When One's Not Enough

Gunshot Suicide Characteristics and Demographics Associated With Having Multiple Gunshots

Soren Jensen, DO, Ashley Perkins, DO,† and Milad Webb, MD†*

Abstract: Self-inflicted gunshot wounds are a common modality of suicide. Cases with multiple gunshot wounds are rare. Problems with determining manner may arise when there is a lack of understanding of how and why they occur. Demographic data has seldom been explored in these cases. Gunshot wound suicides from the years 2015 to 2023 were reviewed at the Hillsborough County Medical Examiner's Office. Nineteen cases with multiple gunshot wounds were found. The multi-GSW cases, compared to the single-GSW cases, had a significantly increased proportion of revolvers (57.9% vs. 29.8%, $P = 0.008$), lower muzzle energy handguns (86.7% vs. 39.6%, $P < 0.001$), and shots to the torso (70.6% vs. 9.0%, $P < 0.001$). Multi-GSW case decedents were significantly older than the single-GSW suicide average (16.2 y, $P < 0.001$). There were also significant age differences between decedents who used the following: (Revolvers vs. semi-automatic pistols, 16.2 y, $P < 0.001$; muzzle energy < 400 vs. > 400 J, 15.8 y, $P < 0.001$; and shots to the torso vs. head, 8.4 y, $P = 0.002$). In our population, older age was associated with factors that might necessitate multiple gunshot wounds in a suicide.

Key Words: forensics pathology, gunshot suicide, multiple gunshot wounds, firearm

(*Am J Forensic Med Pathol* 2025;00:000–000)

In the United States, self-inflicted gunshot wounds are a common cause of death, accounting for around half of all suicides.[1] Males are around 5 to 8 times more likely than females to use this method.[1–6] The fatality rate of a self-inflicted gunshot wound (89.4%) is greater than a gunshot wound sustained due to an assault (25.9%) or if it is unintentional (1.2%).[5] The fatality rate is also high when compared with other suicide modalities, including hanging (52.7%) and drug poisoning (1.9%).[6] Despite the lethality, individuals who shoot themselves can survive, and when not sufficiently incapacitated, may immediately reattempt. Indeed, multiple gunshot wound (multi-GSW) suicides occur in around 1% to 5% of cases in many reported series.[4,7–10] Greater frequencies, up to 18.5%, have been reported.[11–13] Multi-GSW suicide cases are important to recognize as they have the potential to be confused for homicides. To avoid making this mistake, a clear understanding of how and why these cases occur is necessary. In the literature written on these cases, the characteristics of firearms and wound patterns have been used to explain the ability to fire subsequently after the first attempt. However, the demographics, which are a significant factor in the investigation of the individuals, are seldom explored. This study reviews the characteristics and demographics of all GSW suicide cases from Hillsborough County over an 8-year period and determines if there are predictive and characteristic traits associated with having multi-GSW suicides.

Manuscript Received for publication October 28, 2024; accepted May 5, 2025.

From the *Districts 9/25 Medical Examiner's Office, Orlando, FL; and †Hillsborough County Medical Examiner's Office, Tampa, FL.

The authors report no conflict of interest.

Reprints: Soren Jensen, DO, Districts 9/25 Medical Examiner's Office, 2350 E Michigan Street, Orlando, FL 32806. E-mail: soren.jensen@ocfl.net.

ISSN: 0195-7910/25/0000-0000
DOI: 10.1097/PAF.0000000000001052

MATERIALS AND METHODS

At the Hillsborough County Medical Examiner's Office, MEDIAN case management system (a product of Hillsborough County) was used to query all firearm related suicide cases from 2015 to 2023. The case volume was filtered for suicide as the certified manner of death. Cases that were determined to have a cause of death due to a self-inflicted gunshot wound(s) were included in this study. Each case had a full autopsy performed except for 6, which only had external examinations (due to exceptionally long intervals between the suicide attempt and death). These 6 cases were included in the study as relevant details were known. None of these 6 cases had multiple gunshot wounds. Three cases involving a nail gun, an air rifle, and a crossbow were excluded because they are not generally considered to be firearms. A case involving a gunshot to the submentum was also excluded because it was determined that the concurrent jump from a bridge was the cause of death.

The autopsy report, medical death investigator reports, and scene photos were reviewed when present. The age and sex of the decedent, the location of the gunshot wounds, and the firearm characteristics were recorded. Multi-GSW suicide cases were identified based on having multiple self-inflicted gunshot wounds. Cases involving law-enforcement fired gunshot wounds after a single self-inflicted fatal gunshot wound were included in the study, but not in the multi-GSW cohort.

Location of the gunshot wound was assigned based on where the dominant injuries occurred and not necessarily the entrance site. For example, entrances in the epigastric region of the abdomen were assigned "Chest" if they predominately wounded thoracic organs and entrances in the ribcage/sternum were assigned "Abdomen" if they predominately wounded abdominal organs. The locations were also grouped into 2 categories, "Torso" and "Head." Torso included the chest, abdomen, and shoulder. Head included shots to the head and neck.

