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A Study Among the Population of Sevilla of Death due to Submersion

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Death due to submersion is of great interest from the medical-legal point of view, given the increase in nautical activity among children and adults alike over the past number of years. However, the lack of reliable statistical data concerning the impact of this specific form of death in our country must be emphasized. These are the circumstances that have led us to study the incidence of this form of death in a specific area. The population analyzed lived in the city of Sevilla during the period 1967–1993.

Key Words: Drowning—Pathology—Biology—Homicide—Suicide—Accident.

Death due to submersion is of great interest from the medical-legal point of view, given the increase in nautical activity among children and adults alike over the past number of years. It is estimated that 150,000 persons die all over the world in this manner every year. This figure represents an average of ~400 persons per day (1). Drowning is in third place as a cause of accidental death among children up to the age of 5 (2). On the other hand, the increase or decrease in the incidence of this form of death over a year is closely related to climate, time of year, and geographic zone. Studies carried out by various authors confirm that the majority of these deaths occur during the hottest months of the year when people engage in water sports most frequently (3–8).

In like manner, the lack of reliable statistical data concerning the impact of this specific form of death in our country must be emphasized. The extrapolation of data from studies dealing with violent death in specific areas of Spain has been our only source of complete information up to now. These are the circumstances that have led us to study the incidence of this form of death in an area such as the city of Sevilla over a period of 27 years, from 1967 to 1993. The city of Sevilla is in the Southwest of Spain. It has a population of 704,857 inhabitants. The temperature may reach 44°C, and as a result the use of the large number of swimming pools in the city is extensive. Water sports in the Guadalquivir river are also more popular during the warmer months.

MATERIALS AND METHODS

The basic information employed for this study was obtained from the registration books of the Institute of Forensic Medicine in Sevilla. This infor-

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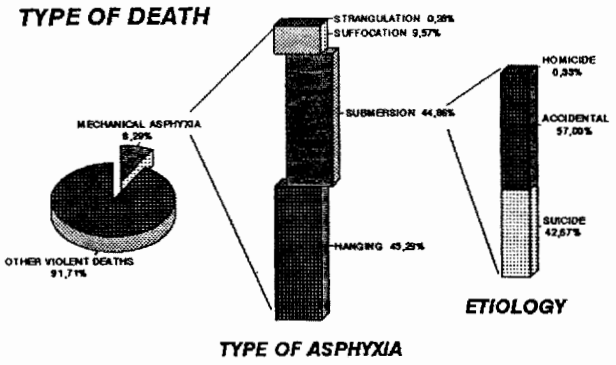

FIG. 1. Incidence of different types of mechanical asphyxia in the city of Sevilla during the period 1967–1993.

mation concerns the corpses that have been subjected to autopsy (name, age, sex, as well as other background information and the medical-legal etiology and cause or manner of death).

RESULTS AND DISCUSSION

During the period of time between 1967 and 1993 a total of 11,655 autopsies were carried out. Of these autopsies, 8,447 (72.47%) corresponded to violent deaths while 3,208 (27.52%) corresponded to natural deaths. Of all the violent deaths, 700 (8.29%) were the result of mechanical asphyxia. Of these 700 deaths, 314 were caused by submersion asphyxia, which represents 3.75% of all violent deaths and 44.86% of all deaths caused by mechanical asphyxia. The figure of 44.86% places asphyxia by submersion along with hanging (45.29%) at the top of the incidence list for the different kinds of mechanical asphyxia that were registered over the period studied (Fig. 1).

The general decline in the number of deaths due

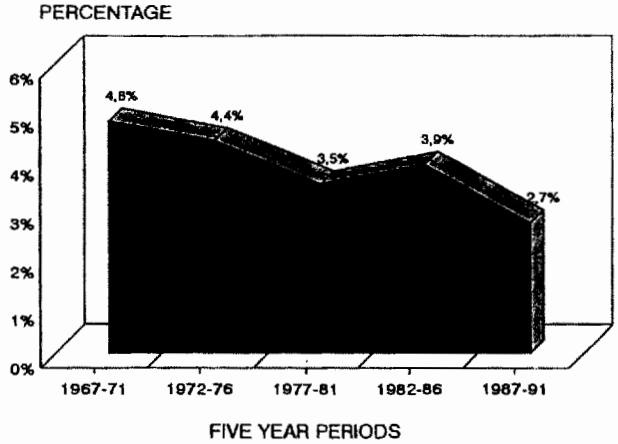

FIG. 2. Death due to submersion in relation to the total number of violent deaths in the city of Sevilla during the period 1967–1993.

