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Contributed Paper

A Retrospective Study on Homicidal Autopsy Cases at Ramathibodi Hospital in Bangkok Thailand

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ABSTRACT

Nowadays, the increasing incidence of homicide is worldwide and it is a matter of great concern all over the world including Thailand. The present study is aimed at a description of distributions of homicide and to find the association and risk ratio of personal characteristics of homicide victim cases for Thai people. A 5-year retrospective review of personal and medicolegal autopsy records was conducted at the Forensic Medicine Division in the Department of Pathology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University. A total of 218 cases of homicide victims autopsied during the study period spanning from January 2003 to December 2007 were identified. Data concerning age, gender, marital status, day and time of death, homicide methods, area of death, and the involvement of alcohol were analyzed. The results showed that homicidal victims were more likely to be male than female. The mean age of the victims was 32.14 years with standard deviation 13.67 years, although the most frequent age range was early adulthood (21-30 years). Blood alcohol was found in 102 cases (46.79%). Mean blood alcohol concentration (BAC) was 71.59 mg/dL with standard deviation 101.59 mg/dL. Approximately 35% of all homicide victims had BAC >50 mg/dL (the legal limit). Gun shot was the favorite homicide method used for both male and female victims (32.11%, 3.21%). Most of the crimes were occurred during the night (33.94%) and evening (26.15%). The rainy season and Sundays were the most common times for homicide. There was significant association between gender and homicide methods at p-value < 0.01. In addition, night time proved to be a significant factor in relation to the occurrence of homicide at p-value < 0.01. Marital status associated homicide had more victims of the single and widowed status (OR = 1.63, 2.29). The daytime of weekdays showed that the number of homicide victims was nearly 1.2 times of weekends (OR = 1.197).

Keywords: homicide autopsy, homicide victims, homicide methods.

1. INTRODUCTION

Homicide means the act of a human killing a human being. Homicide and murder are crimes that are unacceptable to all types of society [1]. The incidence of homicide increase worldwide was a matter of great concern all over the world. Nowadays, the rates of homicides per capita in Finland has for decades been about double the rate of other West European democracies and triple the rate of the other Nordic countries [2, 3].

In Thailand there has been one report of homicides from Siriraj hospital, Bangkok. The study was about homicide victims during 1972 to 1981 [4].

The present study concerning details of cases of homicide on which medicolegal autopsy was conducted at Ramathibodi hospital, Faculty of Medicine, Mahidol University, Bangkok Thailand. Since Ramathibodi hospital is a central hospital in Thailand and gathers as much information as possible about the conditions under which murder can occur it is able to take preventative action and help officers seek documents such as type of death and identify the deceased, cause of death, and to the offender in a criminal investigation. To resolve these fundamental questions, the investigation focuses on the deceased, the crime scene, and medical expertise. Determining the cause of death is important for many reasons. Therefore, the present study is aimed as a description of distributions of homicide and to find the association and risk ratio of personal characteristics of homicide victims for Thai people. The information about the cause of death and the offender could help the officer to establish the identity of the perpetrator.

2. MATERIALS AND METHODS

Complete autopsy reports of 218 homicide victims which consist of 194 males and 24 females during the period of January 2003 to December 2007 from the Forensic Medicine Division, Department of Pathology, Faculty of Medicine, Ramathibodi Hospital,

Table 1. Levels of personal and characteristics of homicide victims autopsied.

Variables	Level
Age	<1, 11-20, 21-30, 31-40, 41-50, 51-60, unknown
Gender	male, female
Marital status	single, married, widowed, not known
Area of homicide	Phaya Thai, Din-Daeng, Mukkasan, Hui-Kuang, Chanasongkram, Dusit, others
Blood alcohol Concentration	none, < 50, 50-149, ≥ 150, unknown
Level of BAC	legal, illegal, unknown
Time of the day	0:00-05:59, 6:00-11:59, 12:00-17:59, 18:00-23:59, unknown
Day of week	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday
Time of week	weekday, weekend
Seasonal variation	summer, rainy, winter
Homicide methods	gun shot, blunt force, sharp force, others (asphyxia, falling from heights, burns, poisoning, neglecting)

Mahidol University, are analyzed. The reports included types of trauma (blunt, sharp, gun shot, and others), age, gender, marital status, day of the week, time of death, method of homicide and blood alcohol concentration (BAC). Levels of personal and characteristics of homicide victims autopsied variables are presented in Table 1.