A muzzle energy approximation was assigned for each handgun case where sufficient information about the firearm

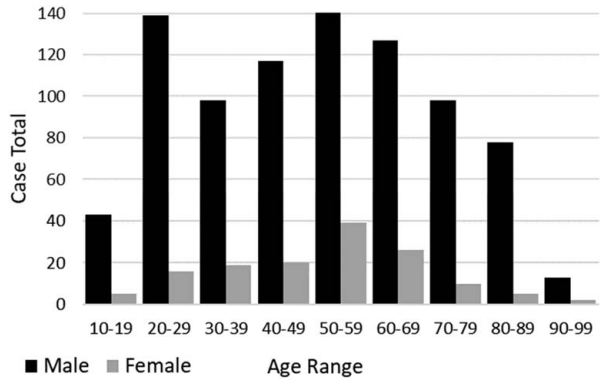

FIGURE 1. Distribution of 1011 gunshot suicides by age group.

was documented. We note that a single firearm may be able to use a variety of ammunition and the exact type ammunition used in each case is not known. For this reason, an exact muzzle energy could not be assigned in each case. These approximations were instead based on published handgun ammunition specifications for the different calibers in the 17th edition of *Cartridges of the World: An Illustrated Reference for Hunters, Shooters, Reloaders, and Collections*.[14] Each caliber's muzzle energy range accounted for different variations of that caliber and different manufacturer specifications published in the resource. For example, the muzzle energy range for the 0.38 included the 0.38 special. For comparing handgun muzzle energy versus age, 2 groups were created based on being $>$ or $<$400 J. This value was chosen as it is near the median value and clearly divides the cases with little overlap. It is not intended to represent a cut off between low and high energy handguns, but instead to evaluate trends.

The data was analyzed using T tests for 2 samples assuming equal variances and Z tests for 2 population portions. Significance was defined as $P < 0.05$.

Although additional information such as toxicology results, medical and mental health history, and social history provide valuable information on suicide cases, they were considered beyond the scope of this study.

RESULTS

Gunshot Suicide Cases

A total of 1899 suicides cases were identified. Gunshot suicides accounted for 1011 (53.2%). Figure 1 shows the age distribution of all gunshot suicides split into male and female groups. Ages ranged from 10 years to 99 years. The total number of males was 869 (86%) and their average age was 51.1 years. The total number of females was 142 (14%) and their average age was 50.5 years. The difference in average age was not significant ($P = 0.74$). Males showed a bimodal distribution with peaks occurring in their 20s and 50s. Females showed one peak in their 50s.

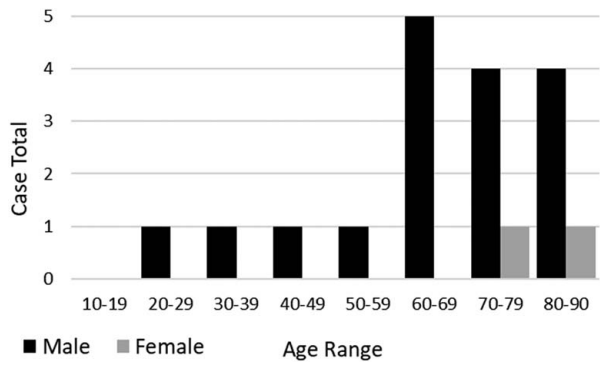

FIGURE 2. Distribution of multi-GSW suicides by age group.

Multi-gunshot Suicides

Nineteen multi-GSW suicides were identified, representing 1.9% of all GSW suicides. Figure 2 shows the age and sex distribution. The distribution is skewed toward an older age. Table 1 highlights the relevant details of each case. The number of males and females was 17 and 2, respectively. The average age was 66.9 years. The age difference between male and female was 17.2 years, although not significant ($P = 0.19$), is in part due to a limited sample size. There was, however, a significant average age difference of 16.2 years between the single and multi-GSW cases ($P < 0.001$, 95% CI: 7.0-25.4 y). Fifteen cases involved 2 shots, 2 cases involved 3 shots, and 1 case each had 4 and 5 shots. The breakdown of firearm characteristics and wound locations are described below in the relevant sections.

Firearms

Table 2 shows a breakdown of firearm use with the average age of the decedents in all the cases. Handguns accounted for close to 90% of the firearms used. Semi-automatic pistols were used more often than revolvers. Derringers were used in 3 cases. The specific type of handgun was not described in 143 cases (14.1%) and the type of firearm was unspecified in 14 cases (1.4%). Long guns made up the remaining 10% with shotguns being more common than rifles. Looking at the average age of the decedent for each firearm type, there is a noticeable difference between the revolvers and the rest. Excluding the small sample of 3 derringer cases, revolvers had the highest average age at 61.7 years. Semi-automatic pistols had the lowest average age at 45.5 years.

Table 3 shows the breakdown of firearms in the multi-GSW cases. Revolvers were used in 11 cases. Five cases used semi-automatic pistols. One case each used an unspecified handgun, a shotgun, and a 0.22 rifle. A greater proportion of these cases used revolvers when compared with the single-GSW cases. This proportion difference (57.9% vs. 29.8%) was significant ($P = 0.008$).

