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Medically important trombiculids: a systematic review of the global distribution and clinical consequences of their bites

Trombicúlidos de importancia médica: un examen sistemático de la distribución mundial y las consecuencias clínicas de sus mordeduras

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Abstract

Background: Mites are among the smallest arthropods that can be seen without magnification, were the use of dermatoscopy is an invaluable tool. They are a cosmopolitan pest, and at the moment more than 250 species have been shown to produce problems for humans and animals alike. These mites are capable of producing a wide array of clinical signs and symptoms, from local to systemic, from mild to severe, as well as transmitting pathogens. This study aimed to provide an update to the clinical impact on human health, the distribution and species involved in the clinical conditions produced by trombiculids through a systematic review. **Methods**: A systematic literature review was conducted in Medline, Lilacs, Redalyc, Scopus, SciELO and Google Scholar, were we use as a threshold of publication date the year 2008. We limited the search strategy to articles published in Portuguese, French, English and Spanish. Eligible studies were case reports and case series that reported outcomes in humans caused by trombiculid bites. Patient-level and study-level information was extracted. **Results**: The literature search yielded 832 studies; 13 were case reports, 4 case series and 2 descriptive studies reporting a total of 49 cases. Most patients were male, and the median age was 33.7±6.4 years old. The most frequently reported symptoms were local erythema, pruritus and papules. No deaths were documented. Trombiculids from the genera *Trombicula, Eutrombicula* and *Leptotrombidium* appear to be the most commonly reported. **Discussion**: Trombiculiasis is an infestation caused by the larval stage of various types of mites, known as chiggers, they belong to the class Arachnida and the family Trombiculidae. This systematic review provides an overview of the trombiculids of clinical importance, their distribution and effects of the bite on human health. Our results show that there are different species of mites that can have important consequences for human health. No fatal cases owere registered.Even so, the transmission of scrub typhus is important and remains one of the most life-threatening rickettsial infections in some regions of Asia. **Conclusions**: The bite of different species of trombiculids around the world can cause a wide array of clinical consequences to human health. Even as mortality appear to be nonexistent, trombiculid bites must be adequately diagnosed and treated properly.

Keywords: trombiculidae, humans, bites, case reports

Resumen

Antecedentes: Los ácaros están entre los artrópodos más pequeños que pueden ser vistos a simple vista , donde el uso de la dermatoscopia es una herramienta invaluable. Son una plaga cosmopolita, y hasta el momento se ha demostrado que más de 250 especies producen problemas tanto para los humanos como para los animales. Estos ácaros son capaces de producir una amplia gama de signos y síntomas clínicos, desde los locales hasta los sistémicos, de leves a graves, así como la transmisión de patógenos. El objetivo de este estudio fue proporcionar una actualización del impacto clínico en la salud humana, la distribución y las especies implicadas en estas condiciones clínicas producida por los trombiculidos a través de una revisión sistemática. **Métodos**: Se realizó una revisión sistemática de la literatura en Medline, Lilacs, Redalyc, Scopus, SciELO y Google Scholar, utilizamos como umbral de fecha de publicación el año 2008. Limitamos la estrategia de búsqueda a los artículos publicados en portugués, francés, inglés y español. Los estudios elegibles fueron informes de casos y series de casos que informaron de resultados en humanos causados por mordeduras de trombicúlidos. Se extrajo información a nivel de paciente y a nivel de estudio. **Resultados**: La búsqueda bibliográfica arrojó 832 estudios, de los cuales 13 fueron reportes de caso, 4 series de caso and 2 estudios descriptivos de casos que informaban de un total de 49 casos. La mayoría de los pacientes eran varones y la edad media era de 33,7±6,4 años. Los síntomas más frecuentes fueron el eritema local, el prurito y las pápulas. No se documentaron muertes. Los trombicúlidos de los géneros Trombicula, Eutrombicula y Leptotrombidium parecen ser los más comúnmente reportados. **Discusión**: La trombiculiasis es una infestación causada por varios tipos de ácarosen la etapa larval, también conocidas como niguas o coloraditos, pertenecen a la clase Arachnida y a la familia Trombiculidae. Esta revisión sistemática ofrece una visión general de los trombicúlidos de importancia clínica, su distribución y los efectos de la picadura en la salud humana. Nuestros resultados muestran que hay diferentes especies de ácaros que pueden tener importantes consecuencias para la salud humana. No se registraron casos de mortalidad. Aún así, el tifus de los matorrales sigue siendo una de las enfermedades producidas por rickettsiosis más peligrosas para la vida en algunas regiones de Asia. **Conclusiones**: La mordedura de diferentes especies de trombicúlidos en todo el mundo puede causar una amplia gama de consecuencias clínicas para la salud humana. Aunque la mortalidad parece no existir, las mordeduras de trombicúlidos deben ser adicionalmente diagnosticadas y tratadas adecuadamente.

