

## The relationship between nonsuicidal self-injurious behavior and manners of death: a multicenter autopsy study

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Received: 18.01.2017 • Accepted/Published Online: 22.08.2017 • Final Version: 19.12.2017

**Background/aim:** This study aimed to determine the relationship between nonsuicidal self-injurious behavior (NSSIB) and manners of death.

**Materials and methods:** This study retrospectively evaluated 6604 autopsy cases evaluated at forensic medicine institutes of six major cities of Turkey. The study group consisted of all cases with NSSIB findings. The control group was created from cases without signs of NSSIB.

**Results:** We found that the numbers of possible suicide and homicide cases in the NSSIB (+) group were significantly higher than in the NSSIB (-) group. The possibility of death due to suicide was 3.213 times and homicide was 2.004 times higher than natural deaths in the NSSIB (+) group compared with the NSSIB (-) group.

**Conclusion:** The presence of NSSIB might increase the risk of death due to suicide and homicide, especially in adolescence.

**Key words:** nonsuicidal self-injurious behavior, suicide, homicide, postmortem examination, autopsy, manner of death

### 1. Introduction

Forensic autopsy is responsible for the investigation of sudden, suspicious, obscure, unnatural, and criminal deaths (1). The most important objectives of an autopsy are to make an identification, to determine the cause and time of death, and to describe external and internal injuries (1). It alone generally does not determine the manner of death (2). Although the manner of death is determined by the public prosecutor after the legal process, some findings such as hesitation marks, defense wounds, etc. recorded during the postmortem investigation and autopsy help to reveal the manner of death (2).

Nonsuicidal self-injurious behavior (NSSIB) is defined as intentional harm to one's body without intentions of

committing suicide (3–6). The most common methods are self-cutting (70%–97%), self-hitting (21%–44%), self-burning (15%–35%), and severe scratching (4%–13%) Apart from direct methods such as self-biting, scratching, tissue plucking, burning, hitting, and compressing, there are also indirect NSSIB methods including overeating, undereating, substance use, and rejection of medical treatment (5,7,8). In some studies, it was noted that more than half of NSSIB cases involved more than one method (9–12). It is estimated that 6% of the general population will engage in NSSIB at some point during their lifetime (5,7,13–15). This percentage is higher in adolescents (13%–29%) (4–6,16–18).

Many psychiatric studies from developed countries reported a relationship between attempted suicide and

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NSSIB. Similarly, numerous psychiatric disorders including depression, anxiety, behavioral disorders, drug abuse, and dissociative, borderline, and antisocial personality disorders are associated with NSSIB and suicidal behavior (4,6,13–15,19–25). There is no autopsy study in the literature about this relationship. Therefore, our study is unique in this area. In this study, our hypothesis proposed that the incidence of suicide and homicide could be higher in NSSIB (+) cases than NSSIB (-) cases.

## 2. Materials and methods

With the permission of the Scientific Committee of the Council of Forensic Medicine, the postmortem examination and autopsy reports of all autopsies performed in six cities in Turkey between 1 January and 31 December 2013 were retrospectively evaluated by the authors of the study.

The autopsy alone could not define the manner of death. It was determined by the public prosecutor after the legal process including both postmortem examination and autopsy. As necessary permissions were not obtained from the public prosecutor, we could not get access to all files related to the manners of death, such as crime scene reports or witness statements. We only investigated the postmortem examination and autopsy reports of all cases. Therefore, we described the manners of death as “possible suicide”, “possible homicide”, etc. in our study.

A total of 6604 autopsy files were examined; 243 cases with NSSIB findings were grouped as NSSIB (+) and the remaining 6361 cases were grouped as NSSIB (-). From those, 357 NSSIB (-) cases were chosen for our study by applying a systematic sampling method.

The conformity of the age variation to normal distribution was examined by Shapiro–Wilk test. As the age variation did not follow a normal distribution, it was expressed with both median and minimum–maximum values. Groups were compared according to causes and manners of death. First of all, we classified causes of death as ‘traumatic’ and ‘nontraumatic’. The manners of death was then classified as ‘natural’, ‘accident’, ‘homicide’, or ‘suicide’. When distributions of manners of death were analyzed, deaths from substance abuse with an unknown manner of death were classified as ‘undetermined’. These cases were included into the ‘intoxication’ group when manners of death were compared with natural deaths. Each categorization was confirmed by a second opinion. The categorical variables were shown as numbers (percentages).

