

Prospective cohort study of definite spider bites in Australian children

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Objectives: To describe the clinical effects of spider bites in a paediatric population and compare to bites in an adult population.

Methods: Prospective follow up study of children with definite spider bites where the spiders were immediately collected and expertly identified. Cases were recruited from Australian emergency departments and poison information centres and followed up. Data were collected on circumstances of bites and clinical effects, and compared with similar data from adult spider bites.

Results: There were 163 cases (62% male, 38% female; age <16, median age 7 years, interquartile range (IQR): 3–11 years). The median duration of effects was 2 h (IQR 0.25–12 h). The commonest spiders were Huntsman spiders (*Sparassidae*) and Orb weavers (*Araneidae*), and comparatively few bites by theridiid spiders, including Red-back spiders. Pain or discomfort occurred in all bites and was severe in 20%. Local effects included puncture marks/bleeding (36%) and red mark/redness (73%). Systemic effects occurred in only 6% of cases. There were no necrotic lesions or ulcers as a consequence of any spider bites (0%; 97.5% CI 0.0–2.2%) and no early allergic reactions or secondary infections. The median duration