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Original Article

An analysis of forensic autopsies performed in the Gwangju and Jeollanam-do areas of the Republic of Korea during the past decade

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Abstract: Autopsy is regarded as the gold standard in death investigation. Moreover, the statistical data from autopsies provides basic statistics for various aspects of society. However, the autopsy rate is low in the Republic of Korea. For a stable forensic autopsy, the Police Agency, the National Forensic Service, and the Department of Forensic Medicine, Chonnam National University concluded an agreement regarding forensic autopsies in the Honam area (Gwangju and Jeollanam-do areas) in 2007. This study aimed to review forensic autopsies performed over the past 10 years according to the trilateral agreement in the Gwangju and Jeollanam-do areas. A total of 3,899 cases were categorized based on the specific region; the manner and cause of death were investigated, and autopsy rates were calculated. The analysis of the manner of death revealed that 2,125 cases (54.5%) were unnatural deaths, 1,347 cases (34.5%) were natural deaths, and 427 cases (11.0%) were from an unknown cause of death. The number of autopsies was relatively stable until 2013 but increased from 2014. Since then, there was a fluctuation in the annual autopsy rates in each region. A negative correlation was noted between the distances from the region requesting autopsies to the institution performing autopsies and the autopsy rates. The authors believe that this study could be used as foundational data to guide the development of a postmortem investigation system and a reference for improving social security and public health.

Keywords: Forensic, autopsy, statistics, Republic of Korea, 10 years

Introduction

Autopsy is the most valuable method for investigating deaths. In the Republic of Korea, the prosecutor has a right to order postmortem investigations and requests a confiscation warrant for autopsy after postmortem inspections, if necessary. When the court grants a confiscation warrant, most of the forensic autopsies in the Republic of Korea are performed by the National Forensic Service which is an institute of the government. Therefore, almost all autopsies performed in the Republic of Korea are forensic autopsies [1]. Regardless of the type of autopsy, the autopsy rate has been declining substantially and this decline has also been noted throughout Europe, the USA, and other countries [2]. The autopsy rates for total mortality and unusual deaths were 2.4% and 18.1%, respectively, in the Republic of Korea in 2015 [1]. Because of such a low autopsy rate, many concerns have recently arisen in the Republic of Korea.

In the Honam region of the Republic of Korea, for a stable forensic autopsy, the Police Agency, the National Forensic Service, and the Department of Forensic Medicine of Chonnam National University concluded an agreement in 2007 for forensic autopsies. Over the past decade, there have been many changes in many areas of society, thus, the authors aimed to conduct a statistical analysis of forensic autopsies in the Honam region (Gwangju and Jeollanam-do) over the past decade.

Methods

Forensic autopsies in the Gwangju and Jeollanam-do areas have been performed by the