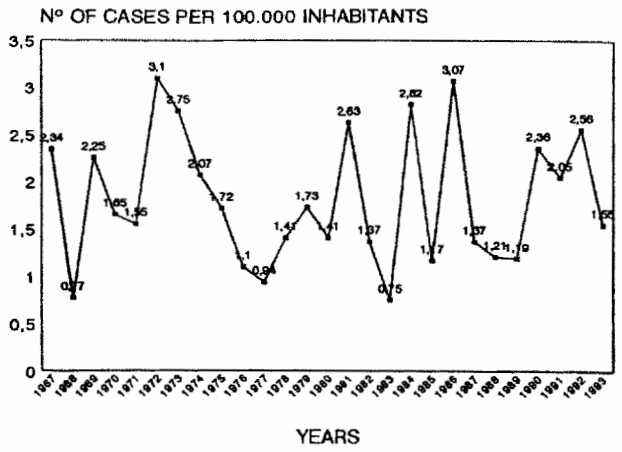

FIG. 3. Variation in the death rate due to drowning in the city of Sevilla during the period 1967–1993.

to submersion over the period studied (1967–1993) in relation to the total number of violent deaths (Fig. 2) stands out. It must be pointed out that in this respect, the maximum percentage of 4.83% was obtained between 1967 and 1971, while the lowest percentage was detected between 1987 and 1991 (2.66%). In like manner, the death rate due to submersion per 100,000 inhabitants (Fig. 3) fluctuated between a maximum of 3.10 in 1972 and a minimum of 0.75 in 1983, the resulting average for deaths due to submersion for the whole period of time studied being 1.81 per 100,000 inhabitants. This last value, as can be seen in Table 1, is considered one of the lowest rates of all those compiled, similar to those obtained in the studies carried out by Hedberg et al. (3) and O'Carroll et al. (9) in Minnesota (U.S.A.) and Los Angeles (U.S.A.), respectively, and appreciably greater than the rate obtained by Bierens et al. (10) in Holland.

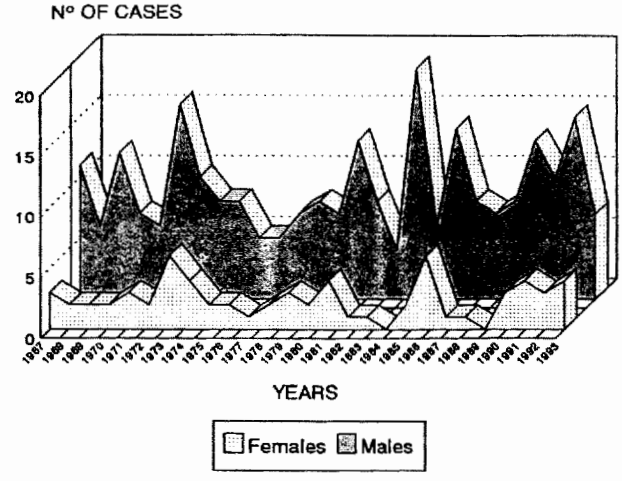

FIG. 4. Distribution of deaths due to submersion according to sex.

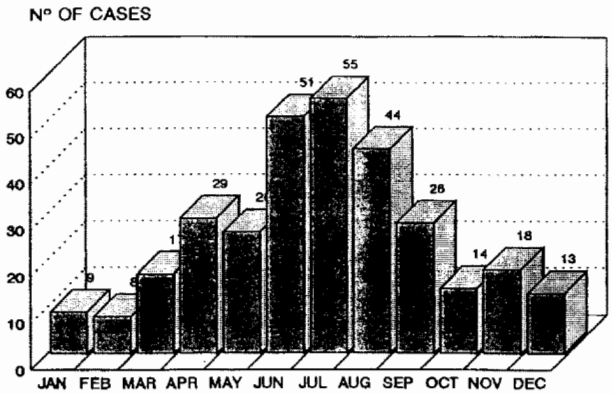

FIG. 5. Incidence of death due to submersion for each month of the year.

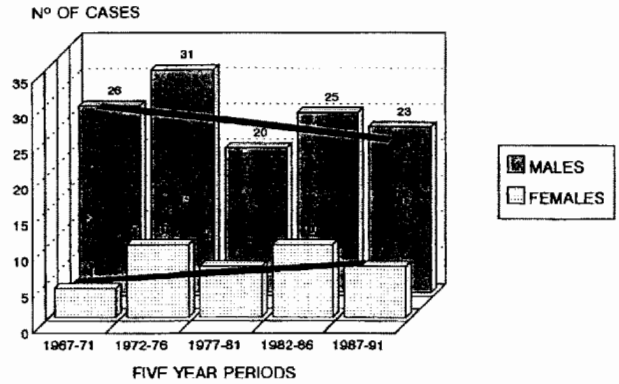

FIG. 7. Submersion of accidental etiology: distribution according to sex and 5-year periods.