All statistical analyses were performed by using SPSS for Windows version 17. Continuous variables were expressed as mean and standard deviation (SD). Categorical variables were presented in numbers and percentages. The chi-square test was performed to find the association between the categorical variables such as gender, method of homicide and time of death while the odds ratio (OR) was performed to find the risk of characteristics of homicide victim cases. Statistical significance was considered at p-value < 0.05.

The chi-square distribution is the most frequently employed statistical technique for the analysis of count or frequency data. The chi-square test procedure can also be used to test the hypothesis of independence or homogeneity of two variables of classification. The observed frequencies are presented in table which is known as a contingency table. A contingency table with r rows and c columns is referred to as an r × c table. The row and column totals are called marginal frequencies. The general rule for obtaining the expected frequency of any cell is given by the following formula:

$$\text{expected frequency} = \frac{(\text{column total}) \times (\text{row total})}{\text{grand total}}.$$

The expected frequency in any row or column adds up to the appropriate marginal total. Statistical theory shows that the problem of small expected frequencies may be encountered when analyzing the data of contingency tables. Many authors currently follow the rule given by Cochran [5]. He suggests that for contingency tables with more than 1 degree of freedom a minimum expectation of 1 is allowable if no more than 20 percent of the cells have expected frequencies of less than 5, then the variable $X^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\left(O_{ij} - E_{ij}\right)^2 / E_{ij}$ is approximated by the chi-square distribution with (r-1)(c-1) degrees of freedom. To meet this rule, adjacent rows and/or adjacent columns may be combined [5, 6].

The test of independence concerned with the two criteria of classification is independent while the homogeneity test is concerned with the samples drawn from populations are homogeneous with respect to some criterion of classification [7].

3. RESULTS

A total of 218 homicide victims were collected from the autopsy report of Ramathibodi hospital that occurred during the years 2003 to 2007 in Bangkok Thailand. The homicide distribution classified by year and gender is shown in Table 2. The percentages of homicide for 194 males and 24 females in 218 cases were 88.99 and 11.01, respectively. The average number of cases was 43.6 cases per year. The majority of the homicides involved males (n = 194, 88.99 %). The ratio of male to female was 8.1: 1.

Table 2. Distribution of homicide victims by year and gender.

Year	Gender		Ratio Male : Female	Total(%)
	Male(%)	Female(%)		
2003	42(80.77)	10(19.23)	4.2 :1	52(23.85)
2004	37(90.24)	4(9.76)	9.2 : 1	41(18.81)
2005	45(90)	5(10)	9 : 1	50(22.94)
2006	26(92.86)	2(7.14)	13 : 1	28(12.84)
2007	44(93.62)	3(6.38)	14.67 : 1	47(21.56)
Total	**194(88.99)**	**24(11.01)**	**8.1 : 1**	**218(100)**
Average	**38.8**	**4.8**		**43.6**

From Table 3, the area of responsibility of homicide death presenting the highest frequency of homicide victims was Phaya-Thai police station, outstandingly accounting for 88 cases (40.4%), followed by Din-Daeng 38 cases (17.4%), Mukkasan 35 cases (16.0%), and Huai-Kuang 27 cases (12.4%). Sam-Sen, Nang-Learng and Bang-Poh areas presented a small number of homicides. The smallest frequency of homicide victims was Dusit police station.

Table 3. Distribution of homicide victims classified by area and year.

Area of homicide (Police Station)	Year					Number of cases (%)
	2003	2004	2005	2006	2007	
Phaya Thai	23	15	21	10	19	88 (40.4)
Din-Daeng	8	7	10	1	12	38 (17.4)
Mukkasan	9	8	8	4	6	35 (16.0)
Huai-Kuang	2	5	9	4	7	27 (12.4)
Chanasongkram	6	1	1	2	2	12 (5.5)
Other[a]	4	4	1	2	1	12 (5.5)
Dusit	0	1	0	5	0	6 (2.8)
Total	**52**	**41**	**50**	**28**	**47**	**218 (100)**

[a] Comprising Sam-Sen, Nang-Learng and Bang-Poh.

