Retrospective analysis of injuries in fatal strangulation cases seen at Ga-Rankuwa Forensic Pathology Service in the period 2016 - 2021

T O C Sechogo; **K K Hlaise**, MB ChB, Dip For. Med (SA), DTM&H, FC For. Path (SA), MBA, Cert Med & Law;
C van Wyk, MB ChB, Dip For. Med (SA), FC For Path (SA), MMed (MedForens); **Y Bismilla**, MB ChB, Dip For Med (SA), FC For. Path (SA)

Department of Forensic Pathology, Sefako Makgatho Health Sciences University, Ga-Rankuwa, Pretoria, South Africa

Corresponding author: *C van Wyk (charmaine.vanwyk@smu.ac.za)*

Background. Fatal strangulation victims suffer different injuries, necessitating analysis to aid forensic pathologists, yet studies from South Africa (SA) on this topic are limited.
Objective. To analyse injuries sustained by victims and the most used method of strangulation.
Methods. This retrospective cross-sectional descriptive study analysed fatal strangulation cases at the Ga-Rankuwa Forensic Pathology Service from 2016 to 2021. Victim data, including demographics, type of strangulation and injury were collected from the mortuary register and autopsy reports. Data were analysed based on sex, race, age group, type of strangulation and type of injury.
Results. Ultimately, 41 cases were analysed, representing an incidence of 0.57% of fatal strangulations. Women were twice as likely as men to suffer from strangulation. The highest incidence occurred among individuals aged ≥18 years old (76%). However, it is alarming to note that 24% of the victims were younger than 18 years. Ligature strangulation was found in 46% of cases, while manual strangulation accounted for 54%. Neck injuries were present in 95% of cases, with internal injuries more prevalent than external ones. In 78% of cases, isolated internal injuries were observed, while 22% exhibited injuries to both internal and external neck structures. The number of reported cases gradually increased from 2016 to 2021, with the highest number occurring in 2021.
Conclusion. This study contributes to the limited research in SA on injuries sustained by victims of fatal strangulation. Reported cases of strangulation are on the rise with victims sustaining different types of injuries.

Undergraduate Res Health J 2024;2(1):e1786. https://doi.org/10.7196/URHJ.2024.v2i1.1786

Student author biography
At the time of publication, Tshiamo Sechogo is a 5th-year medical student at the Sefako Makgatho Health Sciences University. He will be completing his undergraduate studies in 2025

Strangulation is one of the oldest and most widely used methods for murder. In South Africa (SA), strangulation occurs in a context of pervasive and often extreme violence; therefore, presenting major public health and social concerns. Only two studies on fatal strangulation cases in SA were performed at the time of this study. SA studies that provide analyses of the injuries that are sustained by victims of fatal strangulation are limited despite the recognition and description of these injuries being considered one of the fundamental aspects of forensic pathology.[1,2] In cases of strangulation, injuries play a significant role because they can assist in identifying the weapon used and whether the strangulation was manual or ligature-based.

Strangulation often has a sexual connotation and is a common cause of death in cases where sexual assault has also occurred.[1,3] Strangulation is a form of mechanical asphyxia. Mechanisms of death in strangulation include 1) airway occlusion, resulting in hypoxia, neck vessel occlusion or compression of the carotid arteries, resulting in cerebral ischemia and 2) carotid sinus reflex, leading to cardiac arrest.[1] In the context of this study, the term strangulation is specifically used to indicate the external pressure applied to the neck either using ligatures or hands.[3]

Reportedly, SA is estimated to have the highest rate of intimate female homicide in the world, with 8.8 per 100 000 women murdered by an intimate partner.[4] Moreover, men are also victims of such crimes. It was reported that 1 in 6 men are sexually abused or assaulted. Most investigations on strangulation deaths observed a higher female-to-male ratio and others determined a clear male preponderance among victims. Investigations have reported a sharp peak in strangulation rates among adolescents and individuals aged 20 to 30 years old. The majority of victims are younger than 30 years of age.

The number of sexual assaults rises by an average of 7.6% yearly. Bodies of victims are predominantly found in canals, fields or vacant

lots, while some are found in their residences.[5] According to an Indian study by Das Gupta and Tripathi,[6] after perpetrators strangle their victims, they try to hide the crime by disposing of them by burning, burying, hanging, throwing them into water or concealing them in distant places in most cases.