Palabras clave: trombiculidae, humanos, mordeduras, informes de casos.

Introduction

Mites are among the smallest arthropods that can be seen without magnification, were the use of dermatoscopy is an invaluable tool (1). They are a cosmopolitan pest, and at the moment more than 250 species have been shown to produce problems for humans and animals alike (2, 3). These mites are capable of producing a wide array of clinical signs and symptoms, from local to systemic, from mild to severe. These medical problems include: a temporary irritation of the skin, persistent dermatitis, many kind of allergies, transmission of bacterial (4, 5) and metazoan parasites, intermediate hosts for parasites, invasion of respiratory ways, ear channels and internal organs and be the culprits of abnormal fears such as acarophobia and delusional parasitosis (2, 6).

One of such mite dermatitisis known as Trombiculiasis. This clinical condition is defined as the infestation with mites of the family Trombiculidae (2, 7), which occurs specifically during their larval

stage. This infestation can happen in animals, both wild and domestic, and humans. One critical aspect of their infestation, especially in Asia, is that they can be vectors of *Orientia tsugugamushi* (8), etiological agent of scrub typhus, which was formerly included in the rickettsia genus. In South America there is evidence of its endemicity (9). One of the earliest references to these arthropods appeared early in the sixth century in China. On the other hand, in Europe, Linnaeus described Trombicula batatas in 1758 (7).

Colloquially these arachnids are called as Chiggers, Red bugs, Cherry bugs, Qhapas, Aoutat, Lepte autumnalis, Coloraditos, Bichos Colorados, Niguas (must not be confused with Tungiasis), Coloradilla and Tlazahuatl in several parts around the world (2, 10, 11). Their life cycle is fairly complex, and follows the next sequence: egg (6 days), pre-larva (6 days), larva (6 legs, feeds for 3-5 days), protonymph, deutonymph, tritonymph (free life, predatorial) and adult (free life, predatorial). Larval stages prefer to attach to cloths that are tightly fit, therefor they tend to bite around the ankles, lower legs and waist (2, 12). Their alimentation corresponds of skin cells and lymph, not blood, as well, they do not burrow but larvae insert their capitulum into the skin in search of supplements and nutrition (2). With the exception of species of the genus *Leptotrombidium* they do not survive more than 1 or 2 days on human skin. Many of these attacks were secondary to hiking, trekking, contact with animals, but some can be endemic, affecting mostly vulnerable populations. Unfortunately, even as this infestation is relatively mild, is a neglected condition, and, as such, the amount of research is relatively scarce (13, 14).

Although many species have been reported as causing harm on humans. This study aimed to provide an update to the clinical impact on human health, the distribution and species involved in this clinical condition through a systematic review.

Materiales y Métodos

Search strategies

Systematic literature searches were conducted in the following databases: PubMed, Scopus, SciELO, Redalyc, Lilacs and Google scholar. The search strategy combined six search terms related to the impact of trombiculid mite bites on human health: 1) Trombiculid, 2) Bites, 3) Humans, 4) epidemiology, 5) distribution, and 6) Case reports to provide results as broad as possible. The search included all publications until May 27th, 2020, having the year 2008 as the date threshold. Other studies were included when the species or the study was not included in other reviews (15).

Study selection and data extraction

The studies were eligible for inclusion if they reported cases or series of cases of trombiculid bites and included at least one patient. We defined studies as a case report if they described a single case and as a series of cases if they described more than one patient. Titles and abstracts were used to assess the eligibility of each study. Studies that were not published in English, French, Spanish or Portuguese were excluded. Two reviewers independently screened the search results for inclusion and then extracted all data using a standardized data extraction form. The discrepancies were resolved through discussion until consensus was reached. Information was extracted about the first author, country, year of publication, genus and species of Trombiculidae, number of patients, site of bite, days of hospitalization, age, sex, clinical manifestations, treatment, characteristics of the report and outcome.

Quality analysis

We performed as well a general quality analysis of each study. To do this both reviewers extracted all data using the method described above. Afterwards coherence, findings, discussion, conclusion, register of the case and diagnostic reasoning was evaluated.

