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# Verified spider bites in Oregon (USA) with the intent to assess hobo spider venom toxicity

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ABSTRACT

This study compiled 33 verified spider bites from the state of Oregon (USA). The initial goal was to amass a series of bites by the hobo spider to assess whether it possesses toxic venom, a supposition which is currently in a contested state. None of the 33 bites from several spider species developed significant medical symptoms nor did dermonecrosis occur. The most common biters were the yellow sac spider, *Cheiracanthium mildei* ($N = 10$) and orb-weavers of the genus *Araneus* ($N = 6$). There were 10 bites from three genera of funnel web spiders of the family Agelenidae including one hobo spider bite and one from the congeneric giant house spider which is readily confused as a hobo spider. The hobo spider bite resulted in pain, redness, twitching in the calf muscle and resolved in 12 h. Also generated from this study were possibly the first records of bites from spiders of the genera *Callobius* (Amaurobiidae) and *Antrodiaetus* (Antrodiaetidae), both with minor manifestations.

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## 1. Introduction

For many decades and continuing to current day, the spider bite literature has suffered from the proliferation of envenomation reports where spider involvement is suspected or presumed (Anderson, 1991; Vetter and Isbister, 2008; Nentwig et al., 2013). The lack of evidence-based medicine has resulted in misdiagnoses and the artificial expansion of incorrect bite signs and symptoms in the medical literature (Vetter and Isbister, 2008). A call for more stringent requirements in the publication of spider bite reports includes greater proof of spider involvement, preferably verified bites with the offending culprit caught in the act of biting and identified by a qualified arachnologist (Anderson, 1991; Isbister, 2002; Vetter and Isbister, 2008). Indeed, this appears to be occurring with greater frequency in the spider bite literature (e.g., Nentwig et al., 2013).

In North America, the widow spiders (genus *Latrodectus*) were generally accepted to be medically important in the early part of the 20th century (Vetter and Isbister, 2008) and the brown recluse, *Loxosceles reclusa*, was established to cause dermonecrosis in 1957 (Atkins et al., 1957). The hobo spider, *Eratigena agrestis* (see note below regarding a genus name change), was added to the list of toxic North American spiders in 1987 even though Vest (1987a,b) presented this arachnid as a "probable" but not definitive cause of dermonecrosis. Despite this non-definitive assertion, the medical community, news media and the general public quickly embraced this newly implicated spider as a toxic entity such that, without additional proof, it was considered to be a major source of dermonecrosis in the Pacific Northwest, elevated to

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importance through repetitive citation in the medical literature rather than the accumulation of verified bite information (Vetter and Isbister, 2004). However, using electrically milked hobo spider venom, Binford (2001) could not replicate the dermonecrosis-inducing effect in the same strain of rabbits used to initially implicate the spider as being toxic. This spider is European in origin and is not considered toxic in the Eastern Hemisphere. The evidence that a hobo spider bite leads to necrotic skin lesions is suspect (Binford, 2001; Vetter and Isbister, 2004). Hence, hobo spider toxicity has been seriously challenged.

Using verified spider bites (accompanied by the spider) reported to the Oregon Poison Control Center (OPC), this study was initiated with the intent to ascertain whether hobo spider bites were indeed toxic. Although the medical importance of the hobo spider was the instigating factor, we collected data on all verified bites reported to the OPC. This allowed us to determine the degree to which hobo spiders are involved in envenomations in the Oregon area. Additionally, another European immigrant, the congeneric giant house spider, *Eratigena atrica*, is also found in the Pacific Northwest (Vetter et al., 2003), is readily misidentified as a hobo spider due to similarity in appearance and could be involved in bites; we hoped to provide information on envenomations of this spider as well which to date has not been implicated as medically important.

[Taxonomic note: there has been an important change involving the taxonomy of the genus *Tegenaria*. Bolzern et al. (2013) determined through molecular and morphological analysis that the spider genus *Tegenaria* was not monophyletic and reassigned several species to other genera. The hobo spider, *Tegenaria agrestis*, was transferred to a new genus *Eratigena*, an anagram of *Tegenaria*. Several species of closely related taxa were synonymized under *E. atrica* including a second Pacific Northwest inhabitant, the giant house spider, which has been referenced in the literature under the names of *T. gigantea* and *Tegenaria duellica*, causing disagreement among arachnologists over its correct specific epithet (Vetter et al., 2003). This synonymy now renders this disagreement moot as *E. atrica* is considered to have moderate variation in its genitalic structure and is absorbing these other species.]