Use of semi-automatic pistol versus revolver by age group is shown in Figure 3. Each bar represents the percentage of that age group that used either a semi-automatic pistol or a revolver. There was a steady trend of increasing revolver use and decreasing semi-automatic pistol use with age. An almost complete flip between the youngest and oldest groups was seen. There was a significant average age difference of 16.2 years between revolver and semi-automatic pistol use ($P < 0.001$, 99% CI: 12.6-19.9 y).

Handgun Caliber and Muzzle Energy

For handguns, the specific caliber was recorded in 722 cases. Table 4 shows the breakdown in caliber and average age of the decedent. Looking at the average age for each caliber, there is noticeable variation. The 2 most common calibers, the 9 mm and 0.38, made up close to 60% of cases and had an average age difference of 21 years.

TABLE 1. Multi-GSW Suicide Case Details

Case	Age/Sex	Firearm	GSWs	Locations	Wounds
1	23, M	0.38 revolver	5	Submental Chest (4)	Tongue, eye, heart, lungs, liver
2	36, M	0.357 semi-auto pistol	4	Submental (2) Chest (2)	Mandible, teeth, left lung
3	43, M	Unspecified handgun	2	Chest Intraoral	Left lung, aorta, brain
4	59, M	0.38 revolver	2	Abdomen TP	Stomach, pancreas, brain
5	62, M	0.22 revolver	2	Face TP	Right orbit, mandible, brain
6	63, M	0.380 semi-auto pistol	2	Abdomen (2)	Stomach, colon
7	63, M	Unspecified shotgun	2	Neck Submental	Soft tissue, mandible, brain
8	64, M	0.38 revolver	2	Face Chest	Soft tissue, tongue, left lung
9	66, M	0.380 semi-auto pistol	2	Submental TP	Mandible, brain
10	71, M	0.38 revolver	2	Abdomen Submental	Intestines, kidney, brain
11	72, M	0.22 semi-auto pistol	2	TP Chest	Scalp, heart, left lung
12	73, M	0.22 semi-auto pistol	3	Abdomen Chest Forehead	Stomach, colon, left lung, brain
13	75, F	0.38 revolver	2	Submental TP	Mandible, brain
14	77, M	0.22 rifle	2	Chest (2)	Left lung, heart, stomach, spleen
15	81, M	0.357 revolver 0.38 revolver	2	TP (2)	Brain
16	81, M	0.38 revolver	3	Submental (2) Face	Tongue, maxilla, brain
17	83, M	0.38 revolver	2	Abdomen Chest	Spleen, colon, heart, left lung
18	89, M	Unspecified revolver	2	Chest (2)	Heart
19	90, F	0.32 revolver	2	Abdomen Chest	Stomach, spleen, left lung

F indicates female; M, male; TP, temporoparietal.

Trends in handgun muzzle energy among different age groups is shown in Figure 4. Each bar represents the percentage of that age group that used either > or < 400 J. In reference to 400 J, there was a trend toward higher muzzle energy use in younger individuals and lower muzzle energy use in older individuals. An almost complete flip in preference between the youngest and oldest groups was seen. Overall, the average age of decedents who used < 400 J was 60.8 years and those who used > 400 J was 45.0 years. This average age difference of 15.9 years was significant ($P < 0.001$, 99% CI: 12.1-19.6 y).

Table 5 shows the breakdown of known caliber in the multi-GSW handgun cases. A greater proportion of these cases had a muzzle energy < 400 J when compared with the single-GSW handgun cases. This proportion difference (86.7% vs. 39.6%) was significant ($P < 0.001$). Case #15 was counted as having a muzzle energy > 400 J due to it also involving a 0.357.

TABLE 2. Firearms in all GSW Suicide Cases

Firearm	Total	Avg. age
Semi-auto pistol	446 (44.1%)	45.5
Revolver	307 (30.4%)	61.7
Unsp. handgun	143 (14.1%)	47.4
Shotgun	61 (6.0%)	46.5
Rifle	37 (3.7%)	49.5
Unsp. firearm	14 (1.4%)	48.9
Derringer	3 (0.3%)	67.7

Location

Table 6 shows gunshot wound locations and the number of all handgun cases involving them. Temporoparietal accounted for close to 60% of the cases. This was followed by intraoral, chest, submental, and forehead. The abdomen, occiput, neck, face, shoulder, and crown were all rare with each occurring in about 1% or less. The average age of the decedent for each location was variable. Temporoparietal was just below overall average age. Intraoral, chest, and abdomen had the highest average age. Decedents with shots to the torso (chest, abdomen, and

TABLE 3. Firearms in 19 Multi-GSW Cases

Firearm	Total	Avg. age
Semi-auto pistol	5 (26.3%)	62.4
Revolver	11 (57.9%)	70.7
Unsp. handgun	1 (5.3%)	43
Shotgun	1 (5.3%)	63
Rifle	1 (5.3%)	77

