także stanu trzeźwości w chwili śmierci. Średni roczny współczynnik zabójstw wyniósł 1,24 na 100 000 mieszkańców, z obserwowanym wyraźnym trendem spadkowym w analizowanym okresie 10 lat. Średni wiek zmarłych wyniósł około 48 lat, a większość ofiar stanowili mężczyźni (70,1%). Prawie 93% zgonów miało miejsce na terenie Trójmiasta, z wyraźną przewagą Gdańska (49,5%), nad pozostałymi obszarami wchodzącymi w skład aglomeracji (powiat gdański). Większość ofiar (57,8%), u których oznaczono stężenie alkoholu we krwi, było nietrzeźwych, z wyraźną przewagą mężczyzn w tej grupie (70,9%). Charakterystyka ofiar, a także liczby i współczynniki zabójstw w analizowanym materiale są podobne do stwierdzanych w innych krajach Europy Środkowo-Wschodniej, co można wynikać z historycznych, kulturowych i demograficznych podobieństw. Przeprowadzone badania podkreślają istotny wpływ zaburzeń używania alkoholu na zjawisko zabójstwa.

## Słowa kluczowe

zabójstwo, epidemiologia, ofiary przestępstw, analiza danych, medycyna sądowa

## Introduction

According to Eurostat, i.e. European Statistical Office, one of the directorates-general of the European Commission responsible for providing statistical information to the institutions of the European Union, intentional homicide means killing a human being wilfully and illegally. That means the intent was to cause death or serious injury, but not necessarily that it was planned beforehand. This is a wider concept than murder, for which planning and other criteria are also considered. Thus, intentional homicide statistics include murder, honour killing, serious assault leading to death, death as a result of terrorist activities, femicide, infanticide, voluntary manslaughter, extrajudicial killings and killings caused by excessive use of force by law enforcement/state officials. The relevant exclusion criteria are the following: homicide without the element of intent (non-intentional homicide/involuntary manslaughter), as well as non-negligent manslaughter, i.e. unlawful death inflicted upon a person when there is generally an intent to cause harm, but no intent to cause death or serious injury. All cases of 'serious assaults leading to death' as well as acts with 'intent to cause death or serious injury' are also included in the *intentional homicide* category [1,2].

Every year, more than 400,000 people worldwide die of violent death as a result of homicide, which is globally responsible for approx. 0.7% of all deaths [3]. In comparison, in 2017, there were 130,000 victims of conflict and terrorism, almost 750,000 victims of self-harm and almost 1,200,000 victims of road injuries [4]. The number of homicides in individual countries shows far-reaching variations: in Western European countries, homicides account for less than 0.1% of deaths, in Eastern Eu-

ropean countries – less than 0.5%, and in the USA – 0.7%. However, there are countries with particularly high homicide rates, especially Latin American countries, including Honduras, Venezuela, Guatemala and Mexico (6-9%) [4].

Poland is a part of Central and Eastern Europe located between Russia and Western European countries. Since 2004, Poland has been a member of the European Union, occupying the sixth place in terms of resident population, estimated at around 38 million (fifth, excluding Great Britain). The official Eurostat data show that in 2018, in the European Union member states (EU-28), the highest number of intentional homicides was recorded in Germany – 788, in France – 779 and in the United Kingdom – 671. Poland, with an estimated number of homicides at 277, was sixth in this classification. However, only by comparing homicide rates, i.e. the number of homicides per 100,000 residents, does it become possible to more accurately compare differences between countries and changes over time. It appears that the highest homicide rates were recorded in Lithuania (4.56) and Latvia (4.34), and the lowest – in Slovenia (0.48). On the other hand, in countries with the highest absolute numbers of homicides, i.e. Germany and France, the homicide rates were significantly lower and amounted to 0.95 and 1.16, respectively. In Poland, the homicide rate was 0.73, which is over 6 times lower than in Lithuania [5].

It is estimated that in the years 2008-2017, the number of homicides decreased by approx. 20% in the EU member states (Eurostat, 2017). These data are consistent with the Polish national figures kept by the National Police Headquarters (NPH),

which show that in the years 1999-2019, there was a clear downward trend in the number of detected homicides, estimated at 50% [6].

