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## Forensic Characteristics of Suicide by Electrocutation in Bulgaria

**ABSTRACT:** Suicides by electrocution (SE) are relatively rare and insufficiently studied. The purpose of this study is to present a more detailed picture of SE in Bulgaria. Forensic medical files of 59 SE cases were examined. *SPSS* 11.0 software was applied to produce the descriptive statistical analyses. Values of  $p < 0.05$  were assumed to be statistically significant. We studied 59 SE cases, which account for 6.24% of all deaths by electrocution and 0.09% of all forensic autopsies. The average age of victims was 45.19 years old. Males prevailed: 91.53%. Children below 18 years old accounted for 3.39%. 42.37% of the victims applied low voltage (<220 V), and 33.99% applied high voltage (>220 V). The preferred method of SE was by direct contact victim/electrical cable: 47.45%. The summer months June through September account for 49.15% of all cases.

**KEYWORDS:** forensic science, forensic pathology, forensic epidemiology, electrocution, suicides, Bulgaria

Suicides have reached an almost epidemic range nowadays, thus turning into a significant public and health issue. The U.S.A. report an annual number of 30,000 cases of suicide, a fact that proves the problem is really urgent (1,2). The most commonly used methods to accomplish this act of self-directed aggression are “firearm injuries, hanging, and drug overdose” (1,2). Cases of suicide by electrocution (SE) are relatively rare and not sufficiently studied. This prompted us to undertake this study.

The purpose of this study is to present a more detailed picture of SEs in Bulgaria.

### Materials and Methods

The study was conducted in eight districts of the Republic of Bulgaria and covers a period of 41 years (1965–2006); 945 cases of death caused by electricity were identified, out of which 59 were cases of electrocution suicide (autopsy reports). The forensic medical files of the cases were studied for the purposes of this study. *SPSS* 12.0.1 software (SPSS Inc., Chicago, IL) was applied to produce the descriptive statistical analyses. Values of  $p < 0.05$  were assumed to be statistically significant. To build a linear trend, we used the statistical method of the smallest squares, which is provided in the statistical functions menu of Microsoft Excel software (Microsoft XP<sup>®</sup>, Microsoft Corp., Redmond, WA).

### Results

Our material of 59 SE cases makes up  $6.24 \pm 1.54\%$  (cases over the studied period) of all electrocution deaths ( $n = 945$ ) or  $0.09 \pm 0.02\%$  of all forensic autopsies ( $n = 63\ 825$ ).

These cases are distributed rather unevenly through the studied period. There are two peaks at the beginning and at the end of the period, respectively, and their linear trend takes the shape of an almost horizontal line (Fig. 1).

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The average age of the victims is  $45.19 \pm 6.04$  years ( $n = 59$ ;  $SD = 16.59$ , range 14 to 75 years), for males it is  $45.17 \pm 6.04$  years ( $n = 54$ ;  $SD = 16.59$ , range 17 to 75 years), and for females it is  $45.4 \pm 6.07$  years ( $n = 5$ ;  $SD = 16.66$ , range 14 to 66 years) with a negligible difference ( $t = 0.03$ ;  $p > 0.05$ ). To specify the most risky age periods in observance of the WHO requirements we divided the cases into eight groups (Fig. 2). The results show that there are no SE cases in Group I (below 1 year old), VII (76 to 90 years old), and Group VIII (above 90 years old). The greatest number of cases is observed in Group IV (25 to 44 years old):  $33.89 \pm 12.06\%$  ( $n = 20$ ); and Group III (15 to 24 years old) accounts for the smallest number of cases:  $13.55 \pm 8.73\%$  ( $n = 8$ ) with statistically insignificant difference ( $t = 1.24$ ;  $p > 0.05$ ). In Group V (45 to 59 years old), the cases are  $25.42 \pm 11.11\%$  ( $n = 15$ ), which makes as many as in Group VI (60 to 75 years old,  $n = 15$ ). The difference in the relative share between Group IV and Group V is also insignificant ( $t = 0.55$ ;  $p > 0.05$ ). Thus, the analysis shows that the age period of highest risk to commit a suicide is between 15 and 75 years old.