## 2. Materials and methods

### 2.1. Collection of verified spider bite reports

This was a prospective observational study of verified spider bites in Oregon, USA. IRB approval was obtained. After an extensive media campaign, patients who reported a spider bite to the OPC were identified by researchers and invited to participate. Inclusion criteria were any persons who saw or felt themselves get bitten by a spider and immediately obtained the spider at or near the bite site. Patients were contacted within one week of their bite and basic demographics were obtained, as well as circumstances surrounding the bite and any local or systemic symptoms as well as any pertinent past medical history. Patients were sent a container in which to place the spider and were asked to return the container to the OPC. Patients were contacted by phone for 1 and 3 weeks after the bite. Patients who had persistent symptoms after the 3 weeks, were followed until resolution of all symptoms.

Spiders were identified to the lowest taxon possible. Immatures were often only identifiable to genus, although some were assigned to species due to the presence of only one species of that genus in the area. Some specimens were missing critical body parts or were destructively captured which precluded identification to species.

## 3. Results

### 3.1. Bite demographics

In a 3-year period, 33 verified spider bites with the offending spider identified by an arachnologist were reported to the OPC (Table 1). These bites included spiders of at least 13 species, in 10 genera in seven families. Bite victims included 21 females (mean age = 39.6 ± 22.7, range = 1.7–76) and 12 males (mean age = 44.0 ± 13.2, range = 24–67) with an overall mean age of 41.2 ± 19.7 years (range = 1.7–76). Ten bites occurred outdoors, 22 indoors with one of unknown location.

### 3.2. Bite manifestation

None of the verified spider bites in this study resulted in serious injury or dermonecrotic lesions. Of the 33 bite victims, 28 reported redness (85%), 26 pain (79%), 26 swelling (79%) and 17 itching (52%). Only 15 (45%) reported systemic symptoms such as headache, nausea, anxiety, fatigue, fever, and vision changes with only two persons reporting more than one symptom. Mean time to resolution of all symptoms was 7.8 ± 15.3 days (range = 0.13–84) with most signs and symptoms except for small amount of redness and swelling at the bite site resolving within 24 h.

The body part that was envenomated most often was the hand with nine incidents followed by the arm, leg and neck (four each), the back, finger and foot (two each) and single episodes of bites to the abdomen, ear, eyelid, face, lip and scrotum.

### 3.3. Agelenidae

#### 3.3.1. Eratigena *(formerly* Tegenaria*)*

Three episodes involved bites by a male hobo spider, *E. agrestis*, a female giant house spider, *E. atrica*, and an immature of undeterminable species. The hobo spider bite to the leg of a 48-year old man elicited pain, redness, and twitching of the calf muscles with symptoms resolving in 12 h. The giant house spider bite to a hand elicited pain, itching, redness, no systemic symptoms and resolved in a day. The immature *Eratigena* bite had pain, itching, swelling and redness on the hand of a 45-year old male victim, which took 10 days to resolve.

#### 3.3.2. Agelenopsis

Four bites to appendages were administered by three male *Agelenopsis pennsylvanica* and a male *Agelenopsis oregonensis* with pain, swelling and redness for all and itching for the *A. pennsylvanica* bites. One bite resulted in