Ligthelm *et al.*,[7] emphasised that the recognition and description of injuries is one of the fundamental aspects of forensic pathology, with greater importance placed on the interpretation of those injuries. Failure to recognise injury patterns can have detrimental consequences, leading to the oversight of forensically significant injuries. This is of special significance in determining the manner of death. Almost all attempted or completed homicides by strangulation involve either ligature strangulation (strangulation with a cord-like object) or manual strangulation (done with the hands or forearms or standing or kneeling on the victim's throat). Ligature strangulation is reported as the more frequently recorded method of asphyxia homicide.[3,5]

Sexual assault is an event that occurs without the consent of the victim, and it involves the use of force or threat to penetrate the victim's mouth, anus or vagina.[5] In the study by Deming *et al.*[3] on fatal sexual assaults, they described a fatal sexual assault victim as one who dies from mechanical asphyxiation. In that study, 51% of the victims died in this manner. Abrahams *et al.*,[4] concluded in their study that strangulation is one of the most common forms of violent asphyxia and accounts for 10 - 20% of all sexual assault-related cases in various countries, thereby representing a notable manner of death in such cases. This shows that there is a strong relationship between strangulation and sexual assault. Our study aimed to describe and analyse injuries sustained in fatal strangulation cases seen at the Ga-Rankuwa Forensic Pathology Mortuary over a 6-year period. The objectives of this study were to describe and analyse the demographics of the victims of fatal strangulation, analyse and describe the type of strangulation and associated injuries and document the presence of any genital injuries. The goal of this study was to provide data and potentially influence policy making and resource distribution for the vulnerable individuals identified.

Methods

A retrospective cross-sectional descriptive analysis-based study was conducted to identify all the fatal strangulation cases in Ga-Rankuwa Forensic Pathology Service (FPS), Northwestern Pretoria, SA, from 2016 to 2021. All cases where the cause of death was determined to be either manual or ligature strangulation were included. Cases where the cause of death did not implicitly state manual or ligature strangulation were excluded. Incomplete autopsy reports were also excluded.

Victim data were collected from the mortuary register, individual files and finalised autopsy reports. The data were compiled for each year and aggregated. Data were collected from files and autopsy reports stored at the Department of Forensic Medicine at the Sefako Makgatho Health Sciences University and recorded on Microsoft Excel manually. Variables examined included objective, demographics, type of strangulation and sexual assault. The analysis focused on the injuries in fatal strangulation cases. Victims were dichotomised according to sex, age (≤18 or >18) and type of strangulation (manual or ligature). Sexual assault injuries were analysed by aggregating the type of injuries that were sustained by victims. Cases of fatal strangulation that had genital injuries were used to assess the relationship between the two.

Ethics approval for the protocol was granted by the Sefako Makgatho University School Research and Ethics Committee and ethical clearance was provided by the Sefako Makgatho University Research Ethics Committee (SMUREC) (Ethics number: SMUREC/M/53/2023:PG). All the collected data was anonymised.

Results

Table 1 presents data extracted from fatal strangulation cases at Ga-Rankuwa FPS between 2016 and 2021. Over the 6-year study period, 7 229 medico-legal autopsies were performed at the Ga-Rankuwa FPS Mortuary in accordance with the Inquest Act (58 of 1959). Of those, 41 cases of strangulation were identified between 2016 to 2021. There was a gradual increase in the number of strangulation cases reported during this 6-year period, with the highest number of cases being reported in 2021. The incidence of strangulation was 0.57%.

Participant demographics

Figure 1 describes the distribution of strangulation cases by sex, ethnicity and age. There were 28 female and 13 male victims of fatal strangulation within the 6-year period of the study. Women were more likely to be victims of strangulation than men, with a ratio of 2:1.

The use of the terms 'White', 'Black', 'Coloured' and 'Indian' is contentious and does not imply acceptance of the racist assumption on which these labels are based. It is recognised that these categories are a social construction and do not imply that such categories have any scientific basis. In this study, 38 victims were described to be Black and two victims were described as White. This is in keeping with the demographic makeup of the Ga-Rankuwa region used in our study. There were no occurrences or reported cases of coloured and Indian victims in this area during the study period. The age distribution shows the highest incidence among the >18 years age group (76%) (Fig. 1). However, it is alarming to note that 24% of the victims were younger than 18 years.

Types of strangulation

Fig. 2 illustrates the distribution of strangulation type (manual or ligature) across cases throughout the various years. We found 22 cases of manual strangulation and 19 cases of ligature strangulation.

A notable shift in the trend of strangulation type occurred between 2017 and 2019, with ligature strangulation transitioning from being the most common in 2017 to manual strangulation becoming more prevalent in 2019 (46 v. 54%, respectively).