During the period 1967 to 1993 the distribution of deaths due to drowning according to sex was: 248 males (78.98%) and 66 females (21.01%), which is the equivalent of one female for every 3.75 males (Fig. 4). This proportion is similar to the 4.16 males for every female obtained by Wintemute et al. (11) in the county of Sacramento, California (U.S.A.), during the period 1974 to 1985. Other observations yield the following results: 2.31 males for every female in Denmark for the period 1987–1989 (8); 2.47 males for every female in the county of Los Angeles for the period 1976–1984 (9); 4.76 males for every female in Cape Town (South Africa) for the period 1980–1983 (4), and 5.3 males for every female in Minnesota for the period 1980–1985 (3).

Many authors point out that the increase or decrease in the incidence of this form of death over a year is closely related to the time of year, climatological factors, geographic zone where these deaths occur, etc. In this respect, studies carried out

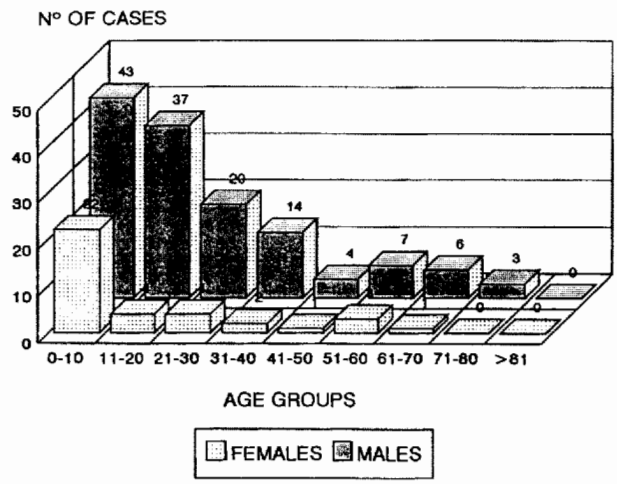

FIG. 6. Submersion of accidental etiology: distribution according to sex and age groups.

confirm that the majority of deaths take place during the hottest months of the year, when water sports are at their most popular (3–8,10). This observation is also applicable to our study (Fig. 5), in which the greatest number of cases of death due to submersion were registered during the months of June, July, and August. Of all deaths due to submersion, during the total period of time studied 48.06% took place in these 3 months.

With regard to the medical-legal etiology, three possibilities are traditionally considered: accidental submersion, suicide, and homicide, although the latter form of death is of little statistical importance. Accidental submersion is the most common cause of death. In this respect, such authors as Giersten (12), Derobert (13), Copeland (14), and Wintemute et al. (11) give figures of somewhere between 80% and 90% of the total number of submersions. However, there may be variations depending on the geographic zone where sampling has taken place.

During the study of the incidence of this particular type of death in the city of Sevilla, it was confirmed that 57% of all submersions were accidental, with a proportion of 3.6 males to every female. Of the victims, 61.9% were under the age of 20 (Fig. 6). This percentage is similar to those given by O'Carroll et al. (9), Shepherd (2), Bierens et al. (10), Shaw and Briede (15), and Hedberg et al. (3) in their studies. The incidence of accidental deaths due to submersion during the different 5-year periods studied is reproduced in Fig. 7. Special note must be taken of the slight increase in the number of female deaths, in contrast to the slight decrease in the number of deaths due to asphyxia by submersion among males over the period analyzed.

On the other hand, of the total number of deaths due to submersion, between 9.1% (10) and 33% (16) were of suicidal etiology (depending on the

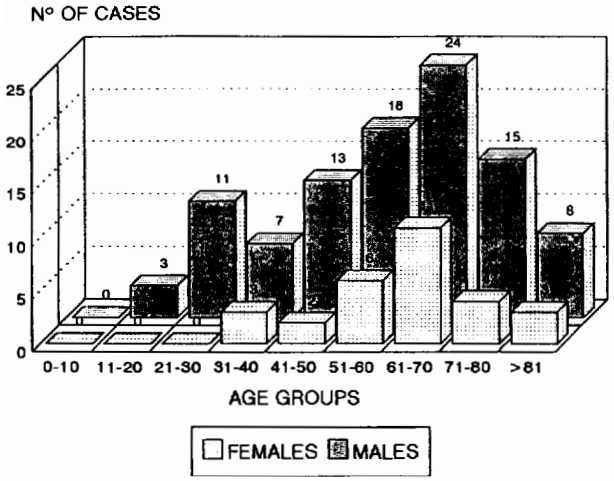

FIG. 8. Submersion of suicidal etiology: distribution according to sex and age groups.