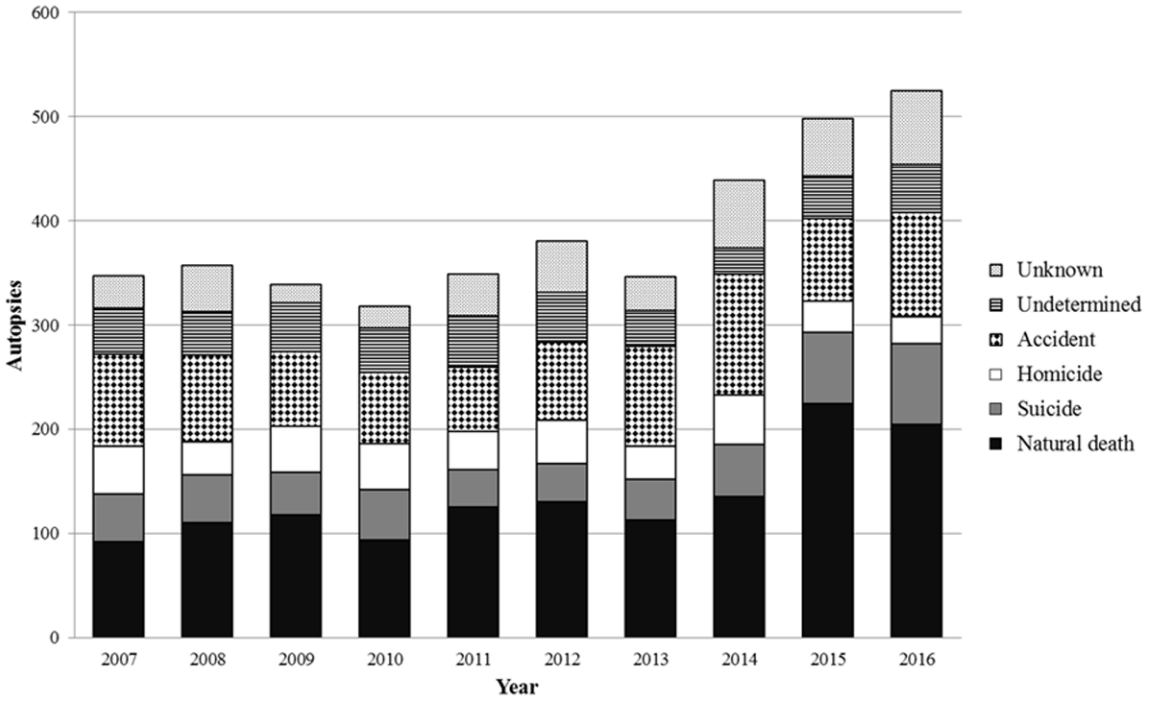

Figure 1. The annual numbers of total autopsies and manners of death are shown over 10 years.

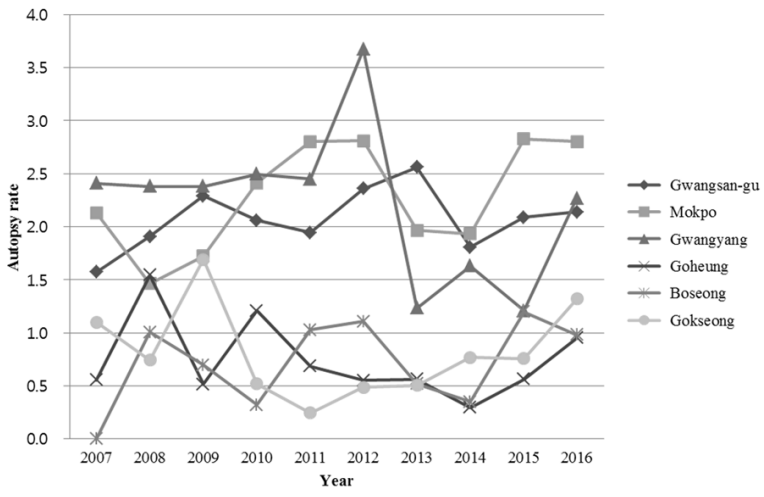

Figure 2. Fluctuation in the autopsy rates by year in each representative sub-region which has high and low autopsy rates.

National Forensic Service Gwangju Institute, the Department of Forensic Medicine, and the Chonnam National University Medical School, and the Department of Pathology at St. Carollo Hospital according to a tripartite agreement. In this study, the authors analyzed 3,899 forensic autopsies that were performed in Gwangju and Jeollanam-do areas over 10 years from 2007 to 2016. The number of unusual deaths was assumed to be the deaths reported to the National Police Agency and the Coast Guard. The total number of deaths, unusual deaths, and autopsies were categorized based on sub-regions, and autopsy rates were calculated by year.

The manners of death were classified as unnatural or natural. When this classification was difficult, the case was classified as 'unknown'. Unnatural deaths were classified as suicides, homicides, accidents and as 'undetermined' for the remaining cases that could not be classified as unnatural deaths. Under unnatural deaths, causes of death were classified as trauma, asphyxia, drowning, poisoning, and thermal injury. Trauma was categorized as blunt force injury, sharp force injury, gunshot and explosion injury, traffic injury, and falls. Asphyxia was classified based on previous research [3].

Natural deaths were classified as deaths caused by diseases of the circulatory system