Injuries sustained

Neck injuries were present in 95% (n=37) of cases and were the most common type of injuries identified, with internal injuries being more common than external injuries (Fig. 3). Of the 37 cases involving neck injuries, 29 had only one type of injury and eight had a combination of injury types. The most common external injury was penetrating incised wounds at 29% (n=12), followed by abrasions at 24% (n=10). Seventy-five percent of internal injuries to the neck were contusions (n=31), followed by 29% penetrating incised wounds (n=12) and 21% due to fractures of either the hyoid bone or thyroid cartilage (n=9). Other injuries include injuries to the abdomen, thorax and limbs. There were no visible injuries to the genitals in all cases.

Table 1. Data sheet

	2016	2017	2018	2019	2020	2021	Total
Number of cases	5	4	7	8	8	9	41
Sex of victims							
Female	4	1	5	4	5	9	28
Male	1	3	2	4	3	0	13
Race							
Black	5	3	6	8	8	9	39
White	0	1	1	0	0	0	2
Coloured	0	0	0	0	0	0	0
Indian	0	0	0	0	0	0	0
Victim age group							
<18	0	0	3	3	1	1	8
>18	5	4	4	5	7	8	33
Type of strangulation							
Ligature	3	4	4	2	2	4	19
Manual	2	0	3	6	6	5	22
Injuries sustained							
Neck injury	5	3	5	7	8	9	34
Other injuries	0	1	2	1	0	0	4
Signs of sexual assault							
Cases present	-	-	-	-	-	-	-
Cases absent	-	-	-	-	-	-	-

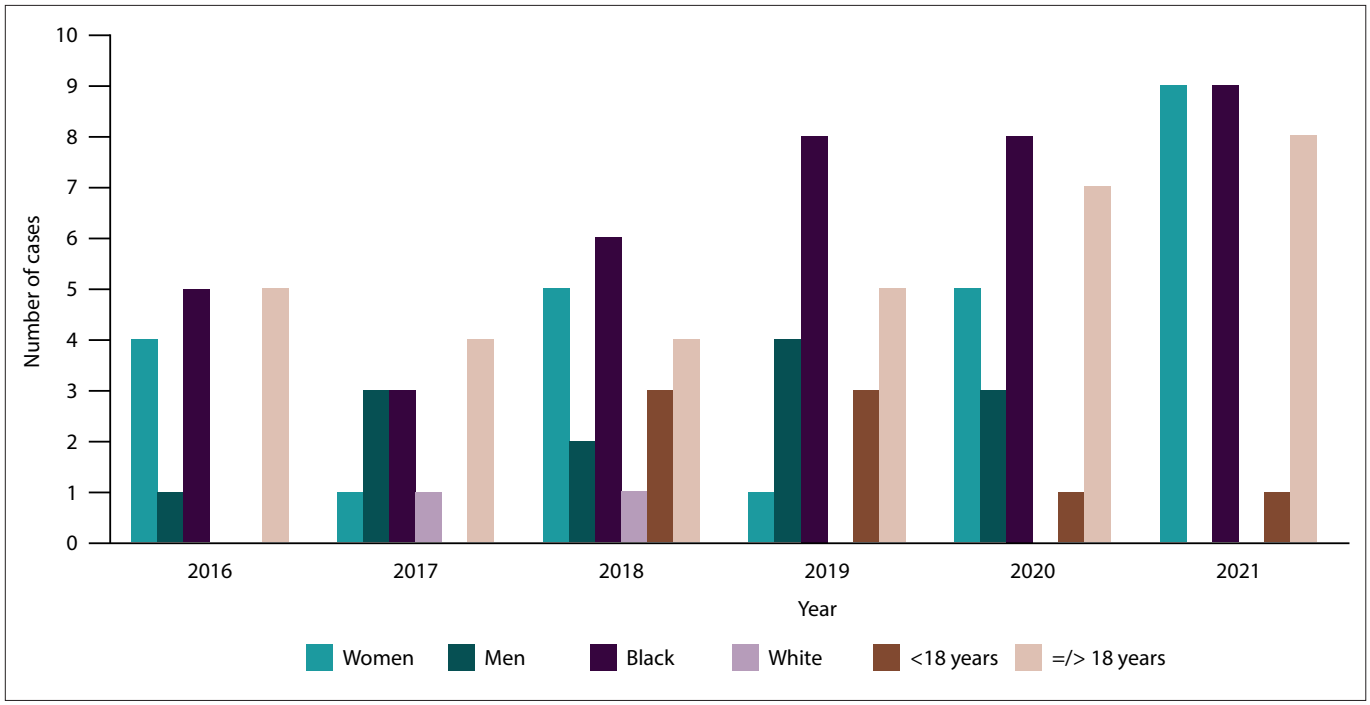

Fig. 1. Distribution of cases by demographics.