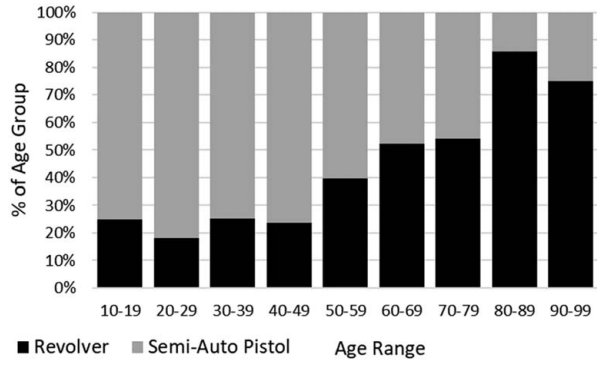

FIGURE 3. Revolver versus semi-automatic pistol use by age group in 753 cases.

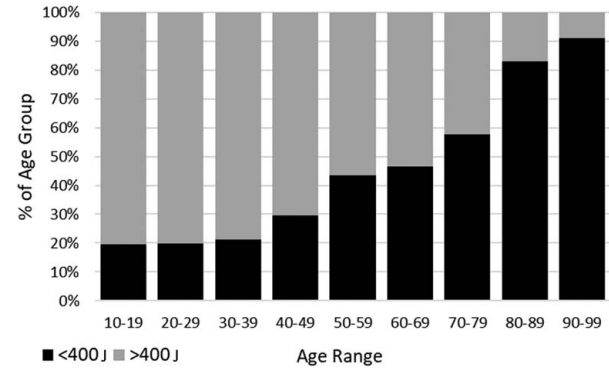

FIGURE 4. Handgun muzzle energy use by age group in 722 cases.

shoulder) had an average age of 58.3 years. Decedents with shots to the head and neck (all other locations) had an average age of 50.9 years. This average age difference of 7.4 years was significant ($P = 0.002$, 95% CI: 2.8-11.9 y).

Table 7 shows gunshot wound locations and the number of multi-GSW handgun cases involving them. The chest was the most common gunshot location, occurring in 9 cases. Submental, temporoparietal, and abdominal shots were seen in 6 cases each. Shots to the face were seen in 3 cases. One case each involved intraoral and the forehead. Table 8 shows the breakdown of how many handgun cases involved the head only, torso only, or a combination of both. A combination of the head and torso was seen in almost half of the cases. A greater proportion of these cases had shots to the torso when compared to the single-GSW cases. This proportion difference (70.6% vs. 9.0%) was significant ($P < 0.001$). Similarly, a greater proportion of these cases had shots to the submentum. This proportion difference (35.3% vs. 6.1%) was also significant ($P < 0.001$).

Table 9 shows the breakdown of shotgun and rifle shot locations for all cases. The most common locations were intraoral and submental. These were followed by the chest, temporoparietal, and forehead. The neck, abdomen, and shoulder were the least common. The average age of the decedent also showed variability. Breaking down the locations into torso versus head, however, did not yield a significant difference for long guns (torso: 49.5 y, head: 47.4 y, $P = 0.68$). For the multi-GSW long gun locations, the chest was the only location in one case and another case involved both the neck and the submentum.

TABLE 4. Known Calibers in 722 Handgun Cases

Firearm	Total	Muzzle energy, J[14]	Avg. age
9 mm	257 (35.6%)	400-630	42.4
0.38	163 (22.6%)	270-390	63.4
0.40	57 (7.9%)	560-710	41.3
0.45	55 (7.6%)	440-1900	49.3
0.22	54 (7.5%)	60-80	62.9
0.380	53 (7.3%)	220-390	52.2
0.357	50 (6.9%)	540-860	57.5
0.32	14 (1.9%)	120-200	59.4
0.25	9 (1.2%)	100	55.1
0.44	5 (0.7%)	400-1350	62.6
0.50	2 (0.3%)	1600-2100	39.5
0.454	1 (0.1%)	2000-2500	26
10 mm	1 (0.1%)	580-920	21
5.7×28 mm	1 (0.1%)	540	19

DISCUSSION

Demographics

In our study, the share of self-inflicted gunshot wounds among all suicides (53.2%) matches closely with the 2020 United States national rate of 52.9%.[1] Males outnumbered females 5:1, in line with other studies showing a range from 5 to 8 time more representation.[1–6] Males and females were both represented in our multi-GSW suicide cases, at a ratio similar to the overall gunshot suicide cases.

Our study showed that there was a significant association between age and multi-GSW suicide cases. This association has not been reported on in prior literature. Many of these past studies, however, have not focused on demographics. A 1981 study of 58 multi-GSW suicide cases did look for potential associations in a variety of areas.[8] In contrast to our results, they reported that the decedents had approximately the same distribution of age, race, and sex as the overall gunshot suicide group, but no specific data was given. However, our studies' populations are separated by about 40 years in time. The factors that cause an association with age today may not have been present in earlier studies.