The age variable was examined by Mann–Whitney U test in order to see if there was a difference between the study and the control groups. The chi-square test was used in order to analyze categorical variables including group, sex, and manner of death. The difference in means

of manners of death according to groups was determined by multinomial logistic regression analysis. Risk factors of every manner of death for every group were found by using binomial logistic regression analysis and the method of forward likelihood ratio. The odds ratio (OR) and 95% confidence interval, Wald statistic, and P-value were calculated by using logistic regression analysis. Statistical significance was reported as  $P < 0.05$ . The data were analyzed using IBM SPSS Statistics 21.0 (IBM Corp., Armonk, NY, USA).

## 3. Results

A total of 6604 autopsy files (57.4% traumatic, 42.6% nontraumatic) from six different cities were examined; 243 cases (3.68%) were grouped as NSSIB (+) and 375 cases (5.4%) were grouped as NSSIB (-).

Of all cases, 84.2% ( $n = 505$ ) were males and 15.8% ( $n = 95$ ) were females. Specifically, 83.5% ( $n=203$ ) were males and 16.5% ( $n = 40$ ) were females in the NSSIB (+) group [age median (IQR) = 27.0 (12.0) (min–max = 12.0–81.0)] while 84.6% ( $n = 302$ ) were males and 15.4% ( $n = 55$ ) were females in the NSSIB (-) group [age median (IQR) = 31.0 (17.0) (min–max = 13.0–82.0)]. No statistically significant difference was found in sex distribution between the NSSIB (+) and NSSIB (-) groups ( $\chi^2 = 0.121$ ,  $P = 0.276$ ). Ages of NSSIB (+) cases were found to be significantly lower than ages of NSSIB (-) cases ( $Z = 2.784$ ,  $P = 0.005$ ).

In the NSSIB (+) group, examined NSSIB methods were cutting (96.3% ,  $n = 234$ ), cigarette burns, and self-harm tattoos (2.1% ,  $n = 5$ ), while 1.6% of NSSIB (+) cases ( $n = 4$ ) involved more than one method. The mean number of scars was  $19.71 \pm 14.78$  and the median was 17.00 in NSSIB (+) cases (IQR = 20.00) (min–max: 2–86). Self-harm scars were observed at the left upper extremity (82.3%,  $n = 200$ ), right upper extremity (10.3%,  $n = 25$ ), thorax (5.3%,  $n = 13$ ), and other locations (2.1%,  $n = 5$ ) respectively.

Death causes were classified as traumatic and nontraumatic. Firearm wounds, hanging, traffic accidents, penetrating stab wounds, substance abuse, falls from heights, drowning, carbon monoxide poisoning, and other causes were classified as “traumatic”. Natural deaths were classified as “nontraumatic”. It was found that 89.3% ( $n = 217$ ) of NSSIB (+) individuals and 81.8% ( $n = 288$ ) of NSSIB (-) individuals died because of traumatic causes (Table 1).

It was recorded that traumatic death causes were firearm wounds (24.2%), hanging (15.1%), traffic accidents (14.5%), and penetrating stab wounds (10.8%), respectively. The most common traumatic death causes in the NSSIB (+) group were found as firearm wounds (30.0%), hanging (22.6%), traffic accidents (13.8%), and penetrating stab wounds (12.9%) (Table 2).

**Table 1.** Causes of death in NSSIB (+) and NSSIB (-) cases.

Causes of death	NSSIB (+), n (%)	NSSIB (-), n (%)	Total	Test statistics	P
Nontraumatic	26 (10.7)	65 (18.2)	91 (15.2)	$\chi^2 = 6.334$	0.012
Traumatic	217 (89.3)	292 (81.8)	509 (84.8)		

OR = 1.859 (95% CI for OR: 1.142–3.021).

**Table 2.** The distributions of traumatic causes of death.

Death causes	NSSIB (+)	NSSIB (-)	Total
Firearm wound	65 (30.0)	58 (19.9)	123 (24.2)
Hanging	49 (22.6)	28 (9.6)	77 (15.1)
Traffic accident	30 (13.8)	44 (15.1)	74 (14.5)
Stabbing	28 (12.9)	27 (9.2)	55 (10.8)
Substance/drug abuse	19 (8.8)	11 (3.8)	30 (5.9)
Falling/jumping from heights	12 (5.5)	31 (10.6)	43 (8.4)
Drowning	6 (2.8)	15 (5.1)	21 (4.1)
Carbon monoxide intoxication	3 (1.4)	30 (10.3)	33 (6.5)
Others (electricity, pesticide intoxication, blunt trauma)	5 (2.3)	48 (16.4)	53 (10.4)

The mortality rate due to traumatic causes in the NSSIB (+) group was found statistically higher ( $\chi^2 = 6.334$ ,  $P = 0.012$ ). The difference between the two groups in means of death risk due to traumatic causes was 1.859 times higher in the NSSIB (+) group (OR = 1.859 [95% CI of OR = 1.142–3.021]).

