

ORIGINAL ARTICLES

## Asian Tiger Mosquito Bites: Perception of the Affected Population After *Aedes albopictus* Became Established in Spain

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**Abstract.** *Introduction.* The presence of *Aedes albopictus* was detected in Spain in 2004 and it has now become fully established, causing significant discomfort among the population in the affected areas.

*Objectives.* The aim of this study was to investigate the impact of the arrival of *A. albopictus* and its subsequent establishment on the population a year after being detected in Spain.

*Material and methods:* A survey questioned 309 users of the Valldoreix-Sant Cugat Healthcare Center about their knowledge of *Aedes albopictus*, the characteristics of bites by this insect, and their attitude to prevention and treatment.

*Results.* Ninety one percent of respondents knew about the tiger mosquito. Sixty-one percent (66 % of women and 53 % of men) had reported suffering bites attributed to this insect. The most common type of bite was a small swelling (78 %) and the most common site was the legs (93 %). Children had a greater number of lesions and a more generalized distribution. Blistering lesions were more frequent in women. Itching was very intense (65 %), particularly in women (71 %) and children (76 %). The majority of patients (80 %) did not seek attention from their health care services and 36 % consulted their pharmacist. Fifty percent (61 % of women and 47 % of men) treated their bites, mainly with topical corticosteroids (56 %) and antihistaminics (26 %). Forty-six percent of respondents—mainly children—reported use of insect repellents.

*Conclusion.* The arrival of the Asian tiger mosquito has had a major impact on the population, with a lower quality of life and a deterioration in skin health, due to the numerous and irritating bites.

**Key words:** insect bites and stings, *Aedes*, skin manifestations, Spain.

### PICADURAS POR MOSQUITO TIGRE. PERCEPCIÓN DE LA POBLACIÓN AFECTADA TRAS EL ESTABLECIMIENTO DE *Aedes albopictus* EN ESPAÑA

**Resumen.** *Introducción.* *Aedes albopictus* se identificó en España en el año 2004 y en la actualidad está plenamente establecido, causando un intenso malestar entre la población de las áreas afectadas.

*Objetivos.* Estudiar el impacto de la llegada y el asentamiento de *Aedes albopictus* sobre la población un año después de su identificación en nuestra comunidad.

*Material y métodos.* Encuesta a 309 usuarios del CAP Valldoreix-Sant Cugat acerca de los conocimientos sobre este mosquito, características de sus picaduras y actitud en cuanto a prevención y tratamiento.

*Resultados.* El 91 % de los encuestados conocían el mosquito tigre. El 61 % referían haber sufrido picaduras (66 % mujeres y 53 % hombres), que atribuían a este insecto. El tipo de picadura más frecuente fue el habón (78 %) y la localización, las extremidades inferiores (93 %). Los niños mostraban mayor número de lesiones y una distribución más generalizada. Las lesiones ampollosas fueron más frecuentes en mujeres. El prurito fue muy intenso (65 %) sobre todo en mujeres (71 %) y niños (76 %). La mayoría de los pacientes (80 %) no consultó a los servicios médicos y un 36 % lo hizo al farmacéutico. Un 50 % realizó tratamiento (61 % mujeres y 47 % hombres), principalmente con corticoides tópicos (56 %) y antihistamínicos (26 %). Un 46 % de los encuestados afirmaba usar repelentes, sobre todo niños.

*Conclusión.* La llegada del mosquito tigre ha tenido un gran impacto sobre la población, mermando la calidad de vida y empeorando su salud dermatológica debido a sus numerosas y molestas picaduras.

**Palabras clave:** picaduras de insectos, *Aedes*, manifestaciones cutáneas, España, mosquito tigre, calidad de vida.

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## Introduction

*Aedes albopictus* (the Asian tiger mosquito) is a dark-colored mosquito with white stripes (Figure 1). Native to southeast Asia, it has spread to faraway countries through inadvertent overseas transport of its eggs and larvae in pneumatic tires and bamboo.<sup>1,2</sup> The tiger mosquito adapts easily to new habitats, laying its eggs in small pools of stagnant water (in flowerpot saucers, buckets, empty snail shells, etc). These eggs develop into larvae, then pupae, and, after 7-10 days, into adult mosquitos.