These factors may include the association between age, firearm characteristics, and gunshot wound locations discussed below. Additional factors underlying the effect of age are likely diverse and complex. We hypothesize that frailty, complex medical conditions, age-related degeneration and debility, and degeneration of executive functions may also play a role.

Multiple Gunshot Wound Scenarios

The percentage that our multi-GSW cases account for (1.9%) is similar to most other series.[4,7–10] The cause for having multiple gunshot wounds in a suicide is hypothesized to vary considerably, including unintended secondary shots due to recoil of a semi-automatic weapon[11] and

TABLE 5. Known Calibers in 15 Multi-GSW Handgun Cases*

Firearm	Total	Muzzle energy, J[14]	Avg. age
0.38	8 (50%)	270-390	67.1
0.22	3 (18.8%)	60-80	69
0.380	2 (12.5%)	220-390	64.5
0.357	2 (12.5%)	540-860	58.5
0.32	1 (6.3%)	120-200	90

*One case used both a 0.38 and 0.357 revolver.

TABLE 6. Number of all Handgun Cases Involving Each Location

Location	Total	Avg. age
T/P	535 (59.5%)	48.5
Intraoral	163 (18.1%)	58.1
Chest	68 (7.6%)	57.0
Submental	60 (6.7%)	53.0
Forehead	44 (4.9%)	54.5
Abdomen	15 (1.7%)	65.1
Occiput	11 (1.2%)	34.0
Neck	8 (0.9%)	55.9
Face	8 (0.9%)	55.9
Shoulder	1 (0.1%)	46
Crown	1 (0.1%)	35

uncontrolled firing from an automatic weapon.[12,13] In these first 2 scenarios, the wounds may be grouped together or within a pattern of recoil. Multiple gunshot wounds can also be due to simultaneous firing of 2 weapons, often one in each hand with wounds to the right and left temple, as seen in case #15 of our series.[15] Finally, multiple gunshot wounds can be due to conscious, repeated trigger pulling. Wounds can involve the same or different sites. Unique scenarios may exist that might be confused for a multi-GSW suicide. For example, law enforcement involved shooting subsequent to a self-inflicted fatal gunshot wound (these cases were excluded from the multi-GSW cohort).

Suicide Versus Homicide

Cases with multiple gunshot wounds may pose a challenge in certification of manner of death as most initially appear suspicious. Multiple GSWs are seen in around 50% of homicide cases.[4,9,10] Certain gunshot wounds details may be predominately seen in either suicides or homicides. Contact range of fire is consistently reported in upwards of 95% of suicides.[4,9,10] With homicides, however, intermediate and distant/indeterminate ranges account for close to 90% of cases. Other factors like trajectory and wound location have been studied as well.[9] Despite certain characteristics being strongly associated with either suicide or homicide, a proper scene investigation is crucial. Evidence of scene staging, defensive wounds, burial, or restraining of the body are more consistent with a homicide.[16] The weapon in or near the hand, soot deposition on the hands, and blood backspatter on the hands/weapon is more consistent with suicide.[3,17,18] Investigative information along with autopsy findings should always be evaluated when determining the manner. In a multi-GSW suicide case, this includes understanding whether the individual is physically capable of pulling the trigger again. This determination requires investigation by an experienced medical examiner and may be fraught with anecdotal evidence.

TABLE 7. Number of Multi-GSW Handgun Cases Involving Each Location

Location	Total	Avg. age
Chest	9 (52.9%)	63.7
Submental	6 (35.3%)	59.3
T/P	6 (35.3%)	69.2
Abdomen	6 (35.3%)	73.2
Face	3 (17.6%)	69
Intraoral	1 (5.9%)	43
Forehead	1 (5.9%)	73

TABLE 8. Number of Multi-GSW Handgun Cases by Location Combination

Location	Total	Avg. age
Head only	5 (19.4%)	73
Torso only	4 (23.5%)	81.3
Head and torso	8 (47.1%)	55.1

Wound Incapacitation

Gunshot wounds can be described in terms of their incapacitation, which can be broken down into 3 categories: delayed, rapid, and instant.[19,20] Delayed incapacitation occurs when there is damage to a structure that would cause relatively slow bleeding such as the liver, kidneys, or small to medium sized vessels. Rapid incapacitation occurs when there is damage to structures that would cause massive, instant bleeding such as the heart or large vessels. There have been reported cases of up to 10 seconds of witnessed, purposeful physical activity following massive trauma to the heart.[21,22] This allows ample time to fire again and in a different location. Instant incapacitation only occurs when motor function is compromised by damage to the central nervous system.

It is important to understand that intracranial gunshot wounds are not always synonymous with instant incapacitation. There are numerous reported cases of decedents having 2 or more gunshot wounds involving the brain.[23–27] There are also numerous cases of gunshots to the head that do not penetrate the skull.[7,8,24,26] In these scenarios, authors hypothesize that relatively low muzzle energy of the firearm is either entirely or in part responsible.[8,24–28] Karger writes that the ability to fire again after shooting the head is increased by minimizing the secondary wound effects. Primarily by using projectiles with lower velocity. He also writes that shots are unlikely to preserve that ability if they involve the posterior fossa and have signs of high intracranial pressures upon impact, such as indirect skull fractures and petechial hemorrhage distant from the wound tract.[24]

With the likely exception of case #15, all of our multi-GSW suicide cases lacked an initial instant incapacitation, evidenced by intentional, additional gunshots. Insufficient muzzle energy and/or the location of the gunshot wounds were the primary reasons and are described in more detail below.