Discussion

This study aimed to describe and analyse injuries sustained in fatal strangulation cases seen at the Ga-Rankuwa Forensic Pathology Mortuary over a 6-year period. This study strove to describe and analyse the demographics of the victims of fatal strangulation, analyse and describe the type of strangulation and associated injuries and describe if any genital injuries were present.

The Ga-Rankuwa Forensic Pathology Mortuary performs medico-legal

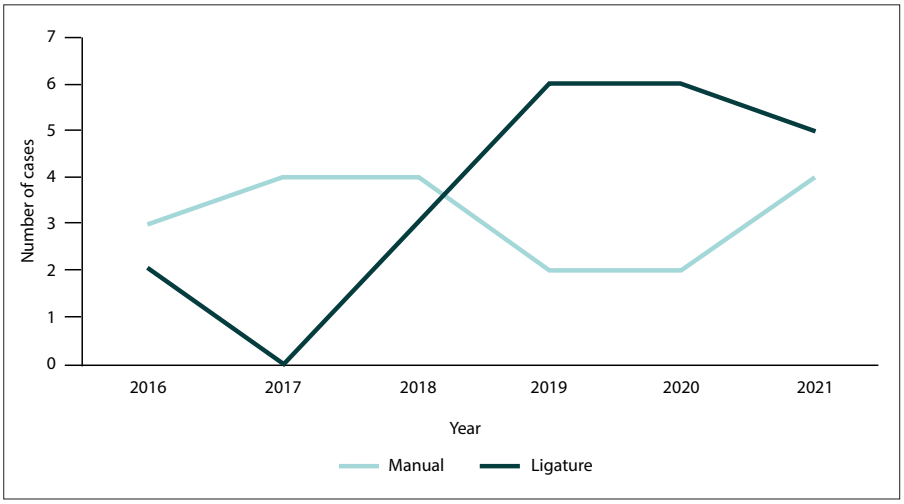

Fig. 2. The number of cases per strangulation type

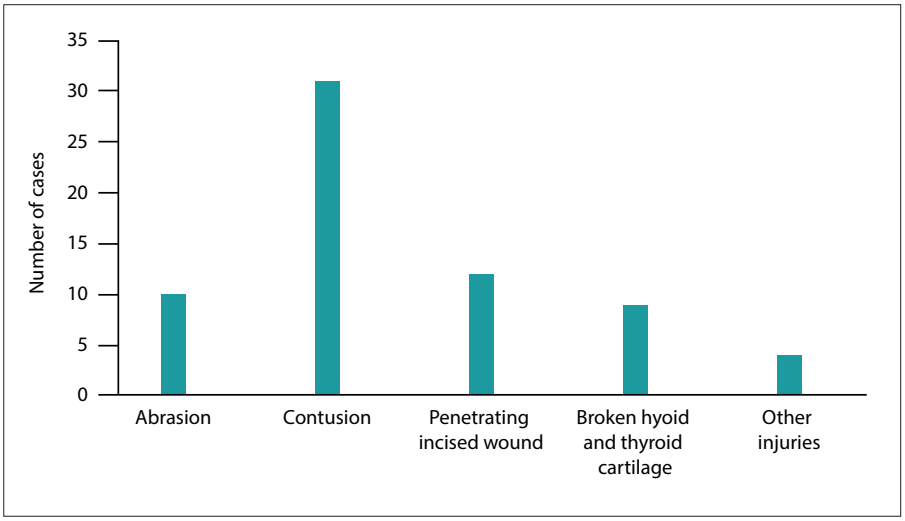

Fig. 3. The number of cases based on the type of injuries

autopsies on all cases where the cause of death is deemed to be 'other than natural' as described in the Inquest Act. A total number of 7 229 of these cases were performed during the 6-year study period. Forty-one cases where the cause of death was determined to be due to strangulation were identified; this is an incidence of 0.57%. This is lower than the incidence reported by Suffla and Seedat[2] in a study conducted in Johannesburg, where they found an incidence of 2.2%. This discrepancy could be attributed to our stricter selection criteria, as only cases explicitly determined to be due to strangulation were included. Hence, cases where external neck injury was present, but strangulation was not explicitly stated and those where the forensic pathologist's determination was vague, only stating the cause of death to have been due to asphyxia could have been missed. In a study performed in Pakistan, strangulation was found to have an incidence of 1.2% which is closer to our results.[8]