The characteristic and gender distribution of homicide victims are given in Table 4. Most of them were 21-30 years, but the total age range was between 1 day and 88 years, the mean age was 32.14 years with SD 13.67 years.

Table 4. Distribution and association of homicide victims by characteristic and gender.

Characteristic		Male		Female		Total(%)
		No. of cases	%	No. of cases	%	
Marital status	Single	21	9.63	3	1.38	24 (11.01)
	Married	80	36.70	7	3.21	87 (39.91)
	Widowed	5	2.29	1	0.46	6 (2.75)
	Not known	88	40.37	13	5.96	101 (46.33)
OR (married/single) = 1.63, 95%CI = 0.39, 6.86 OR (married/widowed) = 2.29, 95%CI = 0.23, 22.39						
Age(Years)	<11	4	1.83	2	0.92	6 (2.75)
	11-20	26	11.93	1	0.46	27 (12.39)
	21-30	69	31.65	14	6.42	83 (38.07)
	31-40	41	18.81	3	1.37	44 (20.18)
	41-50	33	15.14	1	0.46	34 (15.60)
	51-60	10	4.59	2	0.92	12 (5.51)
	>60	5	2.29	1	0.46	6 (2.75)
	Unknown	6	2.75	0	0	6 (2.75)
Average age = 32.14 years, SD = 13.67 years, Min. = 1 day, Max. = 88 years						

The distribution of homicide victims by blood alcohol concentration (BAC) and gender is shown in Table 5. A high BAC was found in 102 cases (46.79%). The BAC was between 0 and 453.88 mg/dL; the mean BAC was 71.59 mg/dL with SD 101.59 mg/dL. An illegal level of BAC was found in 77 cases (35.32%).

Table 5. Distribution of homicide victims by BAC and gender.

BAC [b] (mg/dL)	Male		Female		Total(%)
	No. of cases	%	No. of cases	%	
None	84	38.53	15	6.88	99 (45.41)
<50	23	10.55	2	0.92	25 (11.47)
50-149	29	13.30	2	0.92	31 (14.22)
≥150	43	19.73	3	1.37	46 (21.10)
Unknown[c]	15	6.88	2	0.92	17 (7.80)
Average BAC = 71.59 mg/dL, SD = 101.59 mg/dL, Min. = 0 mg/dL, Max. = 453.88 mg/dL					
Legal level	107	49.08	17	7.80	124 (56.88)
Illegal level	72	33.03	5	2.29	77 (35.32)
Unknown [c]	15	6.88	2	0.92	17 (7.80)
Total	**194**	**88.99**	**24**	**11.01**	**218 (100)**
[b]≤50 mg/dL for legal limit of Thai law, [c]No evidence for BAC					

Table 6. Distribution of homicide victims by period of time and gender.

Period of time		Gender		Number of cases (%)
		Male	Female	
Time of the day (hour)	0:00 - 05:59	69	5	74 (33.94)
	6:00 - 11:59	32	2	34 (15.60)
	12:00 - 17:59	25	10	35 (16.06)
	18:00 - 23:59	53	4	57 (26.15)
	Unknown	15	3	18 (8.26)
Total		**194**	**24**	**218 (100)**
χ^2 = 14.812**, p-value = 0.005				

From Table 6 there was a significant association between homicide victims and period of time of the day at p-value < 0.01. The result showed that during 0:00 to 05:59 hours was the most common period of time that presented the highest frequency of homicide victims, accounting for 74 cases (33.94%), followed by during 18:00-23:59 hours, accounting for 57 cases (26.15%).

Table 7. Distribution of homicide victims by time and gender.