Statistical analysis

The data extracted were summarized as means with standard deviation for quantitative variables and as number and percentage for qualitative variables, as appropriate. Comparisons between groups were performed using the chi-square test or Fisher's exact test, depending on the case. All analyses were performed using the statistical package RStudio, version 1.2.5 (Boston, MA).

Results

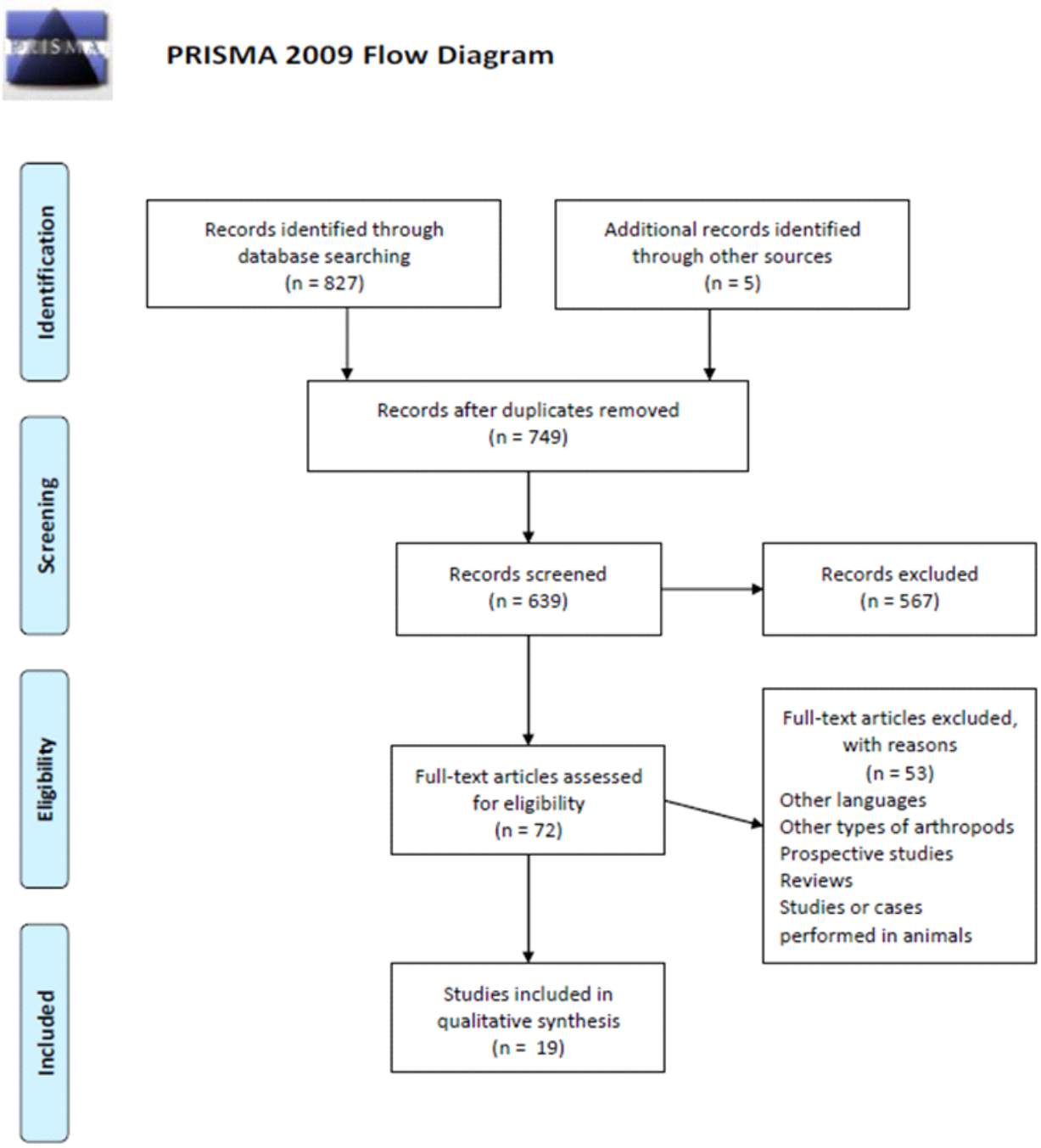
Selection of studies

The systematic literature search yielded 832 records, 827 through database searching and 5 from other sources (Figure 1). After removing duplicates, 749 articles remained. Titles were appraised. After this action 639 records were screened, excluding 567. The remaining 72 articles were assessed for eligibility to finally include 19 in the qualitative synthesis.

