

# Mortality due to Hymenoptera stings in Costa Rica, 1985–2006

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**ABSTRACT**

**Objective.** To analyze mortality due to Hymenoptera stings in Costa Rica during 1985–2006.

**Methods.** Records of deaths due to Hymenoptera stings in 1985–2006 were retrieved from Instituto Nacional de Estadística y Censos (National Statistics and Census Institute). Mortality rates were calculated on the basis of national population reports, as of 1 July of each year. Information for each case included age, gender, and the province in which the death occurred. In addition, reports of Hymenoptera sting accidents received by the Centro Nacional de Intoxicaciones (National Poison Center, CNI) in 1995–2006 were obtained to assess exposure to these insects.

**Results.** Over the 22-year period analyzed, 52 fatalities due to Hymenoptera stings were recorded. Annual mortality rates varied from 0–1.73 per 1 million inhabitants, with a mean of 0.74 (95% confidence interval: 0.46–0.93). The majority of deaths occurred in males (88.5%), representing a male to female ratio of 7.7:1. A predominance of fatalities was observed in the elderly (50 years of age and older), as well as in children less than 10 years of age. The province with the highest mortality rate was Guanacaste. The CNI documented 1 591 reports of Hymenoptera stings (mostly by bees) in 1995–2006, resulting in an annual average of 133 cases, with only a slight predominance of males over females (1.4:1).

**Conclusions.** Stings by Hymenoptera, mostly by bees, constitute a frequent occurrence in Costa Rica that can be life-threatening in a small proportion of cases, most often in males and the elderly. The annual number of fatalities fluctuated from 0–6, averaging 2.4 deaths per year. Awareness should be raised not only among the general population, but also among health care personnel that should consider this risk in the clinical management of patients stung by Hymenoptera.

**Key words**

Hymenoptera, insect bites and stings/mortality, Costa Rica.

Insects of the order Hymenoptera (ants, bees, wasps, hornets) are fre-

quently involved in accidental stings to humans and animals worldwide. In terms of public health, in Latin America bees constitute a relevant group of stinging insects, both in terms of frequency and clinical severity of cases (1, 2). Accidental exposure to bee venom may be life-threatening due to two different mechanisms: allergic reactions and toxic reactions. In the first situation, individuals that are highly allergic to the venom may develop severe systemic anaphy-

laxis (type I hypersensitivity) from a single sting. In the second situation, a massive bee attack can result in toxic reaction—regardless of a pre-existing allergic condition—caused by the large amount of venom proteins entering the body via hundreds or even thousands of stings.

Massive bee attacks have become a public health concern in the Americas, where severe envenomations in humans and animals have been documented (3–9). The increase in the number of such