Homicide as a consequence of the interaction between numerous, individual, interpersonal and social factors shows a strong correlation with the demographic structure of society; it is reported that approx. 80% of homicides involve males, while the highest homicide rates are seen in the group of young males aged 15-29 [2]. Homicides, as well as other forms of interpersonal aggression, also show a strong correlation with socio-economic factors, such as poverty, economic inequality, ethnic fractionalisation, and access to firearms and alcohol [7]. There is also a well-established link between alcohol consumption and an increased risk of violent behaviour, and homicide. The influence of alcohol on the homicide phenomenon is a complex and multifaceted issue.

Homicide is a public health issue, and epidemiological studies help to identify risk factors and provide information on age, gender, and socio-economic status in relation to homicide. Understanding the patterns and causes of homicide enables the development of effective prevention and intervention programmes. The Tri-City agglomeration is an exceptional research area, as it is one of the largest agglomerations in Poland, with a population of almost 1 million people, including both rural and urban areas and covering virtually the entire cross-section of society.

## Material and methods

### Material

The study was based on a review of data recorded in the autopsy reports for the period 2010-2019 held at the archives of the Department of Forensic Medicine at the Medical University of Gdańsk, as well as of data contained in police records and prosecutor's files. Post-mortem data included all homicide cases from the Tri-City metropolitan area consisting of three cities (Gdańsk, Gdynia and Sopot), as well as its less-populated surrounding areas (Gdańsk County), with a total population of 865,185 (2018). The Department of Forensic Medicine at the Medical University of Gdańsk was the only centre responsible for medico-legal autopsies in the area during the 10-year period analysed and, to the best of our knowledge, all cases of violent death, including homicide, were autopsied in our department.

The most important forensic inclusion criterion was the result of the autopsy, in particular the characteristics of the injuries and their pathomechanism described in the report, indicating third party involvement. Among the non-medical factors, apart from information on the circumstances of death and witness statements, the legal classification of the act was of considerable importance. Therefore, individual cases were classified as

homicide and included in the study group on the basis of the legal classification of the act by the public prosecutor's office. Notably, the inclusion criterion was not a final court verdict, as the authors of the study were more concerned with the circumstances of death (third party involvement) and the legal classification of the act (homicide). This is supported by the fact that many homicide cases were not brought to court because the perpetrator could not be found, which in no way detracts from the fact that a homicide had occurred.

The Polish penal code (PPC) distinguishes four prohibited deliberate acts that result in human death: homicide (Article 148, PPC), infanticide (Article 149, PPC), death resulting from grievous bodily harm (Article 156, PPC) and death of a human being as the consequence of a brawl or beating (Article 158, PPC). The first two offences presuppose a deliberate act of the perpetrator in the form of an intention to kill (Articles 148 and 149). The two other offences are complex 'intentional-unintentional' crimes, where the perpetrator intends to cause serious injury (Article 156 section 3) or participates in a fight or beating (Article 158 section 3), and perpetrator's action leads to victim's death. The wide scope of homicide definition provided by both Eurostat and Statistics Poland includes any material offence, the consequence of which is human death. Therefore, the acts classified in Article 156 section 3 and Article 158 section 3 of the PPC were also included in this study.

During the period analysed, a total of 107 cases of intentional homicide were recorded, according to the Eurostat/UNODC definition of 'intentional homicide'. They represented 1.26% of all medico-legal autopsies performed in our department during this period. In all of these cases, the investigations were conducted and concluded under the legal qualifications of Article 148 (76 cases), Article 149 (1 case), Article 156 (24 cases) and Article 158 (6 cases).

### Methodology

Each of the analysed cases was described in terms of quantitative and qualitative variables. The quantitative (numerical) variables included age and blood alcohol concentration (BAC) at the time of death. The qualitative (categorical) variables included sex, time (month) and place of death (corpse location). The Student's t-test and ANOVA were used for the comparison between the means of the analysed numerical variables. Pearson's correlation coefficients ( $r$ ) were calculated to determine the associations between these variables. The  $\chi^2$  test was used to analyse associations between analysed categorical variables.

Statistical analyses were performed with the data analysis software system STATISTICA version 13 (StatSoft®). In general,  $P$  values of  $< 0.05$  were accepted as statistically significant.

The data on the population of Gdańsk, Gdynia, Sopot, and Gdańsk County were obtained from the Statistics Poland website.