area of population studied). In the study carried out in the city of Sevilla, this percentage rose to 42.67% with a proportion of 3.4 males for every female. When asphyxia by submersion in Sevilla is compared with other forms of suicide, it can be seen that it was in fourth place (10.13%) according to a study we carried out in this city during the period 1978–1987 (17,18)—lagging behind falls from heights (39.16%), hanging (16.89%), and ingestion of toxic products (15.70%). When the proportion of 10.13% was compared with the percentages obtained for other regions, it could be seen that this percentage of deaths due to suicidal submersion in relation to the total number of suicides registered in the city of Sevilla was higher than the 8.9% determined by Avis (19) in Newfoundland (Canada), the 7.9% obtained by Auer (20) in the province of Uusimaa (Finland), or the 4.5% found by Copeland (14) in Florida (U.S.A.).

When suicidal submersion is analyzed according to the sex of the victims, clear differences are observed between the results for males and females. In the case of females, drownings of this nature reached the proportion of 22.65% of all suicidal submersions. This percentage is very similar to the 20% obtained by Rodes et al. (21) in the districts of Elda and Villena (Spain) and is significantly lower than the 41.4% and 36.36% obtained by Copeland (14) in Florida and by Avis (19) in Newfoundland, respectively. With regard to males, suicidal submersion reached the proportion of 77.34% of all submersions of this etiology. This is similar to the 80% obtained in the districts of Elda and Villena (21) and appreciably more than the 58.6% and 63.63% obtained in Miami (14) and Newfoundland (19), respectively. When the distribution of suicides due to drowning is analyzed according to both the sex and the age of the victims (Fig. 8), it can be seen that this form of suicide was employed mainly by older males and females.

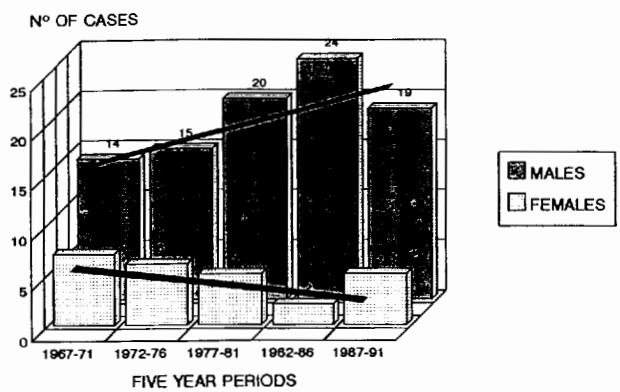

FIG. 9. Submersion of suicidal etiology: distribution according to sex and 5-year periods.

TABLE 1. *Death rate due to submersion asphyxia per 100,000 inhabitants*

Country	Rate/100,000 inhab.	Authors
JAPAN	900	[12]
AUSTRALIA	5-6	[1]
SOUTH AFRICA		
Cape Town (*)	32,3	[4]
Cape Town (•)	13,4	[4]
Cape Town (¥)	24,2	[4]
USA	2,5	[15]
Minnesota	2,1	[3]
Los Angeles	2,36	[9]
Sacramento	4,5	[11]
Georgia	3,2	[23]
New Mexico	4,3	[24]
North Carolina	3,2	[25]
NORWAY	6	[12]
GREAT BRITAIN	4-5	[1]
HOLLAND	1	[10]
DENMARK	4,2	[8]
SPAIN		
Sevilla	1,81	This study

*Black, •White, ¥ Other races

On the other hand, it must be pointed out that homicidal submersion is quite uncommon, given the difficulties this form of murder entails when the victim is an adult, unless the latter is first weakened by other means. In the study carried out, only one case of homicide was found—a girl aged 6. This case represented 0.33% of all deaths due to submersion, a far smaller percentage compared with the 1% and 2.3% obtained by Wintemute et al. (11) and Copeland (22) in the county of Sacramento and Florida, respectively.

Finally, the incidence of deaths due to suicidal drowning according to the sex of victims during the different 5-year periods that have been studied is reproduced in Fig. 9. Special note must be taken

of the upward trend in this form of suicide among males during the period analyzed (1967–1993), except for the last 5-year period (1987–1991) as well as the decline during the same period of time (1967–1986) among females.

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