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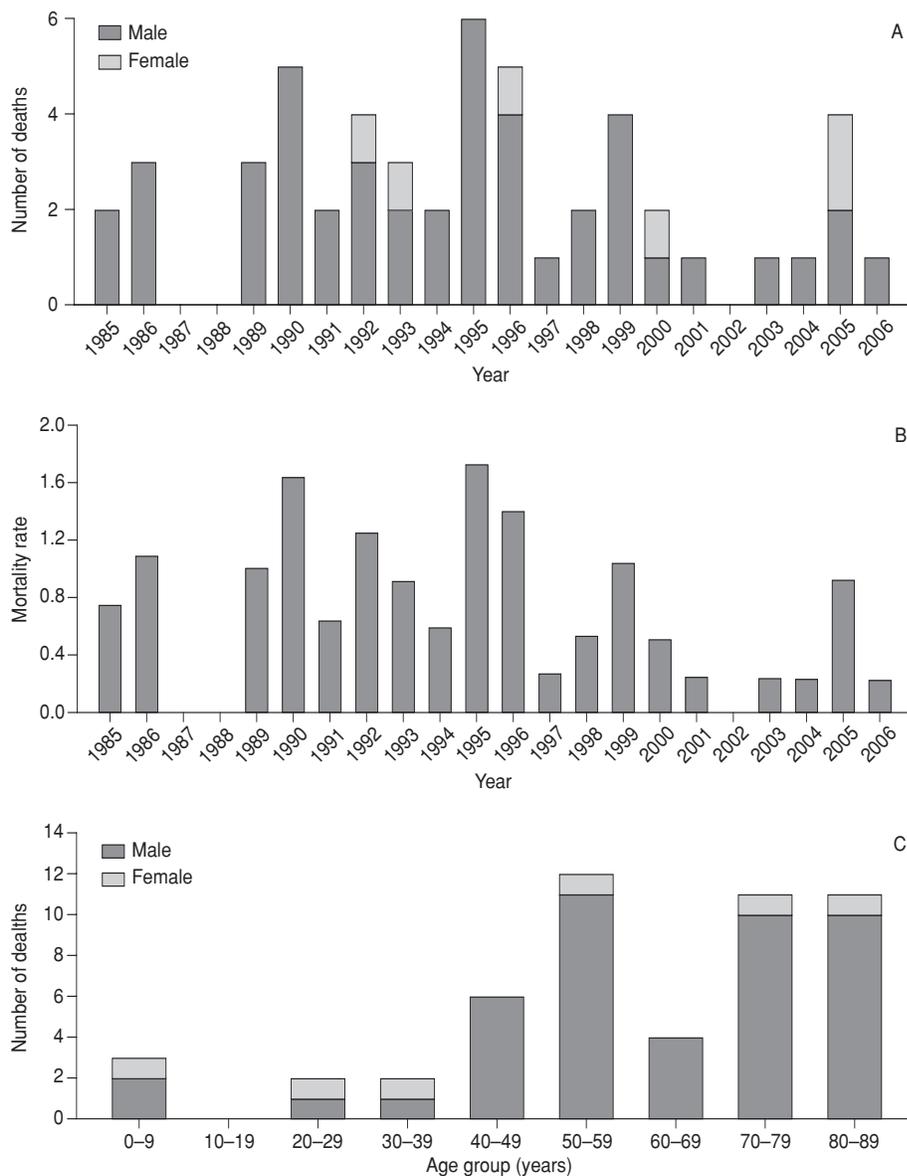
attacks is explained by the spread of the “Africanized” bee, a hybrid that resulted from the interbreeding of the European (*Apis mellifera mellifera*) and African (*A. m. scutellata*) subspecies of honey bees (4). In 1956, the latter were introduced to Brazil in an attempt to increase the commercial production of honey and wax. A year after their arrival, several queens escaped and interbred with the local bee population. Subsequently, the expansion and gradual migration of the hybrids took place, and at present their distribution spans from South America to the southern parts of the United States of America (1, 10). These hybrid bees, popularly known as “killer bees,” have particular features associated with a higher frequency of attacks. They exhibit a strong colony defense behavior characterized by pheromone-coordinated mass attack, high reproductive rates, and lack of discrimination in nesting sites (4).

In Costa Rica, the presence of Africanized bees was first reported in early 1983, in San Isidro de El General (11, 12). In recent years, deaths due to massive bee attacks have been publicized in local newspapers and other nonscientific communication media, suggesting that the number of people affected might be increasing. However, we have not found any reports in the literature analyzing the incidence and outcome of such accidents. Official records of deaths due to stinging by bees, wasps, or hornets are categorized together in epidemiological classifications. Therefore, the aim of the present study was to estimate and to analyze the mortality due to contact with Hymenoptera, as recorded in Costa Rica in 1985–2006, taking into consideration that the vast majority of cases correspond to contact with bees.

## METHODS

Data utilized to estimate the mortality related to Hymenoptera stings in Costa Rica were obtained from the records of the Instituto Nacional de Estadística y Censos (National Statistics and Census Institute, INEC), which tracks all deaths and their causes nationwide. Human accidents involving bees, wasps, and hornets are classified into a single category. However, it is important to note that according to the Centro Nacional de Intoxicaciones (National Poison Center, CNI) of the Caja Costarricense de Seguro

**FIGURES 1A–C.** Mortality due to Hymenoptera stings in Costa Rica, 1985–2006. (1A) number of deaths by gender; (1B) annual mortality rates, per 1 million inhabitants; and (1C) age group distribution of fatal cases, by gender



Social (Social Security Administration of Costa Rica), the vast majority of reports of Hymenoptera stings in this country involve bees (D. Quirós, unpublished data). Thus, although the data collected for this study is strictly referred to as Hymenoptera stings, it is known to correspond mainly to bee stings.

Data obtained from INEC were utilized to retrospectively analyze mortality due to Hymenoptera during a 22-year period (1985–2006). In 1985–1996, fatalities were coded according to the International Classification of Diseases, Ninth

Edition (ICD-9), as the E-code 905.3. Afterwards, in 1997–2006, when the Tenth Edition (ICD-10) was used, the code changed to X23. The information retrieved included age, gender, and province in which the case occurred. Annual mortality rates were calculated on the basis of national population reports, as of 1 July of each year, and were also obtained from INEC.