Europe—and particularly Spain—is now a viable location for settlement and proliferation of the Asian tiger mosquito, given the biological characteristics of the insect combined with the effects of climate change and globalization.<sup>4,5</sup> This mosquito has been observed to be capable of adapting to new habitats<sup>6</sup> and of surviving low temperatures.<sup>7</sup> In summer 2004, the Asian tiger mosquito was detected for the first time in Spain, in the town of Sant Cugat del Vallès, inland from Barcelona. A striking increase in visits to health centers in regard to insect bites alerted the town authorities, leading to the identification of the tiger mosquito as the cause.<sup>8,9</sup> Although it does not appear that the tiger mosquito was introduced into Spain in pneumatic tires, subsequent studies have pointed to these as the possible medium for the spread of the species within Spain.<sup>10</sup> By 2005 *A. albopictus* was well established in several villages and towns in the Sant Cugat del Vallès area and in a few districts in Barcelona city; it subsequently spread to Tarragona (some 100 km south of Barcelona), and, further south again, to Orihuela in the province of Alicante.<sup>11</sup>

The female tiger mosquito bites many times (Figure 2) before laying her eggs and—unlike the common mosquito—these bites occur during the day.<sup>12</sup> In tropical countries, the tiger mosquito spreads arboviruses that cause diseases such as dengue, yellow fever, Ross River virus, La Crosse encephalitis, chikungunya fever, Rift Valley fever, and West Nile fever.<sup>3,13</sup> In Italy, *A. albopictus* is a natural vector for *Dirofilaria immitis*.<sup>14</sup> In Spain, the impact on health has so far been purely dermatological. This was also the case in Europe until an outbreak of chikungunya fever was detected in northern Italy in the summer of 2007.<sup>15</sup>

The aim of our study was to determine—more than 1 year after identification of the tiger mosquito—awareness of the insect among the population of Sant Cugat del Vallès, the extent to which people had been bitten, the characteristics of the bites, and the attitude of patients to treatment.<sup>16</sup>

## Materials and Methods

We administered a questionnaire to users of the Valldoreix-Sant Cugat del Vallès Health Care Center during the month of February 2006; the questionnaire contained a series of



Figure 1. *Aedes albopictus*, also known as the Asian tiger mosquito.



Figure 2. Excoriated lesions caused by Asian tiger mosquito bites on the legs of a child aged 8 years.

questions referring to bites by the tiger mosquito during the summer of 2005. The questionnaire was distributed personally by physicians and staff to consecutive patients in the waiting room. The only selection criteria were that people be willing and able to complete the form.

The variables recorded for the sample of patients were sex and age; awareness of the tiger mosquito; characteristics, number and location of bites received; the symptoms experienced; the health care professionals consulted; the treatment administered; and finally, the use of repellents. The patients were stratified into 3 groups according to age: children (0-14 years), adults (15-59 years), and elderly people (60 years and older).

## Statistical Analysis

Results for the qualitative variables were expressed as percentages, and results for the quantitative variables were

**Table.** Variables Associated with Asian Tiger Mosquito Bites Categorized According to Sex

Variables	Men 125 (46%)	Women 184 (54%)	Total 309 (100%)
Age (SD), y	46 (22)	44 (19)	45 (20)
Patients with bites <sup>a</sup>	66 (53%)	120 (66%)	187 (61%)
<b>Lesion Site</b>			
Legs	59 (91%)	113 (94%)	173 (93%)
Arms	41 (63%)	65 (55%)	107 (58%)
Trunk	18 (28%)	30 (25%)	48 (26%)
Face	9 (14%)	20 (17%)	29 (16%)
<b>Lesion Type</b>			
Erythem <sup>a</sup>	24 (37%)	25 (21%)	49 (26%)
Induration	47 (72%)	99 (82%)	146 (79%)
Blisters	2 (3%)	20 (17%)	22 (12%)
Bleeding	5 (8%)	7 (6%)	12 (7%)
<b>Symptom</b>			
Mild or moderate itch	29 (44%)	35 (29%)	64 (35%)
Severe itch or pain <sup>a</sup>	36 (55%)	85 (71%)	121 (65%)
Patients Treated	21 (32%)	73 (61%)	94 (50%)