**Table 1**
Spider bite demographics.

| Age | Sex | Location | Bite | Pain | Itching | Swelling | Redness | Systemic | Time to symptom resolution | Genus | Species | Spider common name | Gender |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | Male | Inside | Finger | Yes | Yes | Yes | Yes | Back pain | 1 week | *Agelenopsis* | *pennsylvanica* | Funnel weaver | Male |
| 50 | Female | Inside | Leg | Yes | Yes | Yes | Yes | None | 10 days | *Agelenopsis* | *pennsylvanica* | Funnel weaver | Male |
| 18 | Female | Outside | Foot | Yes | Yes | Yes | Yes | None | 1 day | *Agelenopsis* | *pennsylvanica* | Funnel weaver | Male |
| 13 | Female | Inside | Hand | Yes | No | Yes | Yes | None | 3 days | *Agelenopsis* | *oregonsis* | No common name | Male |
| 43 | Male | Outside | Neck | Yes | No | Yes | Yes | None | 4 days | *Antrodiaetus* | *occultus* | No common name | Male |
| 28 | Female | Outside | Hand | Yes | No | Yes | No | Fever, numbness | 12 weeks | *Araneus* | *saevus* | No common name | Female |
| 24 | Male | Outside | Neck | Yes | Yes | Yes | Yes | Anxiety | 2 days | *Araneus* | *diadematus* | Cross spider | Male |
| 35 | Female | Outside | Arm | Yes | Yes | No | Yes | Nausea, ha | 1 week | *Araneus* | *diadematus* | Cross spider | Female |
| 49 | Female | Outside | Leg | No | No | No | Yes | None | 3 weeks | *Araneus* | *diadematus* | Cross spider | Female |
| 56 | Male | Inside | Back | Yes | Yes | Yes | Yes | None | 2 weeks | *Araneus* | *diadematus* | Cross spider | Male |
| 66 | Female | Inside | Leg | Yes | No | Yes | Yes | Muscle cramp | 2 days | *Araneus* | *diadematus* | Cross spider | Female |
| 22 | Female | Inside | Foot | Yes | Yes | Yes | Yes | Nausea | unable to follow | *Callobius* | – | No common name | Immature |
| 30 | Male | Inside | Scrotum | Yes | Yes | Yes | Yes | None | 6 h | *Cheiracanthium* | *mildei* | Yellow sac | Female |
| 37 | Female | Inside | Finger | Yes | Yes | Yes | Yes | None | 2 days | *Cheiracanthium* | *mildei* | Yellow sac | Female |
| 25 | Female | Outside | Arm | No | Yes | Yes | Yes | None | 4 weeks | *Cheiracanthium* | *mildei* | Yellow sac | Male |
| 61 | Female | Inside | Arm | No | Yes | Yes | Yes | Tremors | 2 days | *Cheiracanthium* | – | Yellow sac | Immature |
| 1.7 | Female | Inside | Abdomen | No | No | Yes | Yes | Fever | 5 days | *Cheiracanthium* | – | Yellow sac | Immature |
| 51 | Male | Outside | Back | Yes | No | Yes | Yes | None' | 1 day | *Cheiracanthium* | *mildei* | Yellow sac | Female |
| 30 | Female | Inside | Face | Yes | No | Yes | Yes | None | 3 days | *Cheiracanthium* | *mildei* | Yellow sac | Female |
| 35 | Female | Inside | Lip | Yes | No | Yes | Yes | Sore throat | 2 weeks | *Cheiracanthium* | *mildei* | Yellow sac | Female |
| 34 | Male | Inside | Ear | No | No | Yes | No | None | 1 day | *Cheiracanthium* | *mildei* | Yellow sac | Female |
| 61 | Male | Inside | Arm | Yes | No | Yes | Yes | Vision changes | 3 days | *Cheiracanthium* | – | Yellow sac | Immature |
| 34 | Male | Inside | Neck | Yes | No | Yes | Yes | Fatigue | 2 days | *Hololena* | *nedra* | Funnel weaver | Male |
| 67 | Male | Inside | Hand | Yes | No | Yes | Yes | None | 1 week | *Hololena* | *nedra* | Funnel weaver | Male |
| 36 | Female | Inside | Hand | No | Yes | No | Yes | None | 1 day | *Hololena* | *nedra* | Funnel weaver | Male |
| 71 | Female | Unknown | Neck | Yes | Yes | Yes | Yes | Headache | 5 days | *Latrodectus* | *hesperus* | Black widow | Immature |
| 1.7 | Female | Outside | Hand | Yes | No | No | No | Muscle spasms | 4 days | *Latrodectus* | *hesperus* | Black widow | Immature |
| 66 | Female | Inside | Hand | Yes | Yes | No | No | None | 1 day | *Phidippus* | – | | Abdomen missing |
| 73 | Female | Inside | Hand | Yes | Yes | Yes | Yes | None | 2 days | *Phidippus* | – | | Female |
| 38 | Female | Inside | Hand | No | No | Yes | No | None | 3 h | *Steatoda* | *grossa* | False black widow | Female |
| 76 | Female | Outside | Eyelid | Yes | Yes | Yes | Yes | None | 10 days | *Eratigena* | – | | Immature |
| 45 | Male | Inside | Hand | Yes | Yes | No | Yes | None | 1 day | *Eratigena* | *duellica* | Giant house | Female |
| 48 | Male | Inside | Leg | Yes | No | No | Yes | Twitching in calf | 12 h | *Eratigena* | *agrestis* | Hobo | Male |