In addition to the mortality figures, data recorded by the CNI were utilized to retrospectively assess the number of human accidents involving contact with

Hymenoptera, regardless of the outcome. The CNI provides information and advice by telephone regarding the management of diverse types of poisonings, including both chemical intoxications and envenomations by animal bites and stings. Thus, the information retrieved from CNI was routinely acquired by a process involving telephone calls and the completion of a form for every call reporting a case. It should be stressed that this information reflects only the *minimum* number of cases since it is not mandatory to report sting accidents to the CNI. Notwithstanding, these figures were considered worthy of attention given the lack of any other sources tracking this problem in the country. This approach has been utilized in other studies to analyze poisonings; for example, in India (13). In the present study, data on Hymenoptera contact, including age, gender, and province in which the case occurred, over a period of 12 years (1995–2006) were compiled and analyzed.

## RESULTS

Examination of the data retrieved from INEC revealed that in Costa Rica,

52 deaths attributed to Hymenoptera stings were reported in 1985–2006. Thus, an average of 2.4 fatalities occurred annually, reaching a high of 6 deaths in 1995 (Figure 1A). The annual mortality rates showed an irregular pattern, varying from 0–1.73 per 1 million inhabitants (Figure 1B), with a mean of 0.74 (95% confidence interval (95%CI): 0.46–0.93). A predominance of Hymenoptera sting-related fatal cases was observed among the elderly, and occasionally, in children less than 10 years of age (Figure 1C). Regarding geographic distribution, the highest mortality rate was recorded in the province of Guanacaste—a rate six times that of Heredia, which had the lowest (Figure 2).

## ANALYSIS AND DISCUSSION

Epidemiological data on mortality caused by Hymenoptera stings are scarce in the literature. In 1991–2001, there were 533 deaths attributed to hornets, wasps, and bees in the United States (14), representing an annual mortality rate of 0.179 per 1 million inhabitants, nearly four times lower than the average rate observed in Costa Rica (present study).

Mortality rate due to wasps and bees in Sweden was estimated at 0.24 per 1 million inhabitants (15). In the state of São Paulo, Brazil, there were seven deaths due to bee stings in 1993–1998; considering a total of 2 462 accidents recorded, the lethality was 0.3% (6). In these retrospective analyses, as well as in the present work, it was not possible to distinguish between deaths attributed to allergic reactions and those that were envenomings. Studies would be needed to comparatively estimate the relative contribution of each to the overall Hymenoptera sting-related mortality.

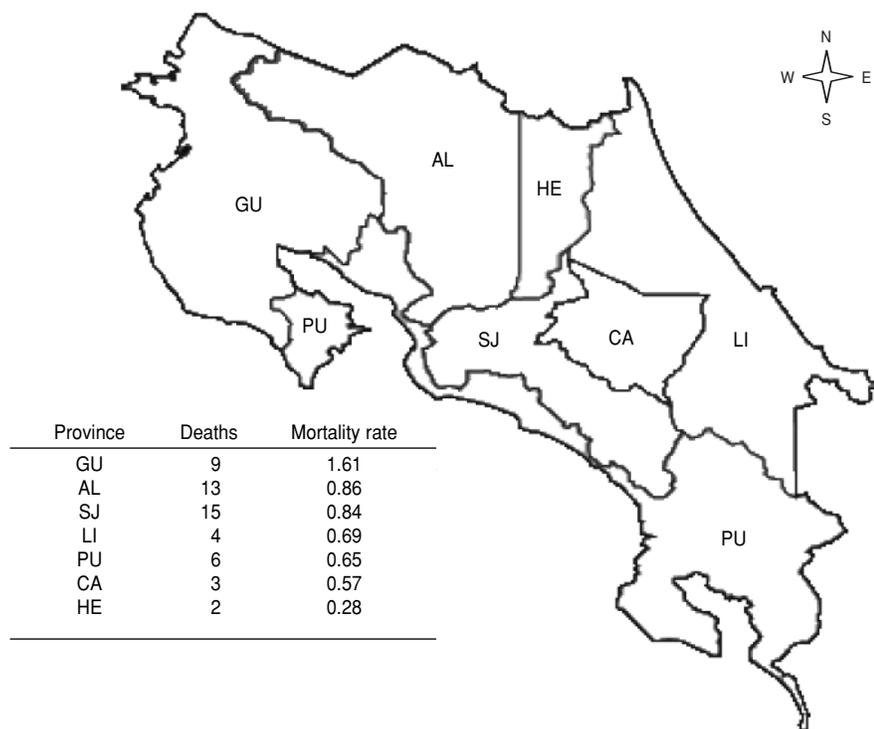
Compared to the first decade of the study period analyzed, the second (1997–2006) saw a reduction in the number of sting-related fatal cases and decline of mortality rates. Interestingly, this reduction occurred in spite of a rise in the number of sting-accident reports during the period (Figures 3A and 3B). This finding could be related to increased public awareness of the Africanized bee threat and to programs implemented by the Ministry of Health that created numerous satellite centers for basic health care (called EBAIS) in both urban and rural areas.