## Results

### Numbers and rates of homicides

In the years 2010-2019, 107 intentional homicides were recorded in the Tri-City metropolitan area, with an annual homicide rate of 1.24 per 100,000 inhabitants. Statistical analysis revealed a downward trend in the number of homicides over this period (Figure 1), and a linear regression curve suggests that the number of homicide victims decreased by less than one case on average each year (according to the equation: number of homicides =  $-0.7455 \times \text{year} + 1512.4182$ ).

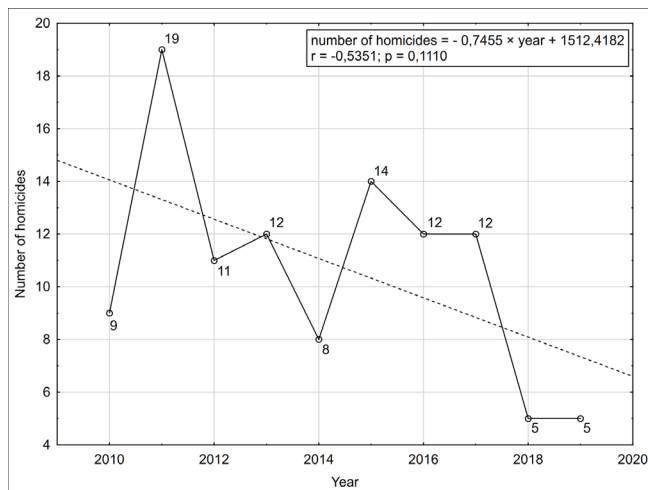


Figure 1. Number of homicides in the Tri-City metropolitan area in the years 2010-2019

### Characteristics of the victims

Of the 107 homicide victims analysed, 70.1% were males (n = 75) and 29.9% females (n = 32). The mean age of the deceased was 47.8 years (SD 18.8). The youngest victim was a female infant (infanticide), and the oldest was a 95-year-old male. Approximately, 4.7% of the victims were minors (under 18 years of age). The distribution of the age variable resembled a normal distribution, with the largest group of victims aged 50-60 (Figure 2).

The mean age of male victims was 48.1 years (SD 16.1), while the mean age of female victims was slightly lower at 47.1 years (SD 24.2) ( $t = 0.249207$ ;  $p = 0.803702$ ). The lowest average age of victims was observed in 2010 (36.9 years), and the highest in 2016 and 2019 (both 63.4 years) ( $F = 2.9579$ ;  $p = 0.003871$ ). In addition, a weak positive correlation between the average age and the consecutive year was observed during the 10-year period studied, described by a linear regression curve:  $\text{age} = 1.1881 \times \text{year} - 2344.87$  ( $r = 0.17$ ;  $p = 0.088135$ ), suggesting ageing of the analysed group of homicide victims.

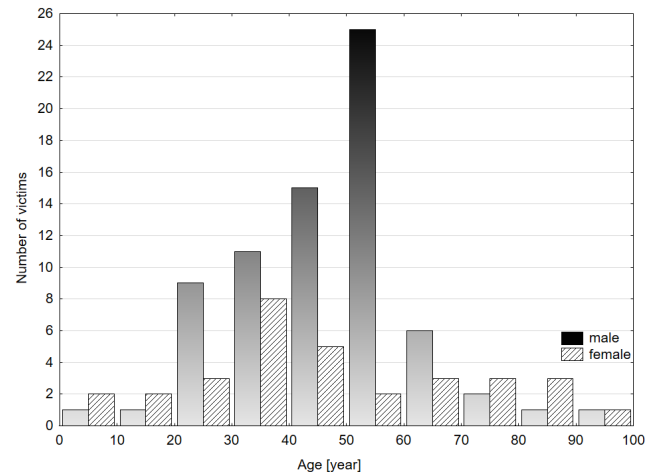


Figure 2. Histogram of age of homicide victims by sex

Females were outnumbered by males throughout the period analysed, and the differences in the years 2015-2019 were clearly lower than in 2010-2014, with a sharp increase in the number of female homicides in 2015 (Table I).