Firearm Ownership and Use in Suicide

Several large studies on firearm ownership from 1994 to 2021 in the United States have demonstrated a few steady trends. The percentage of adults that owned at least one handgun increased from ~16% to 26%.[29–33] Long gun ownership on the other hand has fallen from 19.8% to

TABLE 9. Number of Long Gun Cases Involving Each Location

Location	Total	Avg. age
Intraoral	36 (36.7%)	46.4
Submental	20 (20.4%)	56.2
Chest	15 (15.3%)	48.3
T/P	11 (11.2%)	42.3
Forehead	11 (11.2%)	36.6
Neck	3 (3.1%)	59.3
Abdomen	2 (2.1%)	54.0
Shoulder	1 (1.1%)	59

17.3%.[29–32] Looking at handgun breakdown over the years, revolvers slightly outnumbered semi-automatic pistols in 1994, but the ratio in 2019 was 5:2 in favor of semi-automatic pistols.[29–32] In the 2019 data, the 60+ age group owned about 45% of the total revolvers and only 30% of the total semi-automatic pistols.[32]

The types of firearms used in a suicide deaths have been shown to be reflective of what firearms are owned. This can be demonstrated by comparing our study with a 1992 study also based in the United States. In the 1992 study, the ratio was about 3:1 for both handguns versus long guns and revolvers versus semi-automatic pistols.[3] In our study, the ratios were 9:1 for handguns versus long guns and 2:3 for revolvers versus semi-automatic pistols.

In addition to temporal change within a given population, the association between ownership and use is demonstrated in international studies. For example, shotguns and rifles make up a greater share of gunshot suicides in countries where they outnumber handguns in total ownership.[9,12,34]

These trends in firearm ownership over time may explain, in part, why our series found an association of older individuals and revolver use. Revolvers may have been acquired at a time when they were more popular. If acquired recently, the individual may have chosen what was most familiar to them when they learned about firearms. Although the reasons are entirely speculative, our data shows that older individuals tend to use revolvers.

Our study showed, with significance, that our multi-GSW cases used revolvers at a greater proportion when compared to the single-GSW suicide cases. In similar multi-GSW suicide studies in the United States, revolvers were used in a majority of the cases.[7,8,27] In the 1981 study for example, handguns were used in 52 out of 58 cases and they were all revolvers.[8] More than half of those were a 0.22 caliber. The author attributed general popularity of the gun, low price, ease of use, and low energy as the likely factors.

The most common semi-automatic pistol and revolver calibers, 9 mm and 0.38, had a large average age gap. In addition, for all handguns with known calibers, 77% of the revolvers had a muzzle energy <400 J and 80% of the semi-automatic pistols were >400 J.

Ballistics

Muzzle energy is an important factor in tissue destruction and velocity is the major variable in calculating energy. Tissue injury from a lower velocity projectile is largely confined to the wound tract, also called the primary wound effect.[35] In terms of secondary wound effect involving the brain, low velocity projectiles can cause a temporary cavity of 3.6 cm in diameter.[36] Velocities >300 to 600 m/s cause a significantly greater temporary cavity and tissue damage.[35]

Prior studies often attribute lower muzzle energy for their multi-GSW suicide cases.[8,24–27] However, comparisons of muzzle energy with the overall gunshot suicides are not given. Our study made this comparison and showed, with significance, that our multi-GSW handgun cases had a greater proportion of cases with a muzzle energy <400 J when compared with the single-GSW handgun cases. In our cases that involved nonlethal shots to the head, perhaps a projectile with greater muzzle energy would have been lethal due to greater secondary wounding effects or increased penetration. In case #1, for example, the submental shot had a trajectory to enter the cranial cavity but stopped inside of the orbit.

Gunshot Wound Locations

The general wound location breakdown is similar between our study's total gunshot wound suicides and other reported series.[3,4,10,12] In our multi-GSW suicide cases, shots to the torso and submentum were overrepresented and shown to be significantly greater in the handgun cases. In prior multi-GSW suicide studies in the United States, shots to the torso were also present in the majority of the cases (73% to 89%).[7,8,27] In 2 of the studies, the torso was the only location involved in the majority of cases (67% and 53%).[7,8] While these studies did not compare this data to their overall gunshot suicides, they all attributed gunshot location as a factor in having multiple gunshot wounds.[7,8,27] As previously discussed, gunshot wounds involving the heart or other major thoracoabdominal organs do not cause instant incapacitation. The overrepresentation of torso shots in multi-GSW suicide studies is reflective of a preserved ability to fire again. Gunshots to the head that do not cause instant incapacitation are also not uncommon in the literature, as previously discussed.[7,8,23–28] In our multi-GSW cases, there were 10 gunshot wounds involving the head with injuries that would not cause instant incapacitation. Submental shots that only damaged facial structures were the most common. The remaining shots were too tangential to enter the cranium.