Of note is that most of the Hymenoptera sting-related deaths occurred in males (88.5% of the fatal cases), despite only a slight gender difference in sting cases reported to CNI (Figure 3A). The overall male to female ratio for fatal cases was 7.7:1, in contrast to 1.4:1 for sting accident reports. In males, the increased prevalence of chronic diseases, such as coronary atherosclerosis, has been suggested as a factor that may contribute to their higher mortality in bee sting accidents (16, 17). In addition, males have been reported to be more prone to developing severe reactions after bee stings (18).

Comparison of the age distributions in number of deaths and of reported accidents clearly evidenced the higher risk in the elderly. The age group 50 years and older accounted for 73% of the fatalities. Similar observations were reported in Australia, where deaths occurred predominantly in men over 40 years of age (16); and in Sweden (15) and the United States (14), where most deaths occurred in those more than 50 years of age.

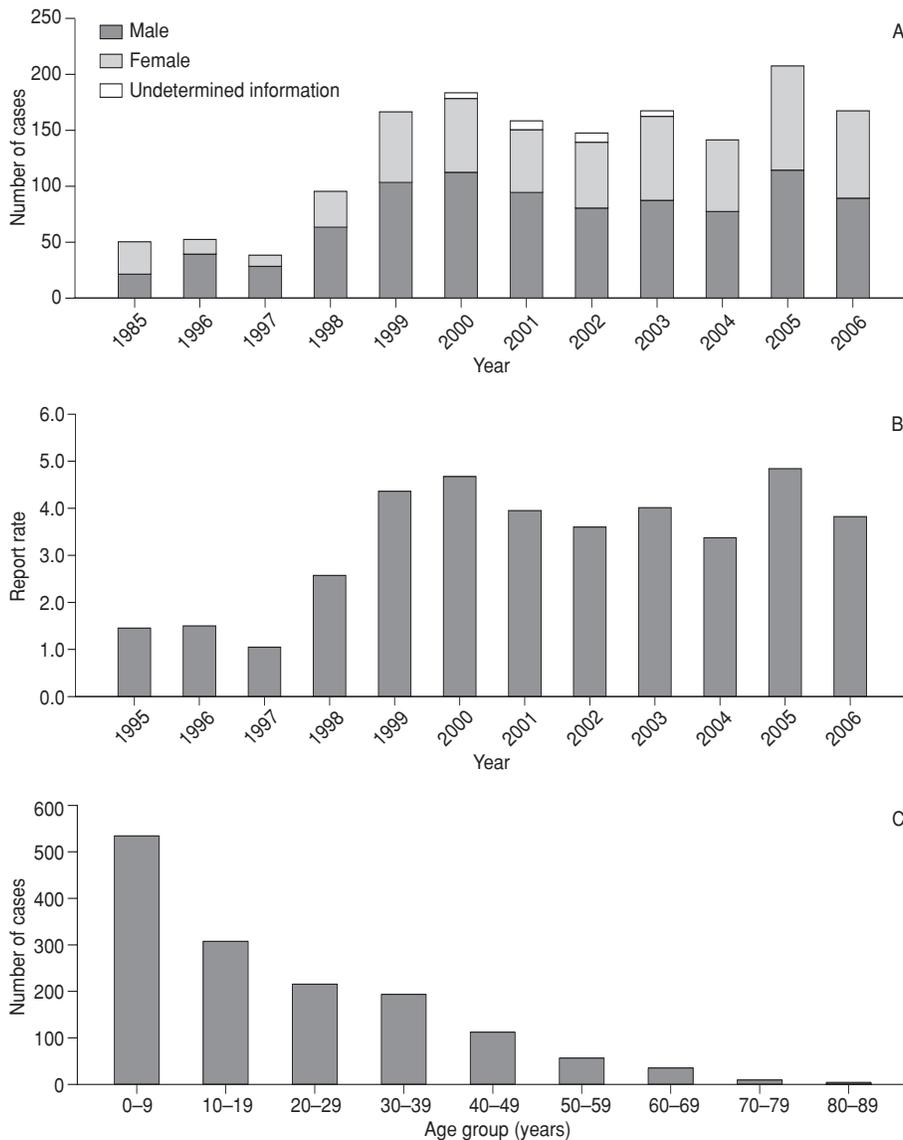
A reliable estimation of the incidence of Hymenoptera sting accidents in Costa