It was determined that the distribution of manners of death in the NSSIB (+) and NSSIB (-) groups was different ( $\chi^2 = 34.980$ ,  $P < 0.001$ ). It was found that the number of possible suicide cases in the NSSIB (+) group was significantly higher than in the NSSIB (-) group ( $P < 0.001$ ). It was also found that possible homicide was statistically significantly higher in the NSSIB (+) group ( $P = 0.019$ ).

The distribution of manners of death in the NSSIB (+) and NSSIB (-) groups is shown in the Figure. Except for homicide and suicide, the rate of other manners of death including natural causes, accidents, and undetermined origin was found significantly higher in the NSSIB (-) group compared with the NSSIB (+) group.

There was no statistically significant difference in the distribution of manners of death between sexes ( $\chi^2 = 5.449$ ,  $P = 0.244$ ).

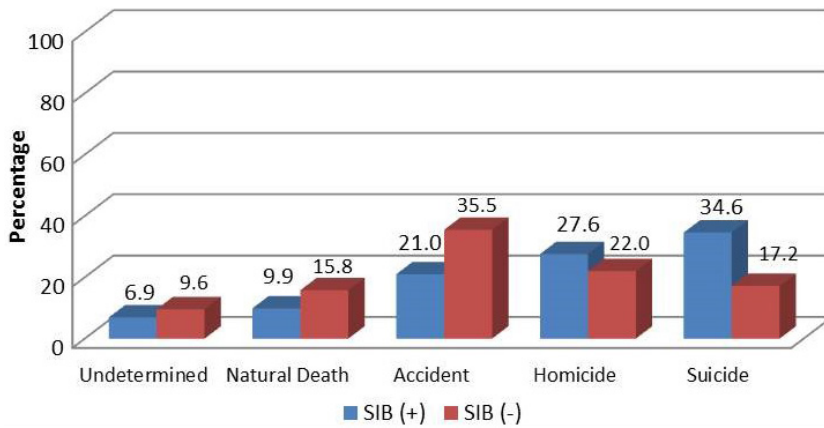
The possibility of death due to suicide was 3.213 times higher than natural deaths (95% CI of OR: 1.798–5.744) ( $P < 0.001$ ) and the possibility of death due to homicide was 2.004 times higher than natural deaths (95% CI of OR:

1.123–3.576) ( $P = 0.019$ ) in the NSSIB (+) group compared with the NSSIB (-) group (Table 3).

There was no statistically significant difference between total scar number and possibility of death due to suicide and homicide in the NSSIB (+) group ( $\chi^2 = 9.224$ ,  $P = 0.161$ ).

In some intoxication-related death cases, it is difficult to determine the manner of death as enough data cannot be collected in the crime scene investigations. In our study, there was a statistically significant difference between the two groups when “death due to intoxication” was accepted as a separate cause of death. The possibility of death due to substance abuse intoxication was 3.889 times higher than the possibility of death due to natural deaths (95% CI of OR: 1.270–11.912). It was found that the possibility of death due to accidents and natural death was similar in both groups ( $P = 0.846$ ). According to the significant data above, deaths due to intoxication are shown as a separate cause of death in Table 3.

Toxicological tests had positive results in 50.5% ( $n = 303$ ) of all cases. Ethanol (35.3%), cannabinoids (19.1%), carboxyhemoglobin (10.6%), amphetamines (8.9%), heroin (3.6%), agrochemicals (1.9%), methanol (1.3%), and therapeutic drugs (19.1%) were found in postmortem toxicological analysis. A second toxic substance was found in 6% ( $n = 36$ ) and a third toxic substance was found in 1% ( $n = 6$ ) of all cases.



**Figure.** The distribution of causes of death in the NSSIB (+) and NSSIB (-) groups (P < 0.001).

**Table 3.** Evaluation of possible manners of death compared to natural deaths among groups.

Manners of death	Factor	OR	95% CI	Wald statistics	P
Accident	NSSIB (+) / NSSIB (-)	0.944	0.530–1.684	0.038	0.846
Homicide	NSSIB (+) / NSSIB (-)	2.004	1.123–3.576	5.539	0.019
Suicide	NSSIB (+) / NSSIB (-)	3.213	1.798–5.744	15.514	<0.001
Intoxication*	NSSIB (+) / NSSIB (-)	3.889	1.270–11.912	5.347	0.017

\*Deaths due to substance abuse.