Table I. Number of homicides in the years 2010-2019 – total number and by sex

Year	total	male (%)	female (%)
2010	9	5 (55.6)	4 (44.4)
2011	19	15 (78.9)	4 (21.1)
2012	11	8 (72.7)	3 (27.3)
2013	12	10 (83.3)	2 (16.7)
2014	8	7 (87.5)	1 (12.5)
2015	14	8 (57.1)	6 (42.9)
2016	12	7 (58.3)	5 (41.7)
2017	12	8 (66.7)	4 (33.3)
2018	5	4 (80.0)	1 (20.0)
2019	5	3 (75.0)	2 (25.0)
Total	107	75 (70.1)	32 (29.9)

### Time and place of death

99 (92.5%) homicides took place in the Tri-City, among them 53 (49.5%) in Gdańsk, 34 (31.8%) in Gdynia and 12 (11.2%) in Sopot. The remaining 8 cases (7.5%) were homicides committed in Gdańsk County (mostly rural areas). Annual homicide rates were also calculated separately for the above locations. The highest homicide rate was recorded in Sopot (3.33), almost three times lower in Gdańsk and Gdynia (1.14 and 1.38, respectively), and the lowest in Gdańsk County (0.69). The number of homicides in Gdynia, Sopot and Gdańsk County in the following years of the analysed period showed slight changes; the largest variation was observed in Gdańsk, with sharp peaks in 2011, 2015 and 2017 and a clear decrease in 2018-2019.

Male victims predominated in Gdańsk, Gdynia and Gdańsk County, while in Sopot, the number of male and female victims was equal at 6. Interestingly, the average age of the victims who died in Sopot was the highest among the locations analysed (Gdańsk, Gdynia, Sopot and Gdańsk County), at 53.8 years. However, the average age of Sopot inhabitants was also the highest in the Tri-City metropolitan area, at 46.67 years. Considering each of these four locations separately, the average age of female victims in Sopot was clearly higher than that of males (59.8 vs. 47.7 years), in contrast to the rural Gdańsk County (36.0 vs. 49.9 years).

During the 10-year period analysed, the highest number of homicides occurred in January ( $n = 13$ ), February ( $n = 12$ ) and July ( $n = 11$ ), while the lowest number of homicides occurred in June, November and December (6 cases each). There was no statistically significant monthly variation in the number of homicides over the period analysed (Kruskal-Wallis rank-sum test:  $H = 11.87930$ ;  $p = 0.3728$ ). On the other hand, an intriguing effect was found when analysing the relationship between sex and month of death, where mirror-like opposite trends in the number of homicides were observed in the subgroups of male and female victims (Figure 3). The plausible explanation of this phenomenon is not currently available.

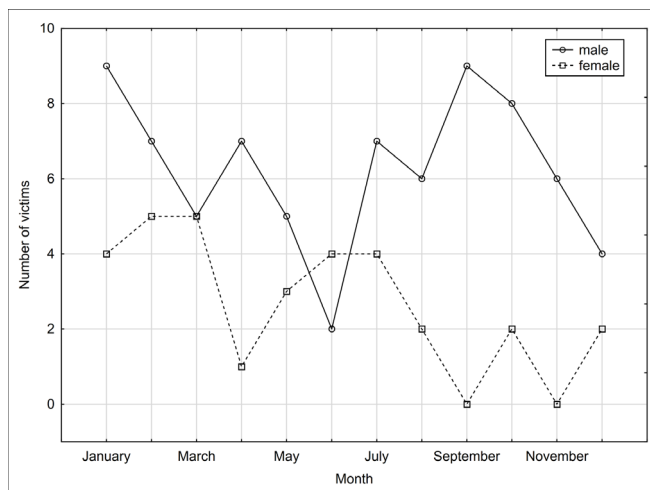


Figure 3. Number of homicides for the following months by sex

### Alcohol

Information on the blood alcohol concentration (BAC) at the time of death was available for 90 of the homicides analysed (84.1%). As the other 17 victims died after prolonged hospitalization, no post-mortem toxicological analysis was conducted in these cases. Of the 90 victims for whom BAC was assayed, 52 (57.8%) were inebriated (BAC values  $\geq 0.2\%$ ) and a clear predominance of males (44 cases, 70.9% of male subgroup) compared to females (8 cases, 28.6% of female subgroup) was observed ( $\chi^2 = 14.21$ ;  $p = 0.002$ ). The mean BAC in the 90 cases

analysed was 1.42‰ (SD 1.45‰) with the highest value of 4.7‰. The mean BAC values of intoxicated male and female victims were comparable (2.48‰ and 2.32‰, respectively).