Study characteristics

Of the 19 included studies, 13 were case reports, 4 case series and 2 descriptive studies that were included due to their novelty. These studies reported clearly 49 cases. The 264 cases included in this review had an average age of 33.7±6.4 years old and affected mostly men but there were no differences. Most cases were published in the year 2017 (Figure 2), the most frequent origin of publication were United States of America and Mexico, other countries included Bolivia, Brazil, Spain, Guyana, Italia, Japan, Peru, South Africa, Turkey.

Figure 1. PRISMA diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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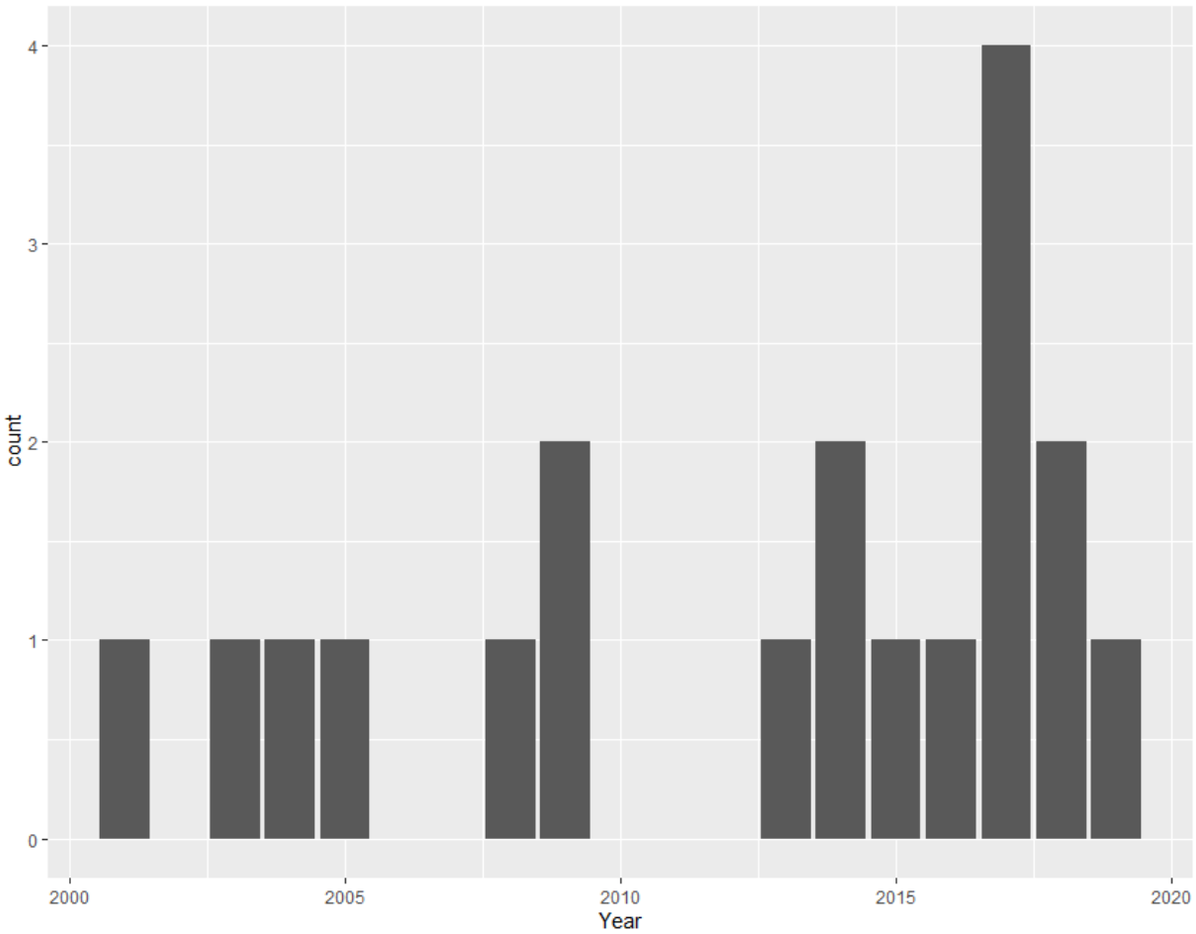
Figure 2. Publication date of the articles included in this systematic review



Distribution of Trombiculidae

Thrombiculid mites are found worldwide. In Europe and the Americas, they tend to be more frequent in hot and humid regions. In the more temperate regions, they are found only during the summer. More than 50 species have been recorded affecting human beings, although, only some are considered medically important because they are vectors of rickettsial diseases, . Some of the recorded are *Neotrombicula* in Europe, several species of *Leptotrombidium* in Asia, and species of *Eutrombicula* in North and South America. Some of the trombiculid species confirmed to bite humans can be seen in Table 1 (2).