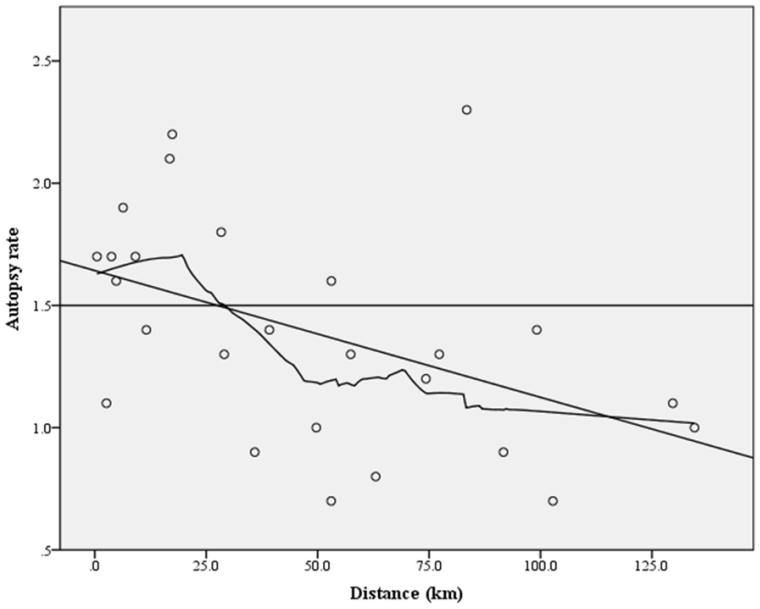

Figure 3. Negative correlation between distances from the requesting autopsy regions to the institution performing the autopsies and the autopsy rates.

Table 1. Cause of unnatural deaths according to forensic autopsies performed in Gwangju and Jeollanam-do areas

	Suicide	Homicide	Accident	Undetermined	Total	(%)
Trauma	70	283	433	123	909	42.8
Asphyxia	178	73	43	11	305	14.4
Drowning	22	8	77	250	357	16.8
Poisoning	199	7	52	9	267	12.6
Thermal injury	19	9	218	23	269	12.7
Electrocution	0	0	11	0	11	0.5
Anaphylaxis	0	0	5	0	5	0.2
Others	0	1	1	0	2	0.1
Total	488	381	840	416	2,125	100.0
(%)	23.0	17.9	39.5	19.6	100.0	

(cardiac or vascular), respiratory or digestive system, as well as endocrine/nutritional/metabolic disease, pregnancy/childbirth/puerperium, and conditions in the perinatal period in accordance with the International Classification of Disease. Cases in which the cause of death was difficult to define, such as sudden infant death syndrome and sudden manhood death syndrome, were classified as 'ill-defined mortality'.

Results

A total of 3,899 forensic autopsies were performed in the Gwangju and Jeollanam-do areas from 2007 to 2016. Of these, 2,699 cases (69.2%) were male and 1,047 cases (26.9%) were female; thus, there were 2.6 times more male than female cases. The number of forensic autopsies was relatively constant from 2007 to 2013; however, since 2014, the annual number of autopsies has been increasing (**Figure 1**). Of the total number of cases, 1,347 (34.5%) were natural deaths, 2,125 (54.5%) were unnatural deaths and 427 (11.0%) were of unknown manner of deaths. Of the 2,125 unnatural deaths, there were 488 (23.0%) suicide cases, the homicidal cases were 381 (17.9%), the accidental cases were 840 (39.5%), and the undetermined cases were 416 (19.6%).

Of all the cases, it was difficult to identify the scene of death for 565 cases, most of which were commissioned by the Coast Guard. The total mortality in the Gwangju and Jeollanam-do areas from 2007 to 2016 was 223,486 cases. Of these, 29,444 unusual deaths were reported to the Police Agency. The autopsy rates for total mortality and unusual deaths were 1.5% and 11.3%, respectively. For total mortality, Mokpo-si had the highest autopsy rate (2.3%), followed by Gwangyang-si (2.2%), Gwangsan-gu (2.1%), Suncheon-si (1.9%) and Yeosu-si (1.8%). The sub-regions with the lowest autopsy rates for total mortality were Goheunggun (0.7%) and Boseong-gun (0.7%), followed by Gokseong-gun (0.8%), Haenam-gun, and Damyang-gun with 0.9%. There was an annual fluctuation in the autopsy rate in the sub-regions (**Figure 2**). A negative correlation was noted between distances from the region requesting autopsies to the institution performing autopsies and the autopsy rates (**Figure 3**, Pearson's correlation coefficient, r = -0.461, P = 0.018).

Table 2. Cause of death due to trauma according to forensic autopsies performed in Gwangju and Jeollanam-do areas

	Suicide	Homicide	Accident	Undetermined	Total	(%)
Blunt force injury	1	116	38	23	178	19.6
Sharp force injury	14	149	6	8	177	19.5
Gunshot injury/Explosion	2	5	11	0	18	2.0
Traffic accident	0	2	227	6	235	25.9
Fall down	53	11	151	86	301	33.1
Total	70	283	433	123	909	100.0
(%)	7.7	31.1	47.6	13.5	100.0	

Table 3. Cause of death due to asphyxia according to forensic autopsies performed in Gwangju and Jeollanam-do areas