The significant association between older individuals and torso shots likely was a contributing factor for the older average age of the multi-GSW cases. Looking back at the handgun cases in Table 8, the individuals who shot themselves only in the torso had an average age of 81.3 years. Previous gunshot wound suicide studies have not made an association between age and gunshot wound location. In 2 older studies in the United States (1992 and 2013), shots to the torso were 1.5 to 2 times more common than in our study.[3,4] If the torso was a more common location in the past, perhaps the older individuals of today still follow those trends. The average age of the multi-GSW cases who only shot themselves in the head was also increased. Being of advanced age or having a chronic illness might make one more prone to having a misplaced shot. Surprisingly, the average age of those who shot themselves in the head and torso was closer to the overall gunshot suicide age. The decision or ability to switch sites may also be influenced by age related factors, such as a baseline physical or mental ability.

Health and Social Factors

Our study focused on demographics, firearm characteristics, and wound locations. The decision to follow through after initial survival is also an important consideration. Factors such as toxicology, medical and mental history, and social history may influence this decision. Although intention is difficult to elucidate, a significant amount of insight may be gained from multi-suicide attempt studies.[37–39]

CONCLUSION

Multi-GSW suicides, through repeated pulling of the trigger, are only possible when the initial wounds do not cause instant incapacitation and when the individual chooses to shoot again. Understanding the factors that lead to these cases are important for accurate manner

determination. Gunshot wounds outside of the cranium or upper cervical region are not likely to cause instant incapacitation and are more likely to preserve the ability to fire again. Lower muzzle energy projectiles are less likely to cause instant or rapid incapacitation due to lower penetrating power and less severe secondary wounding effects. In our study, we found that older individuals were more likely to prefer the torso as a location and to use a firearm with lower muzzle energy (often a revolver). These findings, in part, explain why our series of multi-GSW suicides had a significantly older age. The effects of advanced age may also play a role. The decision to shoot again may be influenced by an individual's mental/physical health, social support system, chronic life stressors, or whether they were under the influence of drugs at the time of death. Future studies exploring these topics and their potential association with multi-GSW suicides are needed. At least in our population and in this given range of time, older individuals are more likely to use firearms and choose body locations that often allow for multiple shots.