## Discussion

### Discrepancies between the data reported by the National Police Headquarters (NPH) and Eurostat

According to the data provided by the NPH, 511 homicides were detected in Poland in 2018 [6], which corresponds to a homicide rate of 1.33 (the number of homicides per 100,000 residents). At the same time, Eurostat reports 265 offences classified as 'intentional homicide', in which a total of 277 people were killed. It is therefore not surprising that the statistical data published by Eurostat indicate a homicide rate almost twice as low (0.73) as that published by the Polish police, which was calculated on the basis of 'raw' national data. The authors of this study cannot currently provide a clear interpretation of this discrepancy between European and national data. However, the annual homicide rate in the study area of northern Poland (1.24 per 100,000 residents) suggests that the nationwide statistics published by the NPH corresponds to the actual homicide rate in Poland, which would indicate a uniform homicide rate across the country. This hypothesis is supported by the infographic on the Eurostat website comparing homicide rates in EU countries in the years 2014-2015, which shows that the homicide rate in Poland in 2015 was around 1.5 [8].

The 'over-recording' of homicides by the NPH seems unlikely, because the published data refer to 'detected homicides', i.e. cases in which at least one suspect was identified. However, Eurostat itself states that 'in some countries, the police register any death that cannot immediately be attributed to other causes as homicide; this heading may, therefore, be over-reported' [9].

Analysis of the NPH and Eurostat reports does not suggest that the above discrepancies are also due to methodological differences, but they may be at least partly related to the different interpretation of the terms 'intentional' and 'homicide'. Unlike Articles 148 and 149 of the PPC, which refer to the intended death of the victim, there is an unintentional component in the outcome of offences under Articles 156 and 158 of the PPC, i.e. the death of a victim, apart from the intentional nature of both offences. The complex nature of offences under Articles 156 (grievous bodily harm) and 158 (participation in a fight and assault) may contribute to a possible misinterpretation of unintentional death as homicide. The problem discussed also reflects differences in the interpretation of the term 'homicide' by forensic medicine (related to the biological effect) and law (related to the construct of the penal code), which are often observed in Poland.

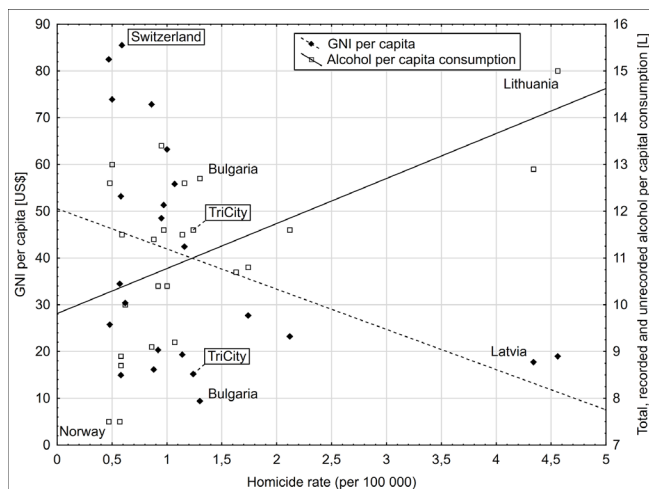
**Number of homicides and homicide rates in the Tri-City area**

Apart from the above considerations, our research has shown that the homicide rate in the study area of northern Poland (1.24) is similar to other countries in Central and Eastern Europe, mostly from the former Eastern Bloc, including Bulgaria, Slovakia, Estonia and Finland, i.e. countries with partly common historical and cultural background and, apart from Finland, members of the EU for a short time (Table II).

**Table II. Intentional homicide victims (rates), Eurostat, 2018**

Lithuania 4.56	Estonia 2.12	Bulgaria 1.30	France 1.16	Germany 0.95	Iceland 0.86	Switzerland 0.59	Slovenia 0.48
Latvia 4.34	Finland 1.63	<b>Tri-City (our research) 1.24</b>	Slovakia 1.14	Hungary 0.88	<b>Poland 0.73</b>	Italy 0.57	Norway 0.47

An intriguing negative exception, which has been analysed repeatedly, are two Baltic States – Lithuania and Latvia – with very high homicide rates (4.56 and 4.34, respectively) [10]. The neighbouring Kaliningrad region of the Russian Federation also has very high annual rates: 8.0 (2016) and 6.1 (2017) [11]. Furthermore, alarmingly high rates of suicide as an extreme form of self-aggression are also observed in the Eastern Baltic region (Kaliningrad region – 21.6; Lithuania – 20.2; Latvia – 16.1; Tri-City metropolitan area – 14.5; Finland – 13.4; Estonia – 12.0), while the European average is 10.5 [12,13].