**FIGURE 2.** Mortality due to Hymenoptera stings in the seven provinces<sup>a</sup> of Costa Rica, 1985–2006



<sup>a</sup> GU = Guanacaste; AL = Alajuela; SJ = San José; LI = Limón; PU = Puntarenas; CA = Cartago; HE = Heredia.

**FIGURES 3A–C. Cases of Hymenoptera stings reported to the Centro Nacional de Intoxicaciones de Costa Rica, 1995–2006. (3A) number of cases reported by gender and their gender distribution; (3B) annual case report rates, adjusted per 100 000 population; (3C) age-group distribution of reported cases**



Rica could not be made, given the lack of any comprehensive sources of information; CNI records only partially capture

the magnitude of the problem. For the year 2006, contacts with Hymenoptera represented 1.5% of the total poisoning

cases reported to CNI. A total of 1 591 persons stung by these insects were recorded in 1995–2006, representing an average of 133 cases per year. Accidents were slightly more common in men than in women (1.4:1 ratio), in agreement with findings of other studies (19, 20). Also, sting reports in children and young adults were more frequent than in groups of older ages (Figure 3C). This may reflect the fact that younger people, especially children, are more frequently involved in outdoor activities. Because of their inherent curiosity and behavior, children may have a higher risk of stings by Hymenoptera, as observed in the present work.

## CONCLUSIONS

The analyses show that in this recent 22-year period, mortality due to Hymenoptera stings in Costa Rica averaged 2.4 fatal annual cases (ranging from 0–6 deaths), with an overall mortality rate of 0.74 per 1 million inhabitants (95% CI: 0.46–0.93). Fatal cases for this type of accident are predominantly observed in males, especially in the elderly, but may also occur in children and occasionally in young adults.

This information could be of relevance to promoting awareness among the general population and among specialized health personnel, as well as for consideration of risks during the clinical management of patients affected by Hymenoptera stings.

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## RESUMEN

### Mortalidad por picaduras de himenópteros en Costa Rica, 1985–2006

**Objetivo.** Analizar la mortalidad por picaduras de himenópteros en Costa Rica en el período de 1985 a 2006.

**Métodos.** Se obtuvieron los registros de picaduras de himenópteros entre 1985 y 2006 del Instituto Nacional de Estadísticas y Censos. Las tasas de mortalidad se calcularon a partir de los datos de la población nacional para el 1 de julio de cada año. La información de cada caso abarcaba la edad, el sexo y la provincia en la que ocurrió la muerte. Además, para evaluar la exposición a estos insectos se contó con las notificaciones de accidentes por picaduras de himenópteros del Centro Nacional de Intoxicaciones (CNI) de 1995 a 2006.

**Resultados.** En el período de 22 años analizado se registraron 52 muertes por picaduras de himenópteros. La tasa anual de mortalidad varió entre 0 y 1,73 por millón de habitantes, con una media de 0,74 (intervalo de confianza de 95%: 0,46 a 0,93). La mayoría de las muertes correspondieron a hombres (88,5%), con una razón hombre:mujer de 7,7:1. Predominaron los casos letales en adultos mayores (50 años o más) y niños menores de 10 años. La provincia con la mayor mortalidad fue Guanacaste. El CNI documentó 1 591 casos de picaduras de himenópteros (principalmente abejas) entre 1995 y 2006, para un promedio anual de 133 casos, con un ligero predominio de hombres sobre mujeres (1,4:1).

**Conclusiones.** Las picaduras de himenópteros, principalmente de abejas, son sucesos frecuentes en Costa Rica que pueden amenazar la vida en una reducida proporción de casos, principalmente hombres y adultos mayores. El número anual de muertes varió entre 0 y 6, con un promedio de 2,4 muertes anuales. Se debe fomentar la conciencia no solo en la población general sino también en el personal especializado de salud, quienes deben tomar en cuenta este riesgo al atender a los pacientes con picaduras de himenópteros.

## Palabras clave

Himenópteros, mordeduras y picaduras de insectos/mortalidad, Costa Rica.