



## Rabies exposure in international travelers: do we miss the target?

Philippe Gautret<sup>a</sup>, Eric Adehossi<sup>b</sup>, Georges Soula<sup>a,c</sup>, Marie-Josèphe Soavi<sup>a</sup>, Jean Delmont<sup>a,c</sup>, Yolande Rotivel<sup>d</sup>, Philippe Brouqui<sup>a,\*</sup>, Philippe Parola<sup>a</sup>

<sup>a</sup>Service des Maladies Infectieuses et Tropicales, Hôpital Nord, AP-HM, Chemin des Bourrely, 13915 Marseille, Cedex 20, France

<sup>b</sup>Faculté des Sciences de la Santé, Université de Niamey, Niger

<sup>c</sup>Centre de Formation et Recherche en Médecine et Santé Tropicales, Faculté de Médecine secteur Nord, Boulevard Pierre Dramard, Marseille, France

<sup>d</sup>Centre National de Référence de la Rage, Institut Pasteur, Paris, France

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### ABSTRACT

**Background:** Little data exist about the spatial distribution of the risk for travelers of being injured by a potentially rabid animal.

**Methods:** Over the last 14 years, animal-associated injuries in 424 international travelers presenting to a travel medicine clinic in Marseille, southern France, were investigated.

**Results:** The majority of cases were reported from North Africa (41.5%) and Asia (22.2%). Most countries where at-risk injuries occurred (Algeria, Morocco, Tunisia, Thailand, and Turkey) were those for which travelers do not usually seek advice at a specialized travel clinic, because these countries are not at risk for specific travel-associated diseases like malaria or yellow fever. The probability of travelers being attacked by each animal species varied significantly according to the destination country. Dogs were more frequently involved in Algeria, cats in Tunisia and the Middle East, and non-human primates in sub-Saharan Africa, Madagascar, and Asia.

**Conclusions:** We suggest that rabies pre-exposure vaccination should be offered to individuals traveling regularly to North Africa to visit their relatives and who are at high risk of exposure to potentially rabid animal attacks. Pre-travel advice when addressing rabies prevention should consider the specific epidemiology of animal-related injuries in the traveled country, as well as the traveler's characteristics. Travelers should be advised about which species of animal are potentially aggressive in their destination country so that they can more easily avoid risk-contacts.

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## 1. Introduction

Some recent reports are available indicating the incidence of potential rabies exposure in travelers, but are limited to a single country or to specific populations of long-term expatriates.<sup>1–5</sup> Little data exist about the spatial distribution of the risk of being injured by a potentially rabid animal. An analysis of animal-associated injuries in travelers in the GeoSentinel Surveillance Network found that among 320 exposure incidents that occurred in rabies endemic countries, 50% were in individuals traveling for tourism for less than 3 weeks. The top countries for animal-related injuries were: Thailand, India, Indonesia, China, Nepal, and Vietnam.<sup>6</sup> In another study involving 261 injured patients from Australia, New Zealand, and France (some of whom were included in the GeoSentinel analysis), the countries from which travelers had most frequently reported injuries included Morocco, Tunisia, and Algeria, Thailand, India, Vietnam, and Indonesia. The vast

majority of patients who had traveled to North Africa were seen in Marseille, while most of the patients who had traveled to Southeast Asia were seen in Melbourne and Auckland.<sup>7</sup> Finally in an Israeli study conducted in 815 injured travelers, most of the individuals had been exposed in Asian countries.<sup>8</sup>

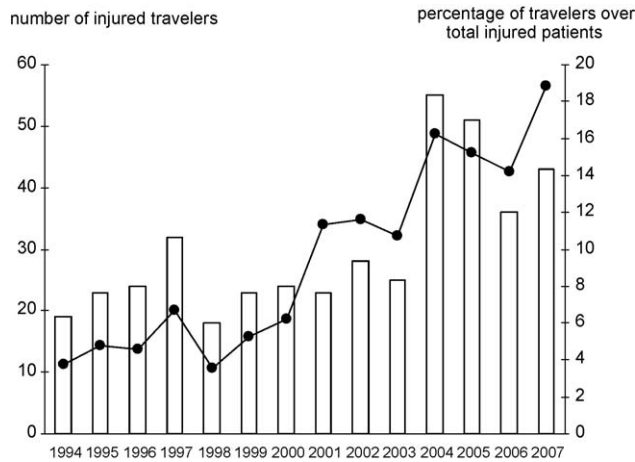
In Marseille, the travel health center and the rabies treatment center are handled by the same medical team who gather the data of both units. This double 'observation' raised the concern that travelers seen before traveling, who received pre-travel information about rabies risk in their country of destination, had very different characteristics to those actually injured abroad and seeking rabies post-exposure prophylaxis.

In this study, we investigated the epidemiology of animal-associated injuries in a large cohort of travelers from Marseille, southern France over the last 14 years, and focused on the traveled country and the animal species involved.

## 2. Materials and methods

Data were prospectively collected on patients presenting to the rabies treatment center in Marseille from January 1994 to

\* Corresponding author. Tel.: +33 0 4 91 96 35 35/36; fax: +33 0 4 91 96 89 38.  
E-mail address: [philippe.brouqui@univmed.fr](mailto:philippe.brouqui@univmed.fr) (P. Brouqui).



**Figure 1.** Numbers of animal-associated injuries in travelers over time (bars) and proportion of travelers over total injured patients (curve).