Clinical aspects

The most frequently reported symptoms were local, with local erythema, pruritus and papules as the most common (Table 2). No deaths or life-threatening conditions were documented. 45% of the reports included were not able to identify the specimen to species level. The most common biting site were the extremities, but face waist, hand and trunk and other biting sites were registered as well (Table 2).

Table 1. Distribution of species of Trombiculidae that have been shown to bite humans

Region	Species
Asia	*Leptotrombidium akamushi*
	Leptotrombidium scutellare
	Leptotrombidium pallidum
	Leptotrombidium pallidum burnsi
	Leptotrombidium palpale
	Eutrombicula wichmanni
	Neotrombicula nagayoi
	Shoengastia hanmyaensis
	Leptotrombidium fuji
	leptotrombidium intermedium
	Leptotrombidium kitasatoi
	Gahrliepia saduski
	Eutrombicula sarcina
	Leptotrombidium deliense
	Leptotrombidium akamushi
	Leptotrombidium pallidum
	Leptotrombidium arenicola
	Leptotrombidium fletcheri
	Leptotrombidium pavlovski
North and South America	*Apolonia tigipioensis*
	Eutrombicula alfreddugesi
	Euschongastia nuñezi-hoffman
	Eutrombicula alfreddugesi
	Eutrombicula splendens
	Eutrombicula lipovsky
Europe	*Neotrombicula autumnalis*
	Eutrombicula alfreddugesi

Source: Obtained and modified from (2), (16) and (17)

Table 2. Clinical characteristics of the patients and studies included in this systematic review*

Author	Year	Region	Patients	Age	Sex	Species	Medical History	Intervention	Symptoms	Site	Lesions
(18)	2001	South Africa	1	NR	M	*Leptotrombidium subquadratum*	NR	NR	Severe allergic reaction. Dermatitis + pruritus	NR	Specimens were attached to the sites
(19)	2003	Guyana	1	45	F	NR	Asthma. Albuterol. 2 arthroscopic knee surgery. Novocain allergy	Elliptical excision followed byflushing. Levofloxacin 7 days 500mg per os per day	Intense pruritus, fever. Erythematous area, with hypertrophy int the sulcus area of the base of the 2n toe, pain to dorsiflexion and palpation	Second toe of her right foot	Black, painful lump.
ÄČĎÅ	2004	Japan	1	50	M	*Neotrombicula nagayoi*	NR	Use of repellants	Pruritus that lasted 10 days, erythematous halos	Left forearm with two orange-colored mites	Vesicle, pruritic papules
ÄČĆÅ	2005	Venezuela	1	74	F	Trombiculids	NR	Topic acaricides alongside antihistamines	Intense pruritus	Trunk, Axillae, cubital areas	erythematous papules of 2/3mm with central red dot. Excoriations
			1	2	M	Trombiculids + *Sarcoptes scabiei*	NR	Topic acaricides alongside antihistamines	Intense pruritus + excoriations + eschars	Axillae, trunk, flex areas, periumbilical areas, and behind the ears	Erythematous papules of 2/3mm with central red dot. Excoriations
(11)	2008	Bolivia	NR		NR	*Eutrombicula batatas*	NR	NR	Pruritus, dermatitis, secondary infection, eschars excoriations	NR	NR
ÄČĈÅ	2009	Peru	18		NR	*Trombicula autmnalis*	NR	NR	NR	Legs, groin, testicles, eyelids, buttocks	Erythema, excoriations and pruritus
ÄČČÅ	2009	United States of America	1	5	M	NR	Unremarkable	NR	Pruritus, persistent crying and inability to sleep	Periumbilical area and groin, Toe and finger webs	Maculopapular rash
ÄČĊÅ	2013	United Kingdom	1	72	F	*Neotrombicula autumnalis*	Left eye cataract. No travel history or hill walking. Cat owner. Used paraffin ointment, no effect	Mite removal, Carbomer gel eye drops (Viscotears)	Pain, erythema	Left conjunctiva	Red eye
ÄČÇÅ	2014	Spain	1	29	F	NR	Owns 2 dogs. Recent travel with relatives (3 adults 1 baby) which developed similar symptoms.	Antihistamines, not accepted due to breastfeeding. Baths with colloidal oatmeal and cotton cloths. Cloth cleaning with hot water was recommended	Pruritus, erythematous papules	Ankles, posterior aspects of knee, groin, external genitals, hypogastrium and lateral thorax	Pruritus, erythematous papules
(25)	2014	United States of America	1	4	M	NR	Unremarkable	Oral diphenhydramine, topical 1% hydrocortisone cream and cold compresses. Symptoms resolved in 1 month	Pruritus and extreme swelling in the penis (Summer penile syndrome)	Back and scrotum	Extreme edema of the scrotum and penis. Multiple crusted, papular lesions on his back, upper extremities and scrotum
ÄČĆÅ	2015	Mexico	1	3	M	Trombiculids	NR	Antihistamine, liquidambar balsam, almond oil and ivermectin	Pruritus, multiple papules	Extremities, upper and lower, face	Pruritic papules, erythema, excoriation crust
ÄČĎÅ	2016	Mexico	4	6	M	Trombiculids	Unremarkable	Oral ivermectin, antihistamine and topical crotamiton	Pruritus, multiple papules	Face, neck, axillae, abdomen, back, limbs, retroauricular	Hyperpigmented lesions, with a hypopigmented central area and a sunburst appearance. Hyperkeratosis with parakeratosis. Mild spongiosis Elimination of the melanin pigment. In the invaginated epidermis, oval structures with an exoskeleton layer were observed in the stratum corneum.
ÄČĐÅ	2017	Italy	1	49	M	*Trombicula autmnalis*	Unremarkable	NR	Erythematous plaques and pruritus	Right leg	Erythematous plaques and pruritus

