

## Human fatalities caused by wasp and bee stings in Sweden

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**Summary.** Bee and wasp stings represent an uncommon cause of death. In a retrospective study of all fatalities due to venomous animals in Sweden during a 10-year-period, we found 19 fatalities due to wasps, 1 due to bees but none due to snake bite. This gives an annual incidence of 0.2 per million inhabitants. Most of the deceased were older than 50 years and had an underlying cardiovascular disease while previous severe reactions after insect stings were uncommon. The number of stings was not a factor of importance. Symptoms and death occurred within minutes after the sting. The autopsy findings were in most cases non-specific. Although uncommon, the possibility of a fatal insect sting should be considered in unwitnessed deaths occurring outdoors in summertime.

**Key words:** Fatalities – Insect stings – Venomous animals – Epidemiology

**Zusammenfassung.** Stiche durch Bienen und Wespen stellen eine ungewöhnliche Todesursache dar. In einer Retrospektivstudie über sämtliche tödlich verlaufende Unglücksfälle durch giftige Tiere in Schweden über einen 10-Jahreszeitraum fanden wir 19 Todesfälle durch Wespen, einen durch Bienen, jedoch keinen durch Schlangenbiß. Dieses ergibt eine jährliche Häufigkeit von 0,2 auf eine Million Einwohner. Die meisten der Verstorbenen waren älter als 50 Jahre und hatten als Grundkrankheit eine Erkrankung des kardiovaskulären Systems, während vorhergehende schwere Reaktionen nach Insektenstichen ungewöhnlich waren. Die Zahl der Stiche war kein bedeutender Faktor. Die Symptome und der Tod traten innerhalb von Minuten nach dem Stich ein. Die Obduktionsbefunde waren in den meisten Fällen unspezifisch. Wenn dies auch ungewöhnlich ist, so sollte die Möglichkeit eines tödlichen Insektenstiches bei Todesfällen außerhalb des Hauses und in der Sommerzeit, welche sich unbeobachtet ereigneten, in Betracht gezogen werden.

**Schlüsselwörter:** Todesfälle – Insektenstiche – giftige Tiere – Epidemiologie

### Introduction

In Scandinavia, there are very few toxic animals. Among the venomous snakes, only the viper (*Vipera berus* L.) exists in Sweden. Among the insects, bees (*Apis mellifica* L.) and wasps (*Vespa spec.*) have the most potent venom. Ticks (*Ixodes persulcatus* L.) are common in the southern parts of Scandinavia and may transmit *Borrelia* infections as well as tick-borne encephalitis, but are not poisonous themselves.

The aim of the present study was to characterize the human fatalities due to venomous animals. The study is a part of a larger study on human fatalities caused by animals in Sweden.

### Materials and methods

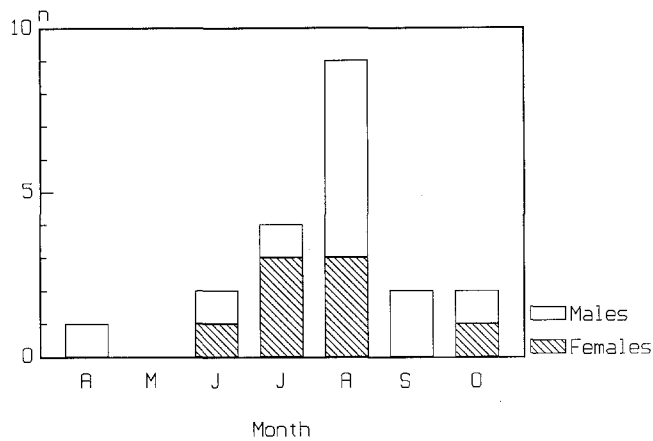
During the years 1975–1984, 22 deaths were registered in Sweden with the external cause of injury code E905 [1], i.e. deaths related to venomous animals (and plants). Death certificates in these cases were supplied by the National Central Bureau of Statistics. Based on data from the death certificates, further information was collected from medical and police records as well as protocols of clinical and medicolegal autopsies.

In one case the death of a chronic alcoholic with coronary atherosclerosis was possibly – but not probably – related to a tick bite with terminal sepsis. This individual as well as an old woman who died after a wasp sting but where no further information could be traced, was excluded from further analysis. In the remaining 20 cases, all fatalities were due to bee or wasp stings. No fatalities caused by snakes or other venomous animals were found.