December 2007. Patients were selected on the basis of having acquired a human or animal-related injury/contact outside of France, and who were seeking care for rabies post-exposure prophylaxis (PEP). All injury cases were recorded on standardized reports that include patient demographic information, place of exposure, and animal characteristics. Rabies PEP characteristics have been described elsewhere.<sup>7</sup> Data were captured anonymously in a Microsoft Access database and transferred to EpiInfo 6.0 software (Centers for Diseases Control and Prevention, Atlanta, USA) for analysis. Differences in proportions were given by the Chi-square test. A  $p$ -value of  $\leq 0.05$  was considered significant. All  $p$ -values were determined by two-tailed  $t$ -test.

### 3. Results

From 1994 to 2007, a total of 424 injured travelers attended the rabies treatment center in Marseille, representing 8.2% of all injured patients attending the center. As shown in Figure 1, the number of injured travelers increased from 24 per year (range 18–

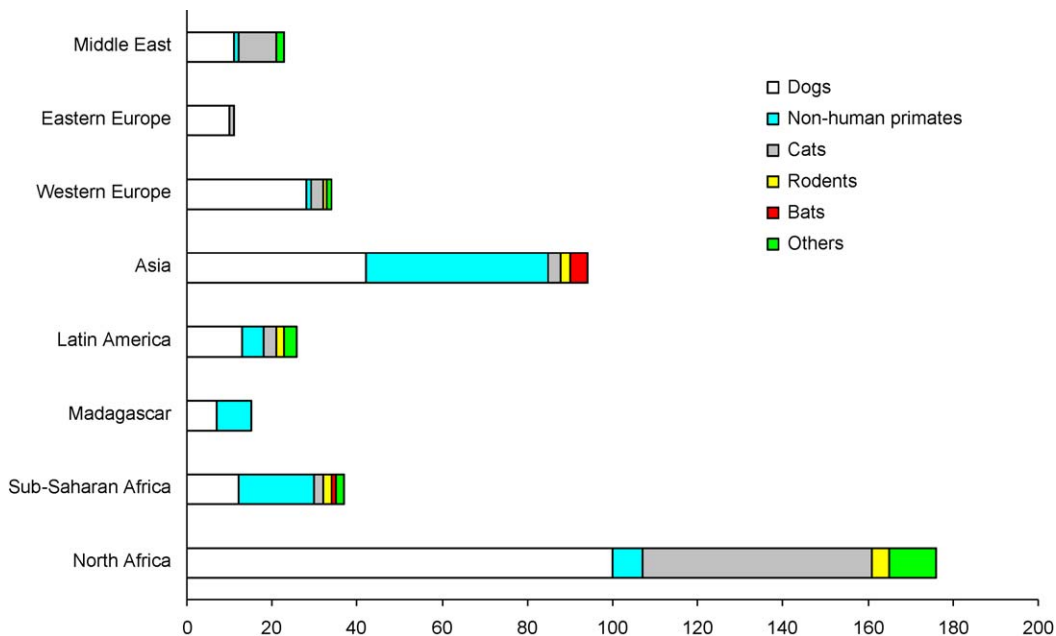
32) in 1994–2003 to 46 per year (range 36–55) in 2004–2007 ( $p < 10^{-5}$ ). The proportion of travelers over total injured patients increased from 4% in 1994 to 19% in 2007 ( $p < 10^{-6}$ ). The number of cases increased significantly by four times in July/August/September compared to other quarters ( $p < 10^{-6}$ ).

As shown in Figure 2, the majority of injured patients seeking care for rabies PEP were reported from North Africa (41.5%) and Asia (22.2%). The top five countries were Algeria (67 patients, 15.8%), Morocco (59 patients, 13.9%), Tunisia (50 patients, 11.8%), Thailand (46 patients, 10.8%), and Turkey (19 patients, 4.5%). The ratio of males to females was 1.04 and the mean age was 34.5 years (median age 33 years, range 2–84 years). Patients aged  $< 15$  years represented 23% of the cohort. The male/female ratio, age, and traveled countries did not vary significantly over time (data not shown).

Domestic animals accounted for injuries in 308 patients (72.6%), wild animal in 109 patients (25.7%), and the species of animal was unidentified for six patients (1.4%). One case consisted of a human bite (0.3%). The most common species were dogs (52.6%) and non-human primates (19.6%). Non-human primate-related injuries resulted mainly from bites and rarely from scratches. Cases for which the species was identified involved Sangeh macaques in Indonesia and Thailand, baboons and green monkeys in Kenya, lemurs in Madagascar, Barbary macaques in North Africa, and capuchin monkeys in Brazil. Cats were involved in 17.7% of the injury cases, rodents in 3.3%, and bats in 2.4% (Figure 2).

The probability of injured travelers being attacked by each animal species varied significantly according to the destination country (Table 1). Travelers injured in Algeria had more than twice the odds of being attacked by a dog compared to the other parts of the world, while those returning from Tunisia and the Middle East had more than eight times and three times the odds of suffering from a cat attack, respectively. Travelers injured in sub-Saharan Africa, Madagascar, and Asia were four to six times more likely to be attacked by non-human primates compared to travelers returning from elsewhere.

Animals were not available for observation by a veterinarian or for testing in 91.5% of the injury cases. Among 36 injury cases for which the animal was available, 16 (44.4%) were associated with a



**Figure 2.** Animal species in injured travelers according to travel destination. Eight cases were also reported from North America/Canada.

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