**Figure 4. Correlation between homicide rate and gross national income (GNI, US\$) and alcohol consumption per capita by country (homicide rate × GNI per capita (US\$):  $r = 0.3926$ ;  $p = 0.0577$ ; homicide rate × alcohol consumption per capita:  $r = 0.5449$ ;  $p = 0.0059$ )**

The number (rate) of homicides is thought to be closely correlated with socioeconomic factors, with lower homicide rates in developed high-income countries and higher homicide rates in low- and middle-income countries. In this context, improvements in economic conditions – particularly poverty reduction – and wider and faster access to health care are positively associated with a decrease in homicide rates [14,15]. Access to alcohol has also been reported to influence homicide rates. Statistical analysis suggests correlations between homicide rates and both gross national income (GNI, US\$) and alco-

hol consumption (litres) per capita in selected countries, the latter being statistically significant. The graph (Figure 4) shows clear similarities between Slovakia, Bulgaria, and the analysed area of northern Poland. Interestingly, the homicide rate in Poland (0.73), as reported by Eurostat, places Poland in the group of countries with higher GNI and lower alcohol consumption per capita than they actually are.

A decrease in the number of homicides was observed over the period analysed. This decrease corresponds to a global downward trend that began at the end of the 20th century and continues to this day. A particularly large decrease was observed in Europe, where the annual rate dropped from 8.8 cases per 100,000 in 1994 to 2.8 in 2018 [16]. This trend also included Poland, where a clear decrease in the number of homicides was observed over the last two decades: from 1123 cases in 1999, to 512 in 2019 [6]. Several reasons have been suggested: increased incarceration, declining drug markets, innovations in policing, economic improvement and increased emigration from Poland [17,18]. Another reason for the observed trend could be the decreasing number of forensic autopsies ordered by the prosecutor’s office in our region during the period analysed. According to previous reports, a decrease in the number of forensic autopsies should correspond to a decrease in the number of homicides detected and thus to a decrease in the homicide rates [10,19-21]. However, we did not find a significant correlation between the number of autopsies and homicides over the entire period analysed ( $r = 0.1665$ ;  $p = 0.6458$ ).

**Characteristics of the homicide victims**

Male sex is a well-established risk factor for homicide. Globally, homicide affects 81% of males and 19% of females, with accentuated regional and temporal differences [10,19,22-26]. These regional effects are most likely related to the differences between countries with high and low homicide rates. In the former, male-to-male violence predominates, often between

gang members (South America, Central America and the Caribbean), whereas in the latter, male-to-female violence predominates, as in intimate partner/family homicides [16]. Thus, in countries with low homicide rates, there is a relative increase in the proportion of female homicides. Our analysis suggests that this trend was also accentuated in our cohort, particularly in the years 2015-2016, when the peak increase in female homicides was observed, accounting for more than 40% of all cases. The relatively high proportion of female homicides in the material studied (almost 30%) may be partly related to the sex distribution of population of Poland, in which females have outnumbered males for many years. However, in the age group with the highest number of female homicide victims (30-40 years), the predominance of men in the sex structure can still be observed.

Contrary to most of epidemiological data suggesting a younger age of homicide victims [10,19,22,23,25-27], victims in our cohort were on average 47.8 years old. Accordingly, the largest subgroup were victims aged 50-60 years. The mean age of male and female victims was comparable and similar to the mean age of the whole cohort. According to UNDOC and Eurostat data, young males aged 15-29 are at the highest risk of homicide, especially in Central and South America. On the other hand, males aged 30-44 are more prone to homicide in Asia and Europe, making data from these regions more comparable to our results. The observed ageing of homicide victims over the 10-year study period (by an average of 1 year per year) may be partially explained by the increase in life expectancy in Poland during this period, estimated from 72.1 to 74.1 years for males and from 80.6 to 81.8 years for females.