Males prevail definitely ( $91.53 \pm 7.1\%$ ;  $n = 54$ ) over females ( $8.47 \pm 7.1\%$ ;  $n = 5$ ) by a significant difference ( $t = 6.38$ ;  $p < 0.001$ ). The females/males ratio is 1:10.8. Children below 18 years old represent a relatively small share:  $3.39 \pm 4.61\%$  ( $n = 2$ ). With regard to voltage applied,  $42.37 \pm 12.61\%$  ( $n = 25$ ) victims chose low voltage (<220 V),  $33.99 \pm 12.08\%$  ( $n = 20$ ) chose high voltage (>220 V) with insignificant variations ( $t = 0.58$ ;  $p > 0.05$ ). We were unable to establish with certainty the type of voltage in  $23.73 \pm 10.85\%$  ( $n = 14$ ) of the cases studied. The most preferred method of SE is through contact between the victim and an electrical cable:  $47.45 \pm 12.74\%$  ( $n = 28$ ); the difference in the relative share when compared with cases of climbing up and touching a long-distance high voltage power transmission line is  $13.56 \pm 8.73\%$  ( $n = 8$ ), which is statistically significant ( $t = 2.2$ ;  $p < 0.002$ ). Third are rated the cases of climbing up a pole and making contact with a live wire of a street power line:  $11.64 \pm 8.18\%$  ( $n = 7$ ). SE cases by contact with a power transformer  $3.38 \pm 4.61\%$  ( $n = 2$ ) are much rarer; cases of SE by touching overhead railway wires are incidental:  $1.69 \pm 3.28\%$  ( $n = 1$ ); and there is a single case of SE by using a specially constructed device:  $1.69 \pm 3.28\%$  ( $n = 1$ ) (Fig. 3).

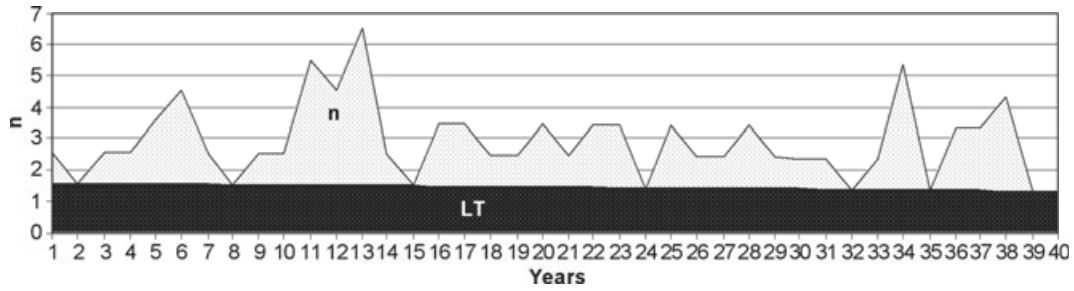


FIG. 1—Distribution of the number of cases (n) and their linear trend (LT) through the studied period.

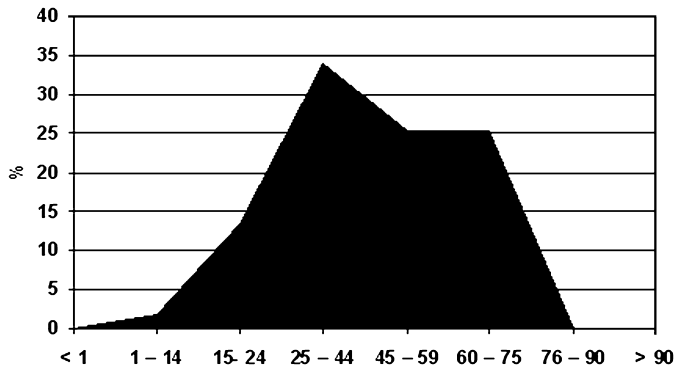


FIG. 2—Distribution of the relative share of the cases per age periods.

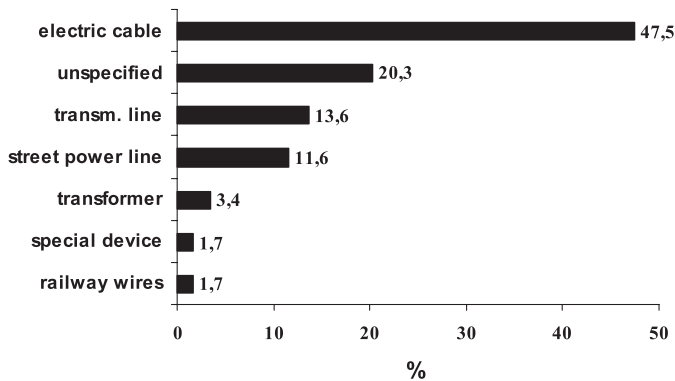


FIG. 3—Methods of suicide by electrocution: victims' relative share.

To look for a cyclic pattern in SE, we studied two cycles: a 7-day weekly cycle and a 12-month annual cycle.

As Fig. 4 shows, the relative share of SE increases from Monday to Thursday when a peak of 25% is reached for all cases followed by a smooth decrease thereafter.