ÄČĐÅ	ږو ۍ	Brazil	10	NR	M/F	*Eutrombicula batatas/Eutrombicula alfreduggesi*	NR	NR	Dermatitis, pruritus, papules	feet, legs, knees, hands, fingers, arms, face and scalp	Circular lesions, focal and multifocal, 2 to 4 cm in diameter. Inflammation, excoriation.
ÄČĖÅ	ږو ۍ	Italy	1	36	M	*Neotrombicula autumnalis*	Unremarkable. History of trekking and contact with animals (owner of dogs)	Rupatadine 10 mg daily per os, triamcinolone benetonide0.03% + fusidic acid 2% cream topically. Washing garments at a minimum of 60 °C for trek participants and their whole families. Veterinary consultation for dogs and other animals. Dogs were treated with a topical permethrin–pyriproxyfen combination, achieving complete healing.	Several intensively pruritic papules and nodules	Arms and legs	Erythematous papules, nodules, excoriations
ÄČĆÅ	ږو ۍ	Italy	1	38	F	*Neotrombicula autumnalis*	NR	NR	Intensely pruritic, erythematous, papules and nodules	Abdomen, hips, buttocks and upper legs	Papules and nodules, excoriations
ÄČĈÅ	ږو ۍ	Italy	1	53	M	*Neotrombicula autumnalis*	NR	Oral antihistamine, and topical application of permethrin, followed a twice daily application of antibiotics and steroids.	an intensely itching and skin eruption	waist, groins, pubes and ankles	clusters of minuscule, reddish corpuscles, hardly visible to the unaided eye, protruded from some lesions. A few excoriations were associated to the dermatitis
ÄČČÅ	ږو ۍ	Italy	2		M/F	*Eutrombicula tinami*	NR	None	Papular dermatitis	Extremities	Circular, focal and multifocal, with papular inflammatory reaction with a center papule and a hyperemic centrifuge halo of sizes ranging from 1 to 3 cm in diameter

* NR: Not recorded/not registered in the original publication. +: Indicates that treatment was a combination of drugs.

Summer penile syndrome

It is a seasonal syndrome characterized by swelling, pruritus and erythema of the penis and scrotum skin, patients tend to be younger than 12 years-old, in someit is a recurrent condition (25), symptoms include pruritus, edema, dysuria and reduction of urine stream. Although it is not pathognomonicin some patients a papule or bite site can also be found (34). Treatment consists in anti-inflammatory drugs and compresses. The duration of the symptoms can be as long as one month (25), although it tends to last 1-18 days (34).

