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 ALBOPICTORUS 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.
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.1,2 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 mosquitoes.

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.4,5 This mosquito has been observed to be capable of adapting to new habitats6 and of surviving low temperatures.7 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.8,9 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.10 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.11

The female tiger mosquito bites many times (Figure 2) before laying her eggs and—unlike the common mosquito—these bites occur during the day.12 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.3,13 In Italy, *A albopictus* is a natural vector for *Dirofilaria immitis*.14 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 2007.15

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.16

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 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
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 that 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 that 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 that 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 (\( P=0.022 \)), 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 that 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.

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.

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Men (125 [46%])</th>
<th>Women (184 [54%])</th>
<th>Total (309 [100%])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (SD), y</td>
<td>46 (22)</td>
<td>44 (19)</td>
<td>45 (20)</td>
</tr>
<tr>
<td>Patients with bites</td>
<td>66 (53%)</td>
<td>120 (66%)</td>
<td>187 (61%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesion Site</th>
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</thead>
<tbody>
<tr>
<td>Legs</td>
<td></td>
</tr>
<tr>
<td>Arms</td>
<td></td>
</tr>
<tr>
<td>Trunk</td>
<td></td>
</tr>
<tr>
<td>Face</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesion Type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema</td>
<td></td>
</tr>
<tr>
<td>Induration</td>
<td></td>
</tr>
<tr>
<td>Blistera</td>
<td></td>
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<tr>
<td>Bleeding</td>
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<table>
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<tr>
<th>Symptom</th>
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<tbody>
<tr>
<td>Mild or moderate itch</td>
<td></td>
</tr>
<tr>
<td>Severe itch or paina</td>
<td></td>
</tr>
<tr>
<td>Patients Treated</td>
<td></td>
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</tbody>
</table>

*Statistically significant differences (P<.05)
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—
particularmente en los miembros—que eran descritas como extremadamente pruriginosas. Esta información concuerda con la información existente sobre picaduras de mosquito tigre.12 Niños fueron particularmente afectados, con 78% de los casos de picaduras; en el caso de adultos la proporción fue de 57%. La película de insectos circulaba frecuentemente y en partes del cuerpo más visibles que en niños. La verdad es que los niños fueron más afectados posiblemente debido a que ellos generalmente pasan más tiempo al aire libre y con ropa menos ajustada. En los niños de menos de 14 años, induraciones fueron las lesiones más frecuentes, seguidas de hemorragias (19%) y lesiones pruriginosas (19%) que también fueron bastante comunes. Sin embargo, dado que las muestras contenían en su mayoría niños, estas estadísticas deben ser interpretadas con precaución. Los niños tienden a quejarse más de prurito y dolor que los adultos. El uso de repelentes fue más difundido entre los niños, probablemente debido al temor de los padres a que el niño se lastrara. Se observó también que las mujeres fueron más a menudo picadas de boca a boca, en parte debido a su mayor uso de repelentes (19%) y al mayor número de lesiones (19%) que se encontraron en mujeres. Además, las mujeres fueron más propensas a quejarse de prurito y dolor que los hombres, aunque no se encontró diferencia en términos de localización de la picadura. Los niños mayores quejaban más de prurito y dolor. Los niños también se quejaban más de prurito y dolor y más a menudo se consultaron por lo que solo las lesiones más serias fueron reportadas. En general, los pacientes que recibieron tratamiento farmacológico se consultaban con mayor frecuencia (probablemente porque habían más flexibilidad en cuanto al horario de visita) que los pacientes que no recibieron tratamiento farmacológico. La falta de acceso directo a un dermatólogo—con listas de espera largas que impiden las consultas por asuntos menores—puede explicar por qué estos visitantes fueron infrecuentes. Los pacientes mayores de 60 años que consultaron el médico debido a las picaduras fueron más frecuentes (probablemente porque tenían más flexibilidad en cuanto al horario de visita) que pacientes mayores de 15-59 años, quienes fueron más propensos a consultar a un farmacéutico (47%). Es claro que el farmacéutico tuvo un papel importante en la recomendación de tratamientos y repelentes. En un estudio, el 10% de los pacientes que consultaron por picadura de insecto lo hicieron usando un antihistamínico; el público propuesto para ser informado de la necesidad de minimizar el uso de estos agentes, sin embargo, a pesar de las afirmaciones bien documentadas del riesgo de sensibilización. Una de las limitaciones de nuestro estudio es que, debido a que los pacientes fueron enrollados consecutivamente durante un periodo de tiempo corto, no se puede considerar que representan la población. No obstante, la población estudiada estaba muy consciente del problema, de hecho, el estudio fue realizado en invierno cuando el mosquito tigre no es activo. Otro caso de limitaciones incluye el hecho de que no podemos estar seguros de que todas las picaduras fueron de mosquito tigre, a pesar de las bites que fueron atribuidas a este mosquito. En efecto, este mosquito, mosquito común, mosca negra, a otra insectos. No obstante, la mayoría de los pacientes confirmó que no tenían miedo de la picadura de este mosquito, que difería en que son activos durante el día y son más propensos a picar en otras zonas. En un estudio de este tipo, la causa de la picadura, el número de lesiones, o la distribución de lesiones no se puede determinar con precisión, dado que las lesiones no se informaron a un médico. A pesar de estas limitaciones, no obstante, nos parece que nos inclinamos a la opinión de que no está es representativa de la experiencia de los que viven en Sant Cugat del Vallés en los últimos años, y se puede extrapolarme a otros lugares donde el mosquito tigre está activo. Se debe también notar que un estudio de picadores que consultaron por servicios médicos sería principalmente el reflejo de pacientes con picaduras más graves o pacientes más propensos a consultar a un profesional sanitario. La erradicación del mosquito tigre es increíblemente imposible. A pesar de los esfuerzos de las autoridades locales para controlar estos insectos bajo el control, la especie de mosquito tigre ha estado activa en distritos vecinos y ciudades, y probablemente se propagará más en los años venideros. Control se basa fundamentalmente en la eliminación de huevos y reproducción (al asegurar que no haya aguas estancadas disponibles para las hembras), lo que significa que el control del mosquito adulto es extremadamente difícil. La verdad es que el mosquito tigre tiene un rango de vuelo y radio de acción (un máximo de 400 metros) que permitiría su control en el nivel de la familia. Información campañas dirigidas a la población general deben ser continuadas, aunque se debe tener en cuenta que en Sant Cugat del Vallés, la concienciación...
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.

References