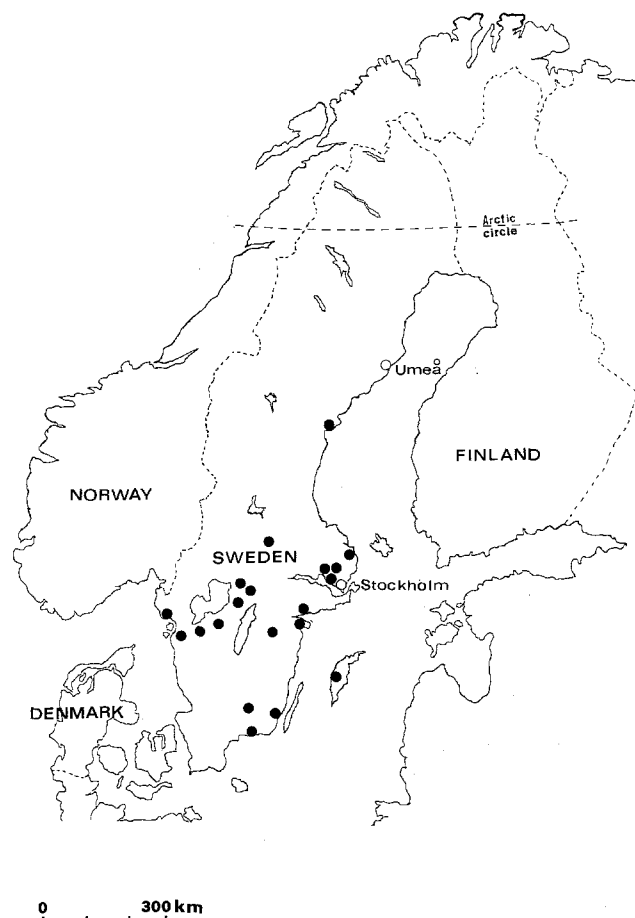
### Results

All deaths occurred during the warm period of the year, i.e. April to October, with a maximum incidence in August (Fig. 1). There were no obvious variations in incidence by year or by day of the week (data not shown). Almost all fatalities occurred in the southern part of Sweden (Fig. 2). The insects were stated to be a bee in one case and wasps in the remaining 19 fatalities.

Of the total number of 20 deaths, 12 were males, 8 were females and all were adults. Most individuals were older than 50 years of age with an average age of 61 years (range 37–79 years).



**Fig. 1.** Monthly distribution of fatalities caused by wasp and bee stings (n) in Sweden



**Fig. 2.** Geographical localization of fatalities caused by wasp and bee stings in Sweden

In 8 individuals, an underlying disease affecting the cardiovascular and/or the respiratory system was present. One additional individual had severe skeletal deformities with pectus excavatus as a result of rickets. An autopsy was performed in only 12 cases (9 medicolegal and 3 clinical autopsies) and revealed that 4 more individuals suffered from coronary artery disease and 1 from a coronary artery anomaly. Thus, at least 13 victims suffered from a pre-existing somatic disease.

Furthermore, 3 individuals had experienced an earlier episode with allergic or toxic reactions after bee or wasp stings but had no history of heart disease. One of these 3 individuals had a post mortem blood alcohol concentration of 2.1 g/l.

At least 5 individuals had multiple stings while at least 9 had only 1 sting. In the remaining cases, the number of stings was unknown. (The locations of the stings are shown in Table 1).

In all cases the first symptoms occurred within minutes after the sting(s) and in most cases death followed within 15–60 min. In 4 cases, initial cardiopulmonary resuscitation was successful but was followed by irreversible brain damage and death within a few days.

The autopsies revealed no specific findings. Laryngeal edema was present in 3 cases and was considered as the immediate cause of death in 1 of these. In most cases, the location of the stings was difficult to detect and in only 1 case a sting track was histologically demonstrated post mortem. Sting marks or probable sting marks were described at autopsy in 7 of the 12 cases.

Radio allerge sorbent test (RAST) was performed post mortem in two cases but IgE specific to bee and wasp venom could not be detected. In 1 of these individuals, however, the serum level of histamine was raised more than 50-fold (to 55 ng/l) over the reference level in living persons (0–0.5 ng/l).