Scrub Typhus - *Orientia tsugugamushi*

Causative agent of Scrub Typhus, is transmitted by the larval stage of *Leptotrombidium* species of trombiculids (35). Its incubation period is 8–10 days, although it can be as long as 20 (36). The bite of the trombiculid is painless, although a local allergic reaction occurs, an eschar at bite site can appear in approximately half of the cases (37). Symptoms of the disease include: fever, chills, headaches, myalgia and hearing loss, which can be considered specific to this infection depending on the context. Signs, such as conjunctival injection, lymphadenopathy and maculopapular rash, can be present. Other symptoms include cough, tachypnea, dyspnea and bibasilar rales, which are accompanied with infiltrates in chest radiography, sign than can be relatively common in patients with the disease. Complications include adult respiratory distress syndrome, acute renal failure, disseminated

intravascular coagulation and encephalomyelitis (38). Its differential diagnosis can be infectious mononucleosis, leptospirosis, tularemia, anthrax, spotted fever group rickettsioses, other rickettsial diseases, murine typhus, and Q fever. It can be treated with tetracycline, doxycycline or chloramphenicol. In childhood and pregnancy, consider the macrolides clarithromycin or roxithromycin (39). The case fatality rates range between 1-15% (17, 37). The cost of this disease can be high (40).

Quality analysis

Trombiculiasis is particularly important in travel medicine (17), and can be confused with a wide array of tropical maladies. Regarding the general quality analysis, the results were heterogenous. Some articles were solid with adequate patient follow-up and consideration of differential diagnoses. In other reports this aspects weresomewhat lacking. Regarding laboratory analysis and identification of the different specimens associated with accident was not possible in some cases. In other case reports the evidence was not as solid, in some, the patient information such as demographic, medical and familial background was not as complete as could be hoped, most of the cases did not present a timeline, and the diagnostic assessment in some was not as clear as possible. In some reports and articles discussion was not present or as solid as it could be. Patient perspective was not present in most if not all the cases, and there was not clearly stated information regarding the informed consent of the patient in several of the reports.

Discusión

Alongside many other neglected diseases and parasitosis, the ones produced by mites are often forgotten. One of such conditions is known asTrombiculiasis, this is an infestation caused by the larvae of various types of mites, also known as chiggers (must not be confused with tungiasis, sometimes called the same), they belong to the class Arachnida and the family Trombiculidae (2). Even so, they are an important parasite and an important vector or rickettsial diseases in several parts of the words. Due to the relatively unrecognized clinical importance this systematic review provides an overview of the trombiculids reported in literature biting humans, their distribution and effects of the bite on human health. Even so, the amount of published information is limited. As well, due to the way this study was conducted it is possible that thesis, monographs, case reports and many other articles, mostly written in the Asian Languages were, most likely, not included.

Our results show that there are different species of mites that can have important consequences for human health, but its plain parasitosis appear to be generally mild, as no cases of mortality were registered, being one of the possible reasons for the lack of knowledge in the region, the perception of non-medical importance. As this is possibly the case, the recent cases of scrub typhus in several part of the world show us the importance of vigilance of all emergent and reemergent diseases, especially due to the relationship this parasite has with animals and that the greatest proportion of new diseases are zoonotic in nature. Even so, it must be saidthat scrub typhus remains one of the most life-threatening and common of the rickettsial infections in some regions of Asia.

In that regard, the transmission of *Orientia* is not restricted to the Asian region. This fact gives way to a wide array of questions, showing our lack of understanding of the global distribution of species of trombiculids with vectorial capacity and the real distribution and burden of scrub typhus. In that regard, we must deepen and expand our knowledge and understandings in the ecology, life cycle, feeding behavior and vectorial capacity, not only to diagnose and treat in a timely manner whichever transmitted pathogen but to prevent the emergence of new pathogens and possible health care emergencies, we must understand the dynamics of transmission, so loss of life can be prevented. This is especially important as more records of scrub typhus in South America, Africa and Middle East are appearing. In that sense, the presence of this cases could indicate the existence of a capable vector in the region, therefore, we must determine which species is responsible, if one is really present, and assessed which one of the associated specimens is the most important. As well, we must determine why was this disease only recently identified, is distribution and burden, if its presence was not identified due to a lack of diagnostic capabilities or if it is new, due to the importation of vectors (or a native capable one) or pathogens. As well physician awareness must be improved, the amount of research increased, to be able to diagnose rapidly and prevent outbreaks of emergent and reemergent diseases.