	Suicide	Homicide	Accident	Undetermined	Total	(%)
Strangulation	171	44	2	7	224	73.4
Hanging	164	0	0	3	167	74.6
Ligature strangulation	7	21	0	0	28	12.5
Manual strangulation	0	21	0	0	21	9.4
Strangulation, NOS	0	2	2	4	8	3.6
Suffocation	5	24	34	3	66	21.6
Smothering	4	21	3	2	30	45.5
Chocking	1	2	26	0	29	43.9
Oxygen deficiency	0	1	5	1	7	10.6
Mechanical asphyxia	0	0	7	0	7	2.3
Positional asphyxia	0	0	3	0	3	42.9
Crush asphyxia	0	0	4	0	4	57.1
Complicated asphyxia	2	5	0	1	8	2.6
Total	178	73	43	11	305	100.0
(%)	58.4	23.9	14.1	3.6	100.0	

Of the 2,125 unnatural deaths, the majority were trauma (909 cases, 42.8%), followed by drowning (357 cases, 16.8%), asphyxia (305 cases, 14.4%), thermal injury (269 cases, 12.7%), and poisoning (267 cases, 12.6%) (**Table 1**). Of the 909 trauma cases, the majority were falls (301 cases, 33.1%), followed by traffic injury (235 cases, 25.9%), blunt force injury (178 cases, 19.6%), and sharp force injury (177 cases, 19.5%) (**Table 2**). Of the 305 asphyxia cases, strangulation was the most prevalent, with 224 cases (73.4%), followed by suffocation (66 cases, 21.6%). Among the 224 strangulation cases, hanging was the most common (167 cases, 74.6%), followed by ligature strangulation (28 cases, 12.5%), and manual strangulation (21 cases, 9.4%). On the manner of death among asphyxia cases, suicides comprised the majority (178 cases, 58.4%) mostly due to hanging (164 cases, 92.1%). Of the 28 ligature strangulation cases, 21 cases were homicide and all of the 21 manual strangulation cases were homicide. Of the 30 smothering cases, 21 cases were homicide. On the other hand, of the 29 choking cases, 26 cases were accidental. All of the seven mechanical asphyxia cases were accidents (**Table 3**). Of the 267 poisoning cases, agrochemical exposure was the leading cause (106 cases, 39.7%), suicides were 103 cases and homicides were 3 cases. Poisoning due to carbon monoxide was the second leading cause (53 cases, 19.9%). Among these, there were 33 cases of suicides and 19 of accidents. All eight deaths due to natural poisoning were accidents (**Table 4**). Among the 269 thermal injury deaths, death due to fire was the leading cause (236 cases, 87.7%), and among these cases, 189 cases

Table 4. Cause of death in poisoning according to forensic autopsies performed in Gwangju and Jeollanam-do areas

	Suicide	Homicide	Accident	Undetermined	Total	(%)
Ethanol	0	0	19	6	25	9.4
Carbon monoxide	33	1	19	0	53	19.9
Cyanides	17	2	0	0	19	7.1
Agrochemicals	103	3	0	0	106	39.7
Therapeutic drugs	38	1	3	2	44	16.5
Chemicals	8	0	1	1	10	3.7
Gas	0	0	2	0	2	0.7
Natural poison	0	0	8	0	8	3.0
Total	199	7	52	9	267	100.0
(%)	74.5	2.6	19.5	3.4	100.0	

Table 5. Cause of death in thermal injury according to forensic autopsies performed in Gwangju and Jeollanam-do areas

	Suicide	Homicide	Accident	Undetermined	Total	(%)
Fire	18	8	189	21	236	87.7
Burn	1	0	5	0	6	2.2
Heat stroke	0	0	3	0	3	1.1
Hypothermia	0	1	21	2	24	8.9
Total	19	9	218	23	269	100.0
(%)	7.1	3.3	81.0	8.6	100.0	

were accidents. Of the 24 hypothermia deaths, 21 cases were accidents (**Table 5**).

Of the 1,347 cases of natural deaths, circulatory disease was the leading cause (1,033 cases, 76.7%). Among these, there were 799 (77.3%) cases of cardiac disease and 234 (22.7%) cases of vascular disease. Among the 799 cases of cardiac disease, ischemic heart disease was the major cause (496 cases, 62.1%). Among the 234 deaths caused by vascular disease, cerebrovascular diseases were the most frequent cause (140 cases, 59.8%), followed by aortic diseases (38 cases, 16.2%), pulmonary vessel diseases such as pulmonary embolism (28 cases, 12.0%), and esophageal varix bleeding (21 cases, 9.0%). Respiratory disease and endocrine/nutritional/metabolic diseases accounted for 69 cases (5.1%) and 66 cases (4.9%), respectively. There were 40 (3.0%) cases of ill-defined mortality and these cases included 17 cases of sudden manhood death syndrome and 23 cases of sudden infant death syndrome (**Table 6**).