In our study, women were more at risk of strangulation, with 68.3% (n=28) of victims being described as female. The male-to-female ratio was determined to be 1:2. This is in keeping with a study performed in Denmark.[9] The rate of female victims in our study is slightly higher than the one reported by DiMao *et al.*,[10] where women accounted for 61% of cases. In contrast, a Finnish study did not find a sex-based difference, with 53% of victims being male and 47% being female.[11] This discrepancy might be due to cultural differences. In that study, alcohol was found to play a significant role in strangulation deaths, with men being overrepresented in the group where alcohol abuse was noted.

Race did not seem to influence the vulnerability of strangulation victims, with 38 victims being described as Black and only two being White. This is in keeping with the demographic makeup of the Ga-Rankuwa region that we used. The study performed in Johannesburg determined that coloured women and white men were more at risk of strangulation, but this was not observed in our study as those two demographics are uncommon in our region.[2]

Cases in our study were dichotomised into those younger and older than 18 years. Adults (older than 18 years) accounted for 76% of the cases. Notably, 24% of the victims were younger than 18 years. These figures are similar to those reported by Thomsen *et al.*[9] in a Denmark study, where they found that 22% of their cases were children under the age of 15 years. This supports the hypothesis that strangulation is a method favoured by assailants who are considerably physically stronger than their victims, as demonstrated by the higher proportion of female deaths.[12]

There is a small difference in the rates of manual and ligature strangulation, with ligature strangulation found in 46% of the cases and manual strangulation in 54% of the cases. This is in keeping with other studies.[10,13] In the Denmark study, 46.4% of cases were manual strangulation, 22.4% were ligature strangulation and 12.8% were a combination.[9] In Finland, Wahlsten and Eriksson[11] reported that manual strangulation accounted for 48.8% of cases and ligature strangulation accounted for 34.2% of all asphyxia deaths examined.

Neck injuries were found in 95% of cases, with internal injuries found more commonly than external injuries. Isolated internal injuries accounted for 78% of injuries, while injuries to both the internal and external structures of the neck accounted for 22%. The most common type of injuries to the neck were contusions (83.7%), then penetrating incised wounds (32.4%), scratch abrasions (27%) and fractures of either the hyoid bone or thyroid cartilage (24.3%). This is similar to findings by a study in India where they assessed strangulation deaths v. hanging deaths and found that in strangulation cases, internal injuries were more predominant (83%) than external injuries (52.86%). The discrepancy might be explained by the fact that bruising is more difficult to see in darker skin colours.

No genital injuries were found in our cases, however in a study in Finland, they found genital injuries in 5.5% of cases examined.[11]

However, this study had substantially more cases (*n*=383) of strangulation over a longer period (30-year period), thus we might have found more cases involving genital injuries over a longer period and with a larger sample size. The absence of genital injuries does however not exclude an aspect of sexual assault or rape.

It is alarming to see a rise in the incidence of strangulation deaths each year, which is in contrast with trends reported by studies from other countries where strangulation deaths are declining.[9,13]

This study is not the first of its kind in SA, but it contributes more insight into the existing studies concerning injuries that are sustained by strangulation victims. The data was obtained from the victim's files, which provide reliable data concerning each specific case. Limitations to this study are noted, taking into consideration that Ga-Rankuwa FPS is a smaller centre in Pretoria. More representative data may be obtained from larger Pretoria mortuaries and may form the groundwork for a larger multivariable analysis of fatal strangulation in SA. Furthermore, the sexual assault analysis in this study could have considered the use of appropriate history, sexual assault examination kits (rape kits) and laboratory confirmation of DNA samples from such cases.

Conclusions

This study aimed to analyse the profile, pathology and trends of injuries in fatal strangulation cases. It was found that women were twice as likely to suffer from strangulation than men, in keeping with local and international trends. Ligature and manual strangulation had a similar prevalence in the cases examined, with almost a quarter of cases comprising victims under 18 years, highlighting the vulnerability of fatal violence in this age group.