## Discussion

### Epidemiology

A total number of 20 deaths related to bee and wasp stings was included in this study, which gives an annual incidence of 0.24 per million, in an average population of 8.2 million. Death due to venomous animals is thus a fairly uncommon cause of unnatural death in Sweden, compared to fatalities where other animals are involved, e.g. in riding and handling cattle [2] or collisions between motor vehicles and animals [3]. A similar low incidence has been reported from the United States [4, 5], Denmark [6] and South Australia [7], while Finland, situated close to Sweden, has an annual incidence of only 0.07 per million [8]. This difference can, however, be explained by the more northerly geographical position of Finland. As can be seen in Fig. 2, the number of fatalities in the northern part of Sweden is lower than in Sweden as a whole. A slightly warmer climate and a larger population of bees and wasps in southern Sweden may contribute to this finding, but it should also be remembered that the majority of the population lives here.

The highest incidence occurred in August, which is not surprising, as the population of bees and wasps in Sweden is largest in the late summer and outdoor activities have not yet decreased. A similar seasonal distribution has been described in Denmark [6] and in the United States [4, 5].

There was an over-representation of male victims, which is in line with results from other investigators [4–6, 7, 9, 10]. Furthermore, no children were found in our material and most victims were older than 40 years,

**Table 1.** Fatalities caused by bee and wasp stings. Clinical and autopsy data of all 20 recorded cases in Sweden 1975–1984

Case no	Age/sex	Previous reaction after insect sting	Clinical data	Autopsy findings	No of stings	Time interval sting/death (min)	Insect	Location of sting
1	63, M		Hypertension	Pulmonary edema	1	< 15	wasp	neck
2	72, M			Coronary atherosclerosis, laryngeal edema		< 15	wasp	
3	58, M			Occlusive laryngeal edema, coronary artery anomaly, cardiac hypertrophy	> 1	< 15	wasp	arm, hand, neck
4	71, F		Hypertension	Coronary atherosclerosis	> 1	< 15	wasp	arm
5	64, F			Sequelae after pneumonia	> 1	< 15	wasp	arm
6	51, M		Hypertension, asthma in youth	Total brain infarction, bronchopneumonia, coronary atherosclerosis	1	Days <sup>a</sup> (ICU-care)	wasp	head
7	62, M			Cardiac hypertrophy, myocardial fibrosis, coronary atherosclerosis	?	Days <sup>a</sup> (ICU-care)	wasp	
8	64, M		Severe skeletal deformities after rickets	Abdominal aortic aneurysm	?	< 15	wasp	
9	44, M			(No autopsy)	> 1	< 15	wasp	face, upper extremities
10	68, F	Seizures		(No autopsy)	?	< 15	wasp	face
11	55, F		Chronic asthmatic bronchitis	(No autopsy)	1	< 15	wasp	mouth
12	79, F		Diabetes mellitus Type II, asthma, hypertension	(No autopsy)	?	< 15	wasp	?
13	73, F	Quincke reaction		(No autopsy)	1	Days <sup>a</sup> (ICU-care)	wasp	hand
14	63, F		“Cardiac disease”	(No autopsy)	> 1	< 15	bee	lower extremities
15	69, M		Previous myocardial infarction, coronary atherosclerosis, RBB-block	(No autopsy)	?	< 15	wasp	?
16	37, M			Total brain infarction	?	Days <sup>a</sup> (ICU-care)	wasp	?
17	50, M	“Serious reaction”		Postmortem blood alcohol concentration 2.1 g/l	1	?	wasp	lower lip
18	54, M		Hypertension	(No autopsy)	?	< 15	wasp	foot
19	74, M			Coronary atherosclerosis	1	< 15	wasp	hand
20	56, M			Coronary atherosclerosis	1	< 15	wasp	hand
Σ		3					19 wasps 1 bee	

<sup>a</sup> Symptoms and circulatory collapse within minutes after the sting(s)

which agrees with previous studies where few or no children and adolescents were found [6, 9, 10]. However, other investigators have described a two-peak incidence curve; the first peak during the first 5 years of life and the other peak after 40–50 years of age [4, 5, 7].

### Insects

In 19 of the 20 cases, wasps were reported to be the inflicting insect. Although it may be difficult for the layman to differentiate between wasps and bees, there was no doubt of the type of insect in one case (Case 14,

Table 1) where a bee keeper was stung. It may be speculated that the domination of wasps reflects their more aggressive behaviour or is due to the differences in venom composition [cf 11]. On the other hand, it has been reported that bees predominate and in the United States cause most deaths due to venomous animals [4, 5].