There were 432 (11.1%) cases with unknown causes of death. Unknown manner of death was the most common (427 cases, 98.8%) and there were 4 natural deaths and 1 accidental death. In most cases (343, 79.4%), the cause of death could not be determined due to putrefaction.

Discussion

A disaster occurred in 2014 in the Republic of Korea where 304 people died when the Sewol ferry sank around Jin Island, which administratively belongs to Jeollanam-do. After this disaster, the investigation of the death scene, including the forensic autopsies, was drew much attention in the Republic of Korea. The annual number of forensic autopsies was relatively constant from 2007 to 2013 in Gwangju and Jeollanam-do areas, and the number of autopsies showed an increasing trend from 2014. The authors believe that this disaster affected this change in the autopsy rate. Because autopsy cases of natural and suicidal deaths have mainly increased since 2014, the authors believe that unusual deaths judged to be natural or suicidal deaths in the initial investigation by the police had forensic autopsies performed subsequently.

The autopsy rate in the Republic of Korea is very low [1]. Although increasing, the autopsy rate in the Gwangju and Jeollanam-do areas is lower than the national autopsy rate [1]. There was a fluctuation in the annual autopsy rates in the same sub-regions. In the Republic of Korea, prosecutors who did not undergo medical training have a right to decide whether an autopsy should be performed or not. The authors believe that regular rules should be established for proper death investigation including an autopsy, and that these rules should be kept constant. Furthermore, a negative correlation was noted between distances from the region requesting autopsies to the institution perform-

Table 6. Cause of death in natural deaths according to forensic autopsies performed in Gwangju and Jeollanam-do areas

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total	(%)
Heart	51	66	75	50	83	63	68	76	137	130	799	59.3
Vascular system	17	18	22	14	17	30	13	24	46	33	234	17.4
Respiratory system	7	6	8	5	4	5	7	8	7	12	69	5.1
Digestive system	6	1	3	5	5	9	1	12	7	5	54	4.0
Endocrine/Nutritional/Metabolic disorder	3	4	2	4	3	7	12	6	9	16	66	4.9
Pregnancy/Puerperium/Delivery	1	2	1	2	1	2	0	0	4	0	13	1.0
Perinatal conditions	1	1	3	0	0	0	1	1	0	1	8	0.6
Ill-defined mortality	2	2	1	8	3	10	7	2	4	1	40	3.0
Others	4	10	3	6	9	4	4	6	11	7	64	4.8
Total	92	110	118	94	125	130	113	135	225	205	1,347	100.0
(%)	6.8	8.2	8.8	7.0	9.3	9.7	8.4	10.0	16.7	15.2	100.0	

ing autopsies and the autopsy rates. This new finding should be considered towards establishing a postmortem investigation system.

Among unnatural deaths, deaths due to trauma, drowning, asphyxia, thermal injury, and poisoning were the major causes. Among deaths due to trauma, falls were a leading cause whereas gunshots and explosions accounted for only 18 cases over 10 years. Furthermore, most of the deaths from explosions occurred in industrial complexes. The low number of deaths due to gunshots was due to strict gun control in the Republic of Korea. On the other hand, homicide was a major manner of death under deaths due to blunt and sharp force injuries. Ligature and manual strangulation and smothering were major methods for homicide as well. For similar reasons, hanging and intoxication with carbon monoxide were major suicidal methods. Of the poisoning cases, agrochemical exposure was the leading cause, with 103 cases being suicides and 3 being homicides. The Jeollanam-do area is a representative agricultural area in the Republic of Korea. This is reflected in the results as most homicidal deaths due to fire were caused by arson during family troubles. Major causes of natural deaths were fatal cases of cardiovascular disease. Ill-defined mortality accounted for 3.0% of total autopsy cases due to natural deaths. Causes of death were 'unknown' in 432 cases after forensic autopsy, and almost all were 'unknown' in the manner of death. In most cases, the cause of death could not be determined due to putrefaction. These cases were investigated by the Coast Guard. This result is thought to be due to the regional character of Jeollanam-do which has many islands.

This study is limited by the fact that regional data were used. However, the authors think that this diachronic study highlights important points which present characteristics of forensic autopsy data in the Republic of Korea and presents valuable data which should be considered for establishing a postmortem investigation system.

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Disclosure of conflict of interest

None.

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