Regarding the location of injuries seen, neck injuries were found in almost all cases, with the vast majority being internal injuries. This helps in highlighting the importance of internal neck examination at autopsy in suspected strangulation cases, as cases may show little to no external neck injuries. There was also a gradual increase in the number of strangulation cases noted over the study period, stressing the need for more community awareness, crime prevention strategies and identification of vulnerable populations. Interestingly, no sexual injuries were noted in this study despite the high rate of intimate partner crime in SA.

This study contributes to the limited literature on injuries that are sustained by victims of fatal strangulation however further research is required in SA. It is recommended that pre-autopsy screening tools be used to help identify suspected strangulation cases along with standardised autopsy protocols, to ensure fatal injuries are not missed in these cases.

Declaration. We declare that this is our original work that has not been submitted elsewhere.

Acknowledgements. The authors would like to express their gratitude to their families, friends, and colleagues for their invaluable contributions to this research. Special thanks are extended to the Department of Forensic Pathology at Sefako Makgato Health Sciences University.

Author contributions. TS conceptualised the research, drafted and submitted the protocol for ethics approval, collected the data and did the data analysis. She submitted a research report to the Department of Forensic Pathology as part of the requirements of her degree. KH was the supervisor and CVW was the co-supervisor. KH, CVW and YB edited the research report for journal submission and made reviewer corrections as suggested.

Funding. None.

Conflicts of interest. None.

1. Linden JA. Sexual assault. Emerg Med Clin North Am 1999 Aug;17(3):685-697. https://doi.org/10.2310/em.4370
2. Suffla S, Seedat M. Risk factors for female and male homicidal strangulation in Johannesburg, South Africa. S Afr Med J 2020 Jul 29;110(8):802. https://doi.org/10.7196/samj.2020.v110i8.14412
3. Deming JE, Mittleman RE, Wetli C V. Forensic science aspects of fatal sexual assaults on women. J Forensic Sci 1983 Jul;28(3):572-576. https://doi.org/10.1520/jfs11551j
4. Abrahams N, Mathews S, Lombard C, Martin LJ, Jewkes R. Sexual homicides in South Africa: A national cross-sectional epidemiological study of adult women and children. PLoS One 2017 Oct 1;12(10). https://doi.org/10.1371/journal.pone.0186432
5. Suffla S, Van Niekerk A, Arendse N. Female homicidal strangulation in urban South Africa. BMC Public Health 2008 Oct 21;8(1). https://doi.org/10.1186/1471-2458-8-363
6. Srivastava AK, Gupta D, Tripathi CB. A Study of Fatal Strangulation Cases in Varanasi (India). Am J Forensic Med Pathol 1987;8(3). https://doi.org/10.1097/00000433-198708030-00005
7. Ligthelm AJ, Van Niekerk PJ. A comparative review of bitemark cases from Pretoria, South Africa. J Forensic Odontostomatol 1994 Dec;12(2):23-29. https://ojs.iofos.eu/index.php/Journal/issue/view/84
8. Mehmood I, Saleem K, Azeem MT, Suhail S, Khan MA, Nadir S. Autopsy based pattern of asphyxial deaths in forensic: A retrospective study. APMC 17(3):289-292. https://apmcfmu.com/index.php/apmc/article/view/1305/899
9. Thomsen AH, Leth PM, Hougen HP, Villesen P. Asphyxia homicides in Denmark 1992–2016. Int J Legal Med 2022 Nov 3;136(6):1773-1780. https://doi.org/10.1007/s00414-022-02787-0
10. DiMaio VJ. Homicidal asphyxia. Am J Forensic Med Pathol 2000 Mar;21(1):1-4. https://doi.org/10.1097/00000433-200003000-00001
11. Wahlsten P, Eriksson A. Asphyxia homicides in Finland, 1983–2012. J Forensic Sci 2020 Sep 30;65(5):1548-1556. https://doi.org/10.1111/1556-4029.14458
12. Rogde S, Hougen HP, Poulsen K. Asphyxial homicide in two Scandinavian capitals. Am J Forensic Med Pathol 2001 Jun;22(2):128-133. https://doi.org/10.1097/00000433-200106000-00004
13. Harruff RC, Johnston R, Lubin M, Perera ULMS. Analysis of female strangulation homicides in King County, Washington, from 1978 to 2022. J Forensic Sci 2023 Sep 27. https://doi.org/10.1111/1556-4029.15384
14. Sharma MK, Singh JP, Kumar K, Chanana A. Ten-year autopsy study of differentiating features between hanging and strangulation. Medico-Legal Update 2020 Oct 23;20(4). https://doi.org/10.37506/mlu.v20i4.1829

Accepted 21 February 2024.