Time		Gender		Number of cases (%)
		Male	Female	
Day of the week	Monday	21	3	24 (11.01)
	Tuesday	29	3	32 (14.68)
	Wednesday	28	5	33 (15.14)
	Thursday	31	1	32 (14.68)
	Friday	24	4	28 (12.84)
	Saturday	30	3	33 (15.14)
	Sunday	31	5	36 (16.51)
χ^2 = 3.49, p-value = 0.75				
Time of week	Weekday	133	16	149 (68.35)
	Weekend	61	8	69 (31.65)
OR (weekday/weekend) = 1.0902, 95%CI = 0.44, 2.68; χ^2 = 0.035, p-value = 0.851				
Seasonal variation	Summer	54	8	62 (28.45)
	Rainy	88	12	100 (45.9)
	Winter	52	4	56 (25.65)
χ^2 = 1.18, p-value = 0.55				
Total (%)		**194 (88.99)**	**24 (11.01)**	**218 (100)**

The incidence that occurred during the day of week, time of week and seasonal variation with gender are shown in Table 7, respectively. Sunday was the highest frequency day that found homicide victims, accounting for 36 cases (16.51%) followed by Saturday and Wednesday accounting for 33 cases (15.14%), and Monday had the lowest account of 24 cases (11.01%). However there was no association between day of week and gender (p-value = 0.75). The association between numbers of homicide victims on weekdays and weekends of male and females were nearly the same (OR= 1.0902, 95%CI = 0.44, 2.68). Further, the rainy season had the highest number of homicides accounting for 100 cases (45.9%). The summer season accounted for 62 cases (28.45%), and the winter season for 56 cases (25.65%). Nevertheless, the association between seasonal variation and gender is not significant (p-value = 0.55). We can say that the distributions of homicide victims are the same for males and females with respect to day of week, time of week and seasonal variation (p = 0.75, 0.851, and 0.554, respectively).

Table 8. Distribution of homicide victims by homicide methods and gender.

Homicide methods	Male		Female		Total	
	No. of cases	%	No. of cases	%	No. of cases	%
Gun shot	70	32.11	7	3.21	77	35.32
Blunt force	59	27.06	5	2.29	64	29.36
Sharp force	56	25.69	6	2.75	62	28.44
Asphyxia	5	2.29	4	1.83	9	4.13
Falling from heights	2	0.92	1	0.46	3	1.38
Burns	1	0.46	0	0	1	0.46
Poisoning	1	0.46	0	0	1	0.46
Neglecting	0	0	1	0.46	1	0.46
Total	**194**	**88.99**	**24**	**11**	**218**	**100**
χ^2 =21.195**, p-value = 0.003						

Gunshot methods were the most common means used for homicide followed by blunt and sharp trauma. There was a significant association between methods of homicide and gender at p-value < 0.01 (Table 8). However, there were 7 cells with expected counts less than 1. The chi-square approximation was probably invalid. Further, there were 9 cells with expected counts less than 5. Therefore, according to statistical theory the adjacent rows were combined, i.e. asphyxia, falling from heights , burns, poisoning, and neglecting were combined into the category others. We found that the new chi-square test was significance at p-value < 0.01 (χ^2 =13.937**, p-value = 0.003).

Table 9. Distribution of homicide victims by time and homicide methods.

Time (hour)	Homicide Methods								Total (%)
	Blunt force		Sharp force		Gun shot		Others		
	Cases	%	Cases	%	Cases	%	Cases	%	
0:00-05:59	21	9.63	22	10.09	27	12.39	4	1.83	74 (33.94)
6:00-11:59	14	6.42	9	4.13	10	4.59	1	0.46	34 (15.60)
12:00-17:59	8	3.67	12	5.50	11	5.05	4	1.83	35 (16.06)
18:00-23:59	15	6.88	14	6.42	23	10.55	5	2.29	57 (26.15)
Unknown	6	2.75	5	2.29	6	2.75	1	0.46	18 (8.26)
Total	**64**	**29.36**	**62**	**28.44**	**77**	**35.32**	**15**	**6.88**	**218 (100)**
$\chi^2 = 6.575$, p-value = 0.88									

From Table 9, there was no significant association of homicide victims between methods of homicide and period of time (p-value = 0.88). The highest numbers of homicides occurred after midnight (0:00 – 5:59 hour) and the most common method used in homicide was gun shot.