**4. Discussion**

Our results showed that when the NSSIB (+) group was compared with the NSSIB (-) group, the possibility of death due to suicide was 3.213 times and the possibility of death due to homicide was 2.004 times higher in the NSSIB (+) group. In the NSSIB (-) group, the incidence of natural deaths or accidents was higher. These results are compatible with our hypothesis. Although there is no autopsy study in the literature, many psychiatric studies have presented the same results. Bongar et al. suggested that 80% of patients who were admitted to emergency psychiatric services because of persistent thoughts of suicide had NSSIB (26). Cooper et al. and Hawton et al. concluded that, in the first 12 months after self-harm, the risk of suicide was 30 or 49 times greater than the average, respectively (27,28). In three different studies, Kimbrel et al. suggested that NSSIB was a robust predictor of suicidal ideation and suicide attempts in veterans with PTSD (29–31). Kaya et al. from Turkey declared that NSSIB was a risk factor for suicidal depression and attempts (6). Özsoy et al. from Turkey found a positive correlation between

NSSIB and aggression in children and adolescents (5). Herpertz et al. said that NSSIB was closely associated with affect regulation (32). Calhoun et al. underlined that the presence of NSSIB was the highest risk for engaging in interpersonal violence (13). Hillbrand et al. suggested that repeatedly self-injurious patients were more frequently and more severely aggressive against others, verbally as well as physically (33). These findings may explain the increased rate of deaths due to homicide in NSSIB (+) cases.

NSSIB could also be seen in the normal population without any psychiatric disorders but the frequency is significantly higher in cases of psychiatric and neurologic/developmental problems (34,35). Among all psychiatric diagnoses, “borderline personality disorder” is the most common psychopathology associated with NSSIB and it is the only psychiatric disorder for which NSSIB is one of its diagnostic criteria. There are also some studies that show the relationship between NSSIB and many other psychiatric disorders like antisocial personality disorder with anger management or impulse control problems, behavioral disorders, major depression, substance abuse,

anger management and impulse control disorder, and schizophrenia (10,11,36,37). However, in our study, no data about psychiatric disorders could be obtained.

In the literature, although some studies reported that there was no significant difference between the sexes in terms of NSSIB incidence (5,19,38–42), some other studies reported that the incidence of NSSIB was higher in females (9,10,37,43). In our study, no statistically significant difference was found in sex distribution between the NSSIB (+) and NSSIB (-) groups.

It is reported that 75% of global suicide cases occur in low- and middle-income countries and the most commonly used methods are the ingestion of pesticide, hanging, and use of firearms (33). We conducted our study with both NSSIB (+) and NSSIB (-) cases and we found that the most frequent suicide methods were hanging (51.7%), firearms (27.6%), intoxication (10.3%), and jumping from heights (8.9%). In our study we also observed that there was no suicidal stabbing. Our results are similar to the literature as we also found that 97.9% of possible homicide cases were related to penetrating stab wounds (44–46).

We observed that 50.5% of self-injuries were performed under the influence of alcohol and illegal drugs and our findings are similar to the results of a study which found that 20% of self-injuries were performed under the influence of alcohol and 13% were performed under the influence of illegal substances (3,39,47).

Our study has two limitations. First of all, in Turkey, forensic medicine specialists do not have the responsibility

for determining the manner of death like public prosecutors do, so we did not get access to all files about the manners of death. Therefore, we described the manners of death as “possible suicide”, “possible homicide”, etc. Secondly, we only investigated the postmortem examination and autopsy reports of all cases based on the permission that we received from the Scientific Committee of the Council of Forensic Medicine. We did not find information on accompanying psychiatric diseases, other medical conditions, or history of medication use data in the postmortem examination and autopsy reports. For future studies, necessary permissions should be obtained from the Ministry of Justice in order to get access to all legal documents. In this way, it could be possible to get access to court files containing crime scene reports, witness statements, hospital files, postmortem examinations, and autopsy reports.

In conclusion, in accordance with our hypothesis, we found that NSSIB is a strong indicator of death due to possible suicide and homicide. Therefore, we conclude that it could be possible to decrease death rates due to suicide and homicide by performing more detailed studies on NSSIB cases and taking preventive measures in the early stages of NSSIB, especially in young children, via increasing social awareness through the press and social media, arranging educational activities for young children, and establishing a center that could support NSSIB psychotherapy and/or drug treatment of NSSIB (+) cases.

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