When considering the distribution of cases over the 12 months of the year (Fig. 5), we find out that the smallest number of cases occur in December ( $n = 2$ ), and the largest number of cases is observed in September ( $n = 13$ ).

The typical summer months from June to September account for  $49.15 \pm 12.75\%$  ( $n = 29$ ) of the cases.

**Discussion**

The cases of SE are very rare (3) and are usually described as incidental or casuistical (3–7). Our previous studies (8,9) revealed an average incidence of 0.09 per 100,000 population per year.

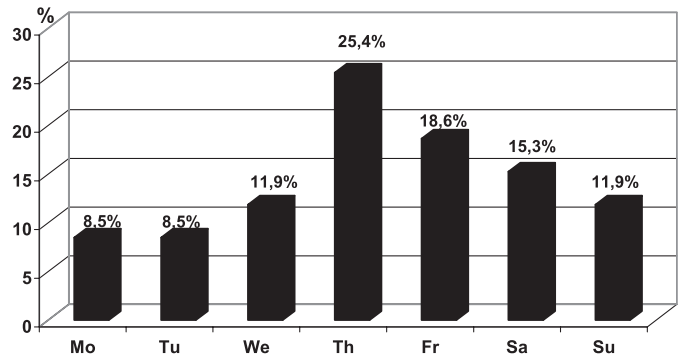


FIG. 4—Patterns in the relative share of SE over a 7-day weekly cycle.

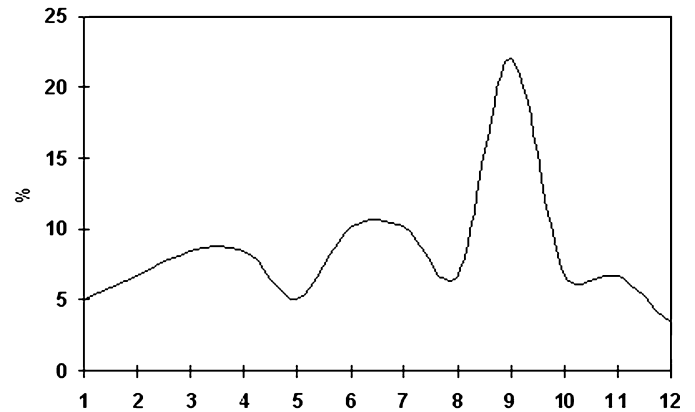


FIG. 5—Distribution of the relative share of the SE cases per months of year.

There is very little research carried out on the forensic epidemiology of this problem. The incidence, according to different studies, varies within a rather wide range. Out of all autopsies of electrocution victims, SE cases account for 0.65% (6) to 29% (10), and out of all forensic autopsies SEs are within 0.04% (11), 0.15% (12), and 1.98% (6). The results obtained by us fall into the outlined range of the said studies and coincide with previous studies of ours (8,9). SEs occur in all age groups (3,12) which is confirmed by our study with the exception of the age group above 76 years old, where we did not ascertain any SE cases. General studies of suicide carried out without consideration as to the method of suicide identify the highest relative share to be within the range of 31 to 40 years old (24.5%) (1), whereas our study specifies that the age group most affected by SE falls within the range between 25 and 44 years old: 33.89%.

All researchers are unanimous on males prevailing over females in SE. The relative share ranges between 66.66% (12) and 85.71% (10). Our results (91.53%) go beyond this range. In contrast to adult electrical deaths, high-voltage electrocutions, suicides, and workplace deaths are uncommon (11). In children and adolescents, according to some authors, “hanging (48%) was the most common method of suicide, followed by firearms deaths (13%), poisoning (10%), drowning (10%), and blunt force vehicular trauma (10%)” (13); and according to others, “hangings (46%), gunshot wounds (13%), five train overrun deaths (10%), four drug overdoses (8%), four jumping deaths (8%), three self immolations (6%), three carbon-monoxide inhalations (6%), and one electrocution (2%)” (11). The cases of SE among children below 18 years old occupy a small relative share in our study: 3.39%.

The methods of committing a SE in adults are not sufficiently studied. Occasional cases mention the use of specially constructed devices for SE (5) which we found in only 1.69%. Unlike some general studies unconcerned with the method of suicide, which establish that the greatest number of suicides occurs in July and the smallest in December (1), we have registered an increased number of SEs during the summer months, the peak being in September.

### Conclusions

SE incidence accounts for 6.24% of all deaths caused by electrocution, or 0.09% of all forensic autopsies. The victims' average age is 45.19 years old with a marked prevalence of males (91.53%). The victims' relative share is the highest in the age group of 25 to 44 years old: 33.89%. The preferred method of SE is by contact between the victim and an electrical cable: 47.45%. The typical summer months from June to September account for 49.15% of the cases.

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