Table 10 shows the number of homicide victims in each age range. There was no significant association between homicide methods and age (p-value = 0.105). Young adults, the age range between 21 and 30 years had the most number of homicide victims. They were accounted for in 83 cases (38.07%) which consisted of 69 males and 14 females (Table 4), followed by the age range between 31 and 40 years accounting for 44 cases (20.18%).

Table 10. Distribution of homicide victims by range of age and method of homicide.

Age	Methods of Homicide				Total (%)
	Blunt trauma	Sharp trauma	Gun shot	Other	
≤ 20	5	10	11	7	33(15.14)
21-30	22	26	32	3	83(38.07)
31-40	13	13	16	2	44(20.18)
41-50	12	9	12	1	34(15.60)
51-60	6	2	3	1	12(5.50)
>60	3	2	0	1	6(2.75)
Unknown	3	0	3	0	6(2.75)
Total	**64(29.36)**	**62(28.44)**	**77(35.32)**	**15(6.88)**	**218**
$\chi^2 = 25.762$, p-value = 0.105					

4. DISCUSSION

A homicidal death has continued to be a serious violent crime. We used all homicide victims cases during January 2003-December 2007 to avoid bias of the retrospective study. In this study, the majority of homicide victims were male (88.99%) and this agrees with previous studies [4, 8-13]. The victims

classified by age group revealed that most subjects were in early adulthood (21-30 years), followed by adulthood (31-40 years) (Table 4) as previously reported [4, 8,9, 11-13]. These age groups people were married and had working careers. Their high responsibility could lead them to face problems, stress, frustrations, quarrels, love affairs, violence, assaults, and finally they have committed homicide. In most homicide cases, the killer has a motive or a reason to kill the victim. But in this study, the motive remains unclear and has not been reported in a substantial number of murders. If we could establish the motive of homicide it might help the officer to investigate the perpetrator. The adolescence group (lower than 20 years) are victims as many times as those of the adult group. This might mean that they could not protect themselves. On the other hand, the elderly had the lowest number of homicide cases. This might mean that they were peaceful and had less violent inclination than the younger. Furthermore in Thai culture, people take good care of their parents, so homicide cases were low.

Alcohol intoxication was still a problem. Alcohol abuse has been reliably linked to violence [10]. In the present study, 50% of the homicide victims were associated with alcohol; 3 in 10 cases found alcohol in blood over the legal limit. Studies in Lithuania and other EU countries showed that alcohol influenced many social processes including possibility to reduce criminality. The majority of cases was the results of personal disputes and not associated with heavy drinking [4]. Problems caused by alcohol consumption could be solved if more information was presented to the public including law to control alcohol.

Homicide often occurred at night time. In this study, the most common time was after midnight (0:00 to 05:59 hour) or after a party (Table 6). However, when the day of the week was in focus, most homicides occurred on Sunday but there was not much difference from other days (Table 7). This could be explained that people had to contact with other people and behavior could not be controlled in an individual. Seasonal variations also affected human behavior; the rainy season showed the highest number of homicide victims which might be due to the fact that bad weather makes people miserable (Table 7). It has been reported that the highest incidence of homicide was in the evening (7:00–10:00 p.m.) and occurred in summer more than in winter [4]. Most crimes occurred during the evening and night hours (52.4%); winter was the commonest season for homicide with more incidences on Saturday and Sunday [9].

Being more powerful and aggressive, males committed homicide more than females. Nevertheless, gunshot was the most common method used for homicide by both genders followed by blunt and sharp forces (Table 8). This agrees with previous findings [4, 8, 12]. Many studies had been reported, 37.7% of the victims exhibited evidence of injuries due to sharp force trauma [9]. Most numbers of homicide deaths were due to blunt trauma [14]. The common method of homicide was using sharp weapons [13]. Firearms were the most common weapons of homicide in the United States [8, 15]. The present study showed that gun shot was the most common method; this could be explained in that Thai people used guns in violent crime (robberies, murder, assaulting) rather than sharp and blunt weapons. Homicide victims due to gun shot had the highest incidence at night time 0:00–05:59 hour (Table 9). This agrees with that reported by Mohanty et al. [9]. However numbers of homicides tended to increase due to population growth, economic crisis and others

human behavior which could not be controlled. The details of the kind of gun need to be recorded in the autopsy report. It might be helpful for the police to find the criminal.