back pain. Resolution of symptoms in these bites ranged from 1 to 10 days.

#### 3.3.3. Hololena

Three bites (two hand, neck) occurred from male *Hololena nedra* spiders all with redness, two with pain and swelling and one with itching. Resolution was reported in 1–7 days. One bite resulted in fatigue.

### 3.4. Miturgidae

Bites by the yellow sac spider, *Cheiracanthium mildei*, were the most frequently recorded in this study ($N = 10$) and envenomation locations were scattered all over the body. They were inflicted by six females, three immatures and one male. All ten bites showed swelling, nine exhibited redness, with six registering pain and only four with itching. Systemic events included sore throat, tremor, fever and vision changes. Resolution of symptoms averaged $5.9 \pm 8.7$ days.

### 3.5. Araneidae

Orb-weavers were responsible for six bites, five from *Araneus diadematus* (two males, three females) and one from a female *Araneus saevus*. The *A. diadematus* bites (two hand, leg, back) involved redness with four causing pain and three resulting in itching and swelling with resolution occurring in $9.2 \pm 8.2$ days. Systemic symptoms involved anxiety, nausea, headache, and muscle cramps. The bite to the hand from *A. saevus* appeared more severe with pain, swelling, fever and numbness; resolution required 12 weeks.

### 3.6. Theridiidae

Immature black widow spiders, *Latrodectus hesperus*, were responsible for two bites with pain, itching, swelling, redness and headache resolving in five days for a neck bite, whereas the second, to the hand, had pain and muscle spasms with resolution in four days. A bite to the hand by a female false black widow, *Steatoda grossa*, caused only swelling with resolution in 3 h.

### 3.7. Salticidae

Two bites to the hand by jumping spiders of the genus *Phidippus* caused pain and itching with swelling and redness with resolution in one and two days.

### 3.8. Amaurobiidae

The bite of an immature spider of the genus *Callobius* to a foot resulted in pain, itching, swelling, redness and nausea. We were unable to follow up for time of resolution.

### 3.9. Antrodiaetidae

A neck bite by a male mygalomorph, *Antrodiaetus coylei*, caused pain, swelling and redness and resolved in four days.

## 4. Discussion

In our study, verified bites of spiders from the state of Oregon did not result in significant medical conditions. This is similar to the conclusions of Nentwig et al. (2013) for 14 Swiss spider bites and Isbister and Gray (2002) for most of the 700 Australian spider bites after those of well-established medical importance (i.e., *Latrodectus*, *Atrax* and *Hadronyche* spiders) were excluded. The lack of medical significance of verified spider bites of less toxic, generic species is an important counterpoint to the decades of presumptive and circumstantial case histories that exaggerated spider bite episodes, leading to a tainted body of toxicological information.