In that sense, it must be said that, even as it is not frequently reported in the literature, Trombiculiasis is relatively common worldwide and can affect people of any age and sex. However, it can be easily overlooked because it is usually transient, affects vulnerable populations and there are, in general, no systemic signs. Trombiculiasis can be often misdiagnosed and it is mainly confused with an allergy. Mite bites are initially painless, and often the only sign of exposure is severe itching that can persist for more than two weeks. There is also irritation caused by contact with the mite's saliva, which can quickly establish itself in some individuals, generating severe inflammation. Mites generally attack in large numbers due to the clumping phenomenon, resulting in multiple bites. Given their preference for adhering where the skin is thin or in closer contact with clothing, stings tend to focus on the knees, ankles, thighs, axillary region, groin, and genitalia.

Despite the great variety of species found in different areas of the world, studies found that mites of medical interest belong to 20 species, the most relevant being *Leptotrombicula, Neotrombicula* and *Eutrombicula* similar to former reviews (15, 17), although we found other mites not included in those papers. The most medically important species, such as the L. delicense group, L. akamushi and L. *fletcheri* are found only in Asia. In that regard, certain species are vectors of scrub typhus in parts of India, Sri Lanka, Burma, China, Korea and Japan. Although most cases are reported in low-lying areas, these infections can occur up to 3,500 m.a.s.l. in the Himalayas, signs and symptoms include fever, headache, muscle pain, cough, and gastrointestinal symptoms. The more virulent strains of O. tsutsugamushi - the causative agent of scrub typhus - can cause bleeding and intravascular coagulation. Leukopenia and abnormal liver function tests are commonly seen in the early phase of the disease. Pneumonitis, encephalitis, and myocarditis occur in the late phase of the disease. Without treatment, the disease is often fatal. The especies associated to transmission of *Orientia tsutsugamushi* belong to the genus *Leptotrombidium* (15, 41)

Finally, there are numerous mites that feed on the blood of domestic and wild animals that can in occasions come into contact with humans and cause dermatitis. People have been seen to generally become infested with mites while walking in areas of long grass and scrub vegetation, but the incidence of the disease is unknown. In endemic areas, diagnosis is generally made clinically, despite the fact that the history of a mite bite is often absent and diagnostic tests are often not available. In relation to laboratory tests for scrub typhus, all currently available tests have their limitations. The serological test that is available is the Weil-Felix test, but it is unreliable. The gold standard is indirect immunofluorescence; however, the availability of fluorescent microscopes is its main limitation. Other methods like polymerase chain reaction, but these are not commonly available.

The main limitations of this study are varied. They include a possible publication bias because less significant findings are less likely to be published, not all languages were used, not gray literature was assessed, the number ofe databases was limited number of languages used, no prospective studies were included. On the other hand, information on the clinical manifestations and comorbidities of the patients was limited, which have a strong impact on mortality. In addition, these were case reports, which are known to have low methodological quality and are not representative of the population.

In synthesis, the systematic review conducted in this study provides a summary of the clinical conditions caused by the bite of a trombiculids as well as the associated species, here mortality was not documented and, to our knowledge has never been associated to the plain bites of this arachnid, although due to the transmission of bacterial pathogens is another story. Due to international travel, increasing human population and globalization the number of accidents involving this species could rise in the future. Knowledge about the medical importance of these arthropods is still lacking.

Conclusión

The systematic review conducted in this study provides a summary of the clinical conditions caused by the bite of a trombiculids as well as the associated species, although the symptomatology was varied no mortality was not documented and has never been associated to the bites of this arachnid, although deaths secondary to the transmission of bacterial pathogens is another story. Several species have been associated to especially from the genera *Leptotrombidium*, *Neotrombicula* and *Eutrombicula*, although other species from other genera were recorded as well. This parasite has a cosmopolitan distribution, but the greatest number of reported species found in this review were from Asia (*Leptotrombidium, Eutrombicula, Gahrliepia)*, followed by America (*Apolonia, Eutrombicula*), Europe (*Eutrombicula, Neotrombicula*), an Africa (*Leptotrombidium*). Due to international travel, increasing human population and globalization the number of accidents involving this species could rise in the future, possible giving . The ability to transmit serious pathogens must prompt more research on the distribution and burden of this parasites. Knowledge about the medical importance of these arthropods is still lacking.

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