5. CONCLUSIONS

Most homicide cases were male more than female with ages between 21 and 30 years. Approximately 46% were associated with alcohol, 60% occurred at night time, mostly on Sunday and in the rainy season. Gun shot was the most common method used (35.32%), followed by blunt force (29.36%), sharp force (28.44%) and others (6.88%).

The results of the present study illustrate specific details in homicide victims by full autopsied of one hospital (Ramathibodi hospital). It did not cover all parts of the city of Bangkok. For this reason, the frequency of homicidal death could not really show the correct numbers of homicide. Other areas should also be studied.

Further, the usefulness of the data in the scientific community is the database of homicide that should be advantageous for pathologists and Forensic scientists work and particularly to be a guideline for homicide investigations in Thailand.

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REFERENCES

[1] Gilbert J.N., *Criminal Investigation.* (7th. Edn.). Prentice Hall, USA, 2007.

[2] Salfati C.G., A European Perspective on the Study of Homicide, Homicide Stud. 2001; **5**: 286–291.

[3] LaFree G. and Drass K.A., *Homicide Trends in Finland and 33 Other Nations Since 1995: Is Finland Still Exceptional?* in: T. Lappi-Seppa¨la¨ (Edn.), Homicide in Finland: Trends and Patterns in Historical and Comparative Perspective, The National Research Institute of Legal Policy; Publication no. 181, Helsinki, 2001.

[4] Tosayanond S., Homicide: A study at Siriraj Hospital, Bangkok, *Medicine, Science and the Law*, 1984; **24**, 3: 222-226.

[5] Cochran W.G., Some Methods for Strengthening the Common χ^2 Tests, *Biometrics*, 1954; **10**: 417-451.

[6] Lucy D., *Introduction to Statistics for Forensic Scientists*, John Wiley & Sons, Ltd, USA, 2005.

[7] Daniel W.W., *Biostatistics: A Foundation for Analysis in the Health Sciences*, John Wiley & Sons, Ltd, USA, 1999.

[8] Hu G., Webster D. and Baker S.P., Hidden Homicide Increases in the USA, 1999-2005. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 2008; **85**, 4: 597-605.

[9] Mohanty M.K., Kumar T.S.M., Mohanram A. and Palimar V., Victim of Homicidal Deaths-an Analysis of Variables, *Clinical Forensic Medicine*, 2005, **12**: 302- 304.

[10] Adler F., Mueller G.O.W. and Laufer W.S., Criminology: The Shorter Version (2nd. Edn.), McGraw-Hill, Inc., USA, 1995.

[11] Ambade V.N., Godbole, H.V., Kukde, H.G., Suicidal and Homicidal Deaths: A Comparative and Circumstantial Approach. *Forensic and Legal Medicine,* 2007;**14**: 253-260.

[12] Saint-Martin P., Bouyssy M., Bathellier S., Sarraj S. and O'Byrne P., Homicide in Tours (Indre-et-Loire, France) : A Four-Year Review. *Clinical Forensic Medicine*, 2006; **13**: 331–334.

[13] Kumar V., Khaw Mae Li A., Zaid Zanail A., Ai Lee D. and Anuar Salleh S., A Study of Homicidal Deaths in Medico-legal Autopsies at UMMC, Kuala Lumpur. *Journal of Clinical Forensic Medicine*, 2005; **12**: 254-257.

[14] Benos A. and Rybalko J., Alcohol Consumption in Homicide Victims. *Forensic Science International*, 2007; **169S**: S2–S21.

[15] Rosenberg M.L. and Mercy J.A. Homicide: Epidemiologic Analysis at the National Level. *Bull N T Acad Med*, 1986; **62**: 376-399.