In regard to the hobo spider, we only received one verified biter of this species resulting in minor manifestations and no necrotic lesion formation. Likewise, one bite from *E. atrica*, also produced minimum deleterious effects. Nentwig et al. (2013) list three *E. atrica* bites from Switzerland, similarly with minimal expression and Jäger (2007) described it as harmless to humans. Although the sample size is small, several notions can be put forward from this data. First, unless our data is not representative of reality, the hobo spider is not a common biting spider in the area that we sampled although it is frequently found around Portland, Oregon (Vetter et al., 2003). The hobo spider is medium-sized and, hence, when adults bite, they should be large enough to cause noticeable pain with fang penetration in skin, and therefore, should be noticed at the bite site, captured and submitted for identification. This lack of verified hobo spider bites is noticeable in the literature. Akre and Myhre (1991) list 34 potential case histories to incriminate hobo and related spiders but a detailed inspection of their data reveals only one verified bite to the lip of a curious dog. Vest et al. (1996) lists one verified hobo spider bite in a woman that led to necrosis. However, she had a co-morbidity of phlebitis which also leads to skin lesions and did not seek treatment until 11 weeks post-bite, making it difficult to tease out the contributing factor of spider involvement in lesion formation. Second, closely related members within a particular genus (e.g., *Latrodectus*, *Loxosceles*, *Atrax*) typically possess the same deleterious venom components. Considering that no other *Eratigena* or *Tegenaria* spider is known to be toxic, the status of hobo spider venom toxicity is dubious. To answer the question of hobo spider toxicity will require more verified bites, however, our study lasted 3 years in a highly populated portion of the Pacific Northwest (approximate population of Portland and suburbs is 2.2 million people). Yet we could only generate one verified hobo spider bite. It does not seem like this spider is a frequent biter and the reports of alleged bites in the media and from the general public greatly outnumber the reality of the situation.

In regard to the other funnel-weaving species, this study is the largest series of *Agelenopsis* bites of which we are aware. Vetter (1998) reported two bites, one on the neck of a 9-year old boy who developed somewhat significant symptoms (pallor, nausea, myalgia, arthralgia) probably due to his small body size. But otherwise, *Agelenopsis* bites are relatively harmless. The three *H. nedra* bites adds to the literature for this genus, where Vetter (2012) reported three

other bites by *Hololena* spiders, two of which caused 4-h episodes of vomiting in robust male bite victims. In our study, the *H. nedra* bites were of minor importance. Also, it may be beneficial to point out that the araneomorph funnel weavers of the family Agelenidae are relatively harmless and are not closely related to the mygalomorph funnel web spiders of Australia which are highly toxic. This mistake was made in a dermatology review of arthropod bites (Steen et al., 2004) and corrected by Vetter and Swanson (2005). Although these corrections may appear academic in nature, if physicians are not aware of the inaccuracy, it could lead to overzealous treatment and an anxiety-induced affair for a spider bite of actual minor importance as well as the further proliferation of errors in the spider bite literature.

Of the remaining species, the yellow sac spider, *C. mildei*, is a common biting spider whose envenomations are consistent with those that have been discussed in Vetter et al. (2006). One possibility for the abundance of this spider in our study is that their bites are painful like bee stings upon inception, sometimes awakening sleeping victims (Vetter et al., 2006) so they are more likely to be noticed. Many other spider bites are like pinpricks and less conspicuous.

Except for the *A. saevus* bite, the bites by orb-weavers were minor similar to that reported by Isbister and Gray (2002). One immature black widow caused muscle spasms which is a typical symptom of latrodectism. The bite by *S. grossa* was minor, similar to other verified cases (Isbister and Gray, 2003; R. S. V., unpub. data). Isbister and Gray (2003) report that *Steatoda* bites resemble mild latrodectism with most bites resolving within 24 h although this spider can cause more significant reaction (Graudins et al., 2002). *Steatoda* bites respond to black widow antivenom (Graudins et al., 2002; Isbister and Gray, 2003). Additional minor responses elicited by *Phidippus* jumping spiders were less severe than a report of bites by that genus (Russell, 1970). The bites of *Callobius* and *Antrodiaetus* may be the first records of verified bites from these species.

Although we did not reach our goal of establishing a series of verified hobo spider bites, the three *Eratigena* bites that we did receive add a modicum of evidence that spiders of this genus do not contribute to being etiologies of dermonecrosis. The hobo spider bite here involved pain, redness and muscle twitching that resolved within 12 h similar to most bites from non-medically important spiders. Considering how rare it was for a hobo spider to contribute to this study, it may require a multi-state effort to generate a series of verified bites to more definitively address the question of its venom toxicity. However, until that happens it seems prudent to consider the hobo spider to be of non-medical significance.

## Ethical statement

We have read the ethical statements and this manuscript complies with all of the standards expected for a manuscript submission.

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## Conflict of interest

The authors declare that there are no conflicts of interest.

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