REFERENCES

1. Simon T, Kegler S, Zwald ML, et al. Notes from the field: increases in firearm homicide and suicide rates. *MMWR Morb Mortal Wkly Rep*. 2022;71(40):1286–1287.
2. Blumenthal R. Suicidal gunshot wounds to the head: a retrospective review of 406 cases. *Am J Forensic Med Pathol*. 2007;28(4):288–291.
3. Stone IC. Characteristics of firearms and gunshot wounds as markers of suicide. *Am J Forensic Med Pathol*. 1992;13(4):275–280.
4. Molina DK, DiMaio VJM, Rowena C, et al. Handgun wounds: a review of range and location as pertaining to manner of death. *Am J Forensic Med Pathol*. 2013;34(4):342–347.
5. Kaufman EJ, Wiebe DH, Xiong RA, et al. Epidemiologic trends in fatal and nonfatal firearm injuries in the US, 2009-2017. *JAMA Inter Med*. 2021;181(2):237–244.
6. Conner A, Azrael D, Miller M. Suicide case-fatality rates in the United States, 2007 to 2014: a nationwide population-based study. *Ann Intern Med*. 2019;171(12):885–895.
7. Introna F, Smialek JE. Suicide from multiple gunshot wounds. *Am J Forensic Med Pathol*. 1989;10:275–284.
8. Hudson P. Multishot firearm suicide: examination of 58 cases. *Am J Forensic Med Pathol*. 1981;2(3):239–242.
9. Karger B, Billeb E, Koops E. Autopsy features relevant for discrimination between suicidal and homicidal gunshot injuries. *Int J Legal Med*. 2002;116(5):273–278.
10. Cave R, DiMaio VJM, Molina DK. Homicide or suicide? Gunshot wound interpretation: a Bayesian approach. *Am J Forensic Med Pathol*. 2014;35(2):118–123.
11. Karger B, Brinkmann B. Multiple gunshot suicides: potential for physical activity and medico-legal aspects. *Int J Legal Med*. 1997;110(4):188–192.
12. Balci Y, Canogullari G, Ulupinar E. Characterization of gunshot suicides. *J Forensic Leg Med*. 2007;14(4):203–208.
13. Sanaei-Zadeh H, Ghorbani M, Ghanizadeh A, et al. Suicide by firearm, a unique pattern from Iran. *Arch Suicide Res*. 2004;8 (2):173–177.
14. Barnes FC. *Cartridges of the World: An Illustrated Reference for Hunters, Shooters, Reloaders, and Collections*, 17th ed. Appleton, WI: Gun Digest Books, an Imprint of Caribou Media Group; 2022.
15. Parroni E, Caringi C, Ciallella C. Suicide with two guns represents a special type of combined suicide. *Am J Forensic Med Pathol*. 2002;23:329–333.
16. Stefan VH. The determination of homicide vs. suicide in gunshot wounds. Martin DL, Anderson CP, eds. *Bioarcheological and Forensic Perspective on Violence*. New York: Cambridge University Press; 2014:51–62.
17. Karger B, Nusse R, Schroeder G, et al. Backspatter from experimental close-range shots to the head. I. Macrobackspatter. *Int J Legal Med*. 1996;109:66–74.
18. Di Maio VJM. *Gunshot Wounds, Practical Aspects of Firearms, Ballistics, and Forensic Techniques*, 3rd ed. Boca Raton, FL: CRC Press; 2016.
19. Heard BJ. *Handbook of Firearms and Ballistics, Examining and Interpreting Forensic Evidence*, 2nd ed. West Sussex, UK.: Wiley-Blackwell; 2008.
20. Raniero D, Del Balzo G, Vermiglio E, et al. A hard way to die: when multiple lethal gunshots mean suicide. *Int J Legal Med*. 2022;136(1):179–187.
21. Levy V, Rao VJ. Survival time in gunshot and stab wound victims. *Am J Forensic Med Pathol*. 1988;9(3):215–217.
22. Spitz WU, Petty CS, Fisher RS. Physical activity until collapse following fatal injury by firearms and sharp pointed weapons. *J Forensic Sci*. 1961;6:290–300.
23. Karger B. Penetrating gunshots to the head and lack of immediate incapacitation. I. Wound ballistics and mechanisms of incapacitation. *Int J Legal Med*. 1995;108(2):53–61.
24. Karger B. Penetrating gunshots to the head and lack of immediate incapacitation II. Review of case reports. *Int J Legal Med*. 1995;108(3):117–126.
25. Maghin F, Antonietti A, Farina D, et al. A case of suicide by double gunshot wounds to the head: the ability to act after the first shot. *Int J Legal Med*. 2019;133(5):1469–1476.
26. Hejna P, Safr M, Zátopková L. The ability to act—multiple suicidal gunshot wounds. *J Forensic Leg Med*. 2012;19(1):1–6.
27. Arunkumar P, Maiese A, Bolino G, et al. Determined to die! ability to act following multiple self-inflicted gunshot wounds to the head. The Cook County Office of Medical Examiner Experience (2005–2012) and Review of Literature. *J Forensic Sci*. 2015;60(5):1373–1379.
28. Adams J. An unusual case of multiple-gunshot suicide with nine gunshot wounds by an active-duty soldier. *J Forensic Identif*. 2020;70(4):395–405.
29. Cook PJ, Ludwig J. *Guns in America: Results of a Comprehensive National Survey on Firearms Ownership and Use*. Washington, DC: The Police Foundation; 1996.
30. Hepburn L, Miller M, Azrael D, et al. The US gun stock: results from the 2004 national firearms survey. *Inj Prev*. 2007; 13:15–19.
31. Azrael D, Hepburn L, Hemenway D, et al. The stock and flow of US firearms: results from the 2015 national firearms survey. *RSF J Soc Sci*. 2017;3(5):38–57.
32. Berrigan J, Azrael D, Miller M, et al. The number and type of private firearms in the United States. *Ann Am Acad Pol Soci Sci*. 2022;704(1):70–90.
33. English W. 2021 national firearms survey: updated analysis including types of firearms owned. SSRN Electronic Journal. Georgetown McDonough School Business Research Paper, No. 4109494. May 2022. Accessed June 21, 2024. http://dx.doi.org/10.2139/ssrn.4109494
34. Sutton L, Hawton K, Simkin S. Gunshot suicides in England: a multicentre study based on coroners' records. *Soc Psychiatry Psychiatr Epidemiol*. 2005;40(4):324–328.
35. Stefanopoulos PK, Filippakis K, Soupiou OT, et al. Wound ballistics of firearm related injuries—part 1: missile characteristics and mechanisms of soft tissue wounding. *Int J Oral Maxillofa Surg*. 2014;43(12):1445–1458.
36. Oehmichen M, Meissner C, König HG, et al. Gunshot injuries to the head and brain caused by low-velocity handguns and rifles: a review. *Forensic Sci Int*. 2004;146(2):111–120.
37. Nichter B, Maguen S, Manteith L, et al. Factors associated with multiple suicide attempts in a nationally representative study of US military veterans. *J Psychiatr Res*. 2021;140:295–300.
38. Ho Choi K, Wang S, Yeon B, et al. Risk and protective factors predicting multiple suicide attempts. *Psychiatry Res*. 2013;210 (3):957–961.
39. Craig B, Clemans T, Leeson B, et al. Acute vs. chronic stressors, multiple suicide attempts, and persistent suicide ideation in US soldiers. *J Nerv Ment Dis*. 2015;303(1):48–53.