### Impact of alcohol on homicide

The association between the abuse of alcohol or other psychoactive substances and violent behaviour, both interpersonal and self-directed, is well-established. Homicide is an extreme form of interpersonal violence associated with substance abuse [28-29]. Alcohol abuse leads to emotional disturbances and disrupts cognitive functions, which in turn impairs self-awareness, self-control and the anticipation of action outcomes. As a result, alcohol-related mental disorders predispose both perpetrators and victims to risky, violent behaviour, especially in cases of severe abuse. In such cases, the perpetrator's actions may be extremely aggressive, while the victim may display aggressive and/or provocative behaviour, which may play a triggering role in homicide [30-32]. Numerous epidemiological studies have shown that 1/3 to 2/3 of homicide perpetrators were intoxicated at the time of the offence. As the perpetrator and victim often drink alcohol together before the incident (co-intoxication), it is not uncommon to find elevated BAC in homicide victims [28,31,32].

According to previous reports, alcohol intoxication usually occurs in 40-50% of homicide victims [10,19,22,24,27,28]. In our cohort, almost 60% of victims were intoxicated at the time of

death, and males outnumbered females by almost 2.5, which is very high and alarming. A victim's intoxication may play an outstanding role in homicide. The provocative behaviour of an inebriated victim is a well-established trigger that very often leads to interpersonal violence. Furthermore, the aggravating effect of alcohol is exaggerated by a high BAC, which was observed in our cohort, where the mean BAC in the subgroup of intoxicated cases was 2.46‰. This high mean value suggests increase in disorders related to alcohol abuse. In the BAC range of 2.0-3.0‰, i.e. in the excitement phase of abuse, there are accentuated mental and behavioural disturbances, manifested *inter alia* by a lack of criticism and emotional control, as well as psychomotor agitation [33].

### Strengths and limitations

Limitations of our study include the relatively small number of autopsies ordered and the inclusion criteria adopted, in particular the recognition of the autopsy result and the legal classification of the act (crime) by the public prosecutor (rather than the court verdict) as the main factors determining the inclusion of a case in the group of homicides analysed, as discussed in detail in the 'Material and methods' section. These factors could potentially have had an impact on the calculated homicide rates, although – in the opinion of the authors of the study – minimal, if any.

Despite the limitations, our study is the first of its kind in the Tri-City area, shows the scale of the homicide phenomenon and provides a description of the victims of violence. It also demonstrates once again the profound impact of alcohol on the phenomenon of interpersonal aggression. The main implications of the study are therefore the need to develop anti-violence programmes and to prevent alcohol use disorder (AUD).

### Conclusions

There are apparent discrepancies between the number of homicides in Poland reported by the National Police Headquarters and Eurostat, which may be related to different interpretations of the term 'intentional homicide'. However, the numbers and rates of homicides and the characteristics of homicide victims in the Tri-City area are similar to those reported in other Central and Eastern European countries, which may be related to the common historical, cultural and demographic background. Moreover, the homicide rate in the analysed region of northern Poland does not differ significantly from the homicide rate in Poland as a whole, indicating a uniform homicide rate across the country. The majority of homicide victims were male, although there were some fluctuations between male and female victims. In contrast to global data suggesting a younger age of homicide victims, the average age of victims in our cohort was 48 years, with a clear upward trend over the period analysed. Most victims had been drinking before they died, and no significant difference in BAC levels was observed between males and females.

Preliminary analyses of national data after 2019 suggest a 'noticeable' increase in homicides between 2020 and 2021, which may have been influenced by the COVID-19 pandemic. For this reason, the authors of this paper plan to continue the study in the future.

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**Corresponding author:**

dr n. med. Karol Karnecki  
Katedra i Zakład Medycyny Sądowej,  
Gdański Uniwersytet Medyczny,  
ul. Dębowa 23, 80-204 Gdańsk  
e-mail: k.karnecki@gumed.edu.pl

**ORCID:**

Karol Karnecki: 0000-0001-8386-4207  
Adrian Wrocławski: 0000-0003-2184-9110  
Dorota Pieśniak: 0000-0002-9096-9901  
Wojciech Dalewski: 0000-0003-3831-6564  
Tomasz Gos: 0000-0003-0161-9270  
Michał Kaliszan: 0000-0002-8119-3494