### Pre-existing disease

In our material almost all individuals were older than 50 years. A higher incidence of somatic disease in this age

group may have contributed to the fatal outcome. At least 13 individuals had a disease affecting the cardiovascular and/or the respiratory system and thus probably had a reduced tolerance to hypoxemia and hypotension. As autopsies were not performed in all cases, the incidence of underlying disease may have been even higher.

#### *Number and location of stings*

The number of stings did not appear to be a factor of major importance. At least 9 individuals died after only 1 single sting. In 2 of these cases, the sting was located in the mouth and the lip, and the subsequent edema may have contributed to airway obstruction. Most victims were stung on the upper extremities, neck or head. Even though it cannot be ruled out that stings in these areas are more likely to cause severe reactions, this finding is more probably simply a reflection of the fact that these areas are often not protected by clothing.

#### *Time interval between sting and death*

Bee and wasp venom causes symptoms very soon after the sting and, in unfavourable cases, loss of consciousness and circulatory collapse follows soon after the initial symptoms [6, 12]. This pattern differs from that of snake bites where death is uncommon within the first hour [4, 5]. Thus, rapid resuscitative procedures are necessary or the patient may suffer irreversible brain damage within minutes. Some of the patients in our series were rapidly admitted to hospital after the sting and circulation was restored, but in spite of this irreversible anoxic brain damage followed.

#### *Pathology and cause of death*

In many cases the locations of the stings were difficult to detect post mortem. This may reflect the short time interval between sting and death, and thus too short a time for local signs to develop macroscopically. Histological examination of the suspected location of a sting may show a sting track [9, 13] and such an examination was in fact performed in 1 case.

An insect sting may cause death through at least 3 different mechanisms, i.e. through anaphylactic, local and toxic reactions. An anaphylactic or anaphylactoid reaction may in itself be lethal [12, 14] but it is more likely that such a reaction will be fatal in an individual with a pre-existing disease of the cardiovascular or respiratory organs, as present in at least 13 of the individuals studied here. Furthermore, although anaphylactic reactions are more common in young individuals, they are more seldom fatal, which may explain the fact that no children or young adults were found in our material. The patho-anatomic findings in anaphylaxis are often non-specific or even absent, but laryngeal edema, acute pulmonary emphysema and pulmonary congestion with hemorrhages may be seen [cf also 13, 14].

Of the deceased in our material, 15% had a history of sensitivity to insect stings which is in line with the allergy incidence in previous studies of insect stings with fatal

outcome [6, 12]. In 1 of these individuals a high blood alcohol concentration may have contributed to the fatal event. It has also been reported that many individuals dying after insect stings have had 1 or many previous strong reactions to insect stings [9, 10]. Post mortem demonstration of anti-venom-specific IgE has been described [8, 15, 16], but did not seem to have any diagnostic value in the few cases tested in our material. In one case the histamine level was highly increased compared to the reference value.

Another fatal mechanism is suffocation due to severe laryngeal or subcutaneous edema [10]. Massive laryngeal edema was considered as the cause of death in 1 case. Furthermore, a purely toxic reaction may be fatal after massive attacks by insects [15, 17], but no such case was found here. However, survival without treatment has been reported in individuals who have suffered more than 500 bee stings [18]. In the literature, non-fatal cases of coronary thrombosis, myocardial infarction, and cerebral infarction after single bee or wasp stings have also been reported [9, 13, 19–21], but such complications can of course also lead to death. Also myasthenia gravis [22] and connective tissue diseases [23] have been associated with insect stings.

As the autopsy findings are non-specific, with coronary atherosclerosis as the only post mortem finding in many cases, it is obviously of importance to consider the possibility of an insect sting in the investigation of any unwitnessed death that occurs outdoors (or even indoors) in the summer. Although not demonstrated in our study, serological demonstration of appropriate antibody activity may corroborate the diagnosis of a fatal insect sting [16] and may also provide useful additional data in unwitnessed deaths of undetermined cause [15]. A correct diagnosis is especially important from the insurance point of view, as an accidental death may result in disbursement of insurance premiums, while a natural death may not. In this context, it is important to remember that previous severe reactions do not necessarily precede a fatal sting.

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