<sup>a</sup>Statistically significant differences ( $P < .05$ )

expressed as means (SD). The qualitative variables were compared using the  $\chi^2$  test, and the  $t$  test was used to compare the quantitative variables. For significant variables, 95% confidence intervals (CI) were established, and the level of statistical significance was set to .05. Statistical analyses were performed using SPSS version 12.0.

## Results

A total of 309 questionnaires were completed by 184 women (59%) and 125 men (41%). Patients were aged between 2 and 91 years (mean [SD] of 45 [20] years), with no differences encountered between the sexes. The final sample was composed of 27 children, 202 adults, and 77 elderly people.

### Awareness of the Tiger Mosquito

A total of 280 (91%) of the surveyed patients stated that they had heard of the tiger mosquito. On average, these

were 13 years younger than those who had not heard of the insect (95% CI, 5–21 years); no differences were encountered between the sexes. A total of 230 persons (74%) stated that they had seen a tiger mosquito. On average, these were 7 years younger than those who had not seen the insect (95% CI, 2–12 years); again, no differences were encountered between the sexes.

### Bites

Of the total sample, 187 people (61%) responded that they had been bitten by a tiger mosquito in the summer of 2005. On average, these patients were 6 years younger than those who had not been bitten (95% CI, 2–11 years). In terms of age groups, 21 children (78%), 129 adults (64%), and 37 elderly people (48%) were bitten. A statistically significant relationship was found between sex and bites ( $P = .022$ ), with 13% more women bitten by the insect compared to men (95% CI, 2%–24%) (Table).

### Bite Location

Bites were located mostly in the limbs; among children, however, distribution was more generalized.

Bites occurred on the legs of 173 patients (93%). No differences were encountered between the sexes or between age groups. Bites occurred on the arms of 107 patients (58%). Again, no differences were encountered between the sexes; however, there were differences according to age groups, as those who had received bites on the arm were 7 years younger than the rest of the patients who had been bitten (95% CI, 2–13 years).

A total of 48 patients (26%) were bitten on the trunk. As with bites on the arm, differences were encountered between age groups but not between sexes. Those who had received bites on the trunk were, on average, 9 years younger than the rest of the patients who had received bites (95% CI, 3–16 years).

Bites occurred on the face of 29 patients (16%), with no differences encountered between the sexes or between age groups.

As for the number of affected areas, 16 persons (9%) had received bites on several parts of the body; 27 persons (14%) on 3 areas, and 71 (38%) and 72 persons (39%) on 1 and 2 areas, respectively. The number of affected areas was associated with age; those who were affected in several areas were, on average, 7 years younger than those with bites in one specific part of the body (95% CI, 1–13 years).

In terms of age groups, 43% of children received bites in 3 or 4 areas compared to 20% of adults. No differences were observed in relation to sex.

## Number of Bites

A total of 72 persons (38%) responded that they had received 5 to 10 bites, and 63 persons (34%) responded that they had received fewer than 5 bites. Among the group of children, 10 (48%) reported having been bitten more than 10 times, compared to 31 adults (25%).

No significant differences were encountered according to sex or age.

## Type of Lesion

In regard to the type of lesion, and bearing in mind that a single patient could have had various types, the most frequently occurring bites were indurations (146 [78%]), followed by erythema (50 [26%]), blisters (23 [12%]), and hemorrhagic lesions (12 [6%]). Significant differences were encountered for sex but not for age. Women experienced 16% less reddening than men (95% CI, 1%-31%). Women, furthermore, experienced more blistering—on average, 14% more frequently than men (95% CI, 6%-22%). There were no differences according to sex for the remaining lesions. As for age groups, 19% of children had blisters and 19% had hemorrhagic lesions.

## Symptoms

The patients in our sample described the discomfort caused by the bites as follows: mild itchiness (19 patients [10%]), moderate itchiness (46 [25%]), severe itchiness (113 [61%]), and pain (8 [4%]). Of the group of children, 16 complained of severe itchiness (76%). Although no significant differences were encountered according to age, it was observed that older people tended to experience less discomfort.

Complaints of pain and severe itchiness were 15% more frequent among women compared to men (95% CI, 1%-29%).

## Consultations

Most patients (80%, or 151 of those who had been bitten) did not consult a physician about their bites. In fact, 83 (44%) did not consult any health care professional. Of the patients who did, 68 (36%) consulted a pharmacist, 15 (8%) visited an emergency department, and 18 (10%) visited their family physician or pediatrician; only 3 patients (2%) consulted a dermatologist.

A greater tendency to consult a physician about the bites was observed among older people. Among adults, there was a greater tendency to consult a pharmacist (55 patients, or 43% of the adults who had been bitten); only 19 adults

(15%) sought medical attention. Of people aged 60 years or older, 8 consulted a pharmacist (22%), and 12 consulted a physician (32%). Sex was not observed to have a bearing on the type of consultation.

## Treatment

A total of 94 of the people who had been bitten (50%) administered treatment for the bites—13 children (62%), 61 adults (47%), and 20 elderly people (54%). No significant differences were found according to age group.

An association was observed between treatment and the female sex ( $P < .001$ ), with 29% more women resorting to treatment (95% CI, 15%-43%). Of the respondents who had treated their bites, 48 (51%) could not remember exactly what they had used. In the other 46 cases, topical corticosteroids (26 subjects) and antihistamines (12 subjects) were used, representing 56% and 26% of the total sample; of the 12 patients who took antihistamines, 7 took oral antihistamines and 5 applied topical antihistamines. A further 4 patients (9%) applied topical antibiotics as treatment and another 4 patients (9%) applied ammonia to the bites.

## Repellent Use

As for preventative measures, 97 persons (46%) stated that they had used insect repellent. Although no significant differences were found for sex or age, there was a greater tendency for younger people to apply repellents, with 14 children (56%) using such products compared to 16 elderly people (34%). This tendency was also observed among women, 50% of whom used repellents compared to 37% of the men ( $P = .089$ ).

The most frequently used repellent was diethyltoluamide, followed by eucalyptus-based products.

## Discussion

The population of Sant Cugat del Vallès was very much aware of this new health problem, as indicated by the high level of awareness, with 91% stating that they knew what the tiger mosquito looked like and 74% indicating that they had seen a tiger mosquito. This level of awareness is explained by the numerous information campaigns that were run in the town (involving the distribution of information leaflets, the publication of articles in local authority magazines, the provision of information in health centers and schools, etc).

A total of 61% of the surveyed population attested to having been bitten by the tiger mosquito in the summer of 2005. In general, the bites resulted in several indurations—

particularly in the limbs—that were described as extremely itchy. This information concurs with existing information on tiger mosquito bites.<sup>12</sup> Children were particularly affected, with 78% of those in our sample bitten, generally more frequently and in more parts of the body than adults. The fact that children were more affected is undoubtedly due to the fact that they were likely to have spent more time outdoors and to have worn less clothing. In children aged under 14 years, indurations were most frequent, although blisters (19%) and hemorrhagic lesions (19%) were also quite common. However, given that the sample contained few children, these data should be interpreted with care. Children tended to complain more of itchiness and pain than adults. The use of repellents was more widespread among children, probably given the concern of parents to protect them.

It was also observed that more women were bitten than men, although there was no difference in terms of location or number of lesions. Women were also more likely to develop blisters, which tend to be more pruriginous and painful than the other lesions. Use of repellents was more widespread among women, who were also more likely to administer a treatment. N,N-diethyl-3-methylbenzamide or N,N-diethyl-m-toluamide (DEET) is the most effective mosquito repellent, although the duration of effectiveness varies according to dose and also depends on sex; DEET is known to protect women less,<sup>17</sup> which would explain why women are bitten more frequently despite their greater use of repellents. Given the possible toxicity from continuous use of repellents (daily over an entire summer)—particularly in children—prevention based on wearing long-sleeved tops and long trousers when outdoors is recommended, although this would require a change in habits.

In the summer of 2004, the large increase in medical consultations for insect bites in the town of Sant Cugat del Vallès led to the discovery of this new species of mosquito in Spain. The study by Giménez et al<sup>9</sup> showed that, whereas medical consultations for insect bites in 1998 had totalled 4 per 1000 inhabitants, by 2004 they had risen to 16 per 1000 inhabitants. One year on, despite the fact that the number of mosquitoes was higher, the population had been warned and so the number of consultations was likely to be lower. In general, patients did not seek medical advice for insect bites unless the bites were severe, in which case they consulted their family physician, pediatrician, or emergency department. Visits to dermatologists were rare, and, when they did occur, consultations about insect bites tended to be “by-the-way,” meaning that a patient attending for other reasons took advantage of the visit to ask about treatments and repellents. The lack of direct access to a dermatologist—with long waiting lists preventing consultations for minor complaints—could explain why such visits were infrequent. People aged 60 years and over consulted the medical

services more often (probably because they had more flexibility in regard to visit schedules) compared to patients aged 15-59 years, who were more likely to consult a pharmacist (47%). It is clear that the pharmacist played an important role in recommending treatments and repellents. Noteworthy was the fact that 10% of the patients who treated their insect bites did so using a topical antihistamine; the public needs to be made aware of the need to minimize the use of these agents, however, given the well-documented risk of sensitization.

One of the limitations of our study is that, because patients were enrolled consecutively over a short period of time, it cannot be considered to be representative of the population. Nonetheless, the surveyed population was very aware of the problem, despite the fact that the survey was conducted in winter when the tiger mosquito was inactive. Other evident limitations include the fact that we cannot be sure that all the bites were tiger mosquito bites, as some bites attributed to this insect may have, in fact, been caused by the common mosquito, black fly, or another insect. Nonetheless, a number of people confirmed that they no longer saw “normal” mosquitos, given the large numbers of tiger mosquitos in evidence. Tiger mosquito bites are morphologically no different from the bites of other mosquitos; in other words, all mosquito bites result in indurations in exposed skin.<sup>18</sup> Tiger mosquitos, however, differ in that they are active during the day and are likely to bite several times. Although the bite is in itself painless, the reaction is potentially extremely irritating. In a study of this kind, the cause of the bite, the number of lesions, or the distribution of lesions could not be accurately determined, as the lesions were not reported by a physician. Despite these limitations, however, we are of the opinion that not only is the study representative of the experience of the people living in Sant Cugat del Vallès in recent years, it can also be extrapolated to other towns where the tiger mosquito is active. It should also be noted that a study of bitten patients who consulted medical services would mainly reflect only patients with more serious bites or patients more likely to consult medical professionals.

Eradication of the tiger mosquito is well nigh impossible. Despite the efforts of the local authorities to bring these insects under control, the tiger mosquito species has become active in neighboring districts and towns, and is likely to spread further in the coming years. Control is based fundamentally on limiting egg-laying and reproduction (by ensuring that no stagnant water pools are available to the females), given that control of the adult mosquito is extremely difficult. The fact that the tiger mosquito has a limited flight range and radius of action (a maximum of 400 meters) makes control at the level of the individual household crucial.<sup>12</sup> Information campaigns targeting the general population should be continued, although it should be pointed out that, in Sant Cugat del Vallès, awareness-raising

measures have so far proved ineffectual and the problem continues as before.

## Conclusions

The arrival of *A. albopictus* in Sant Cugat del Vallès has had a negative impact on the quality of life of the population. Most of the people surveyed in our research were aware of the existence of this mosquito and had been bitten by it. The tiger mosquito is very likely to spread to other areas, and, consequently, public health authorities should be alert to any increase in consultations about insect bites (particularly if the bites are numerous and pruriginous), so as to be able to set in motion measures to control tiger mosquito reproduction and limit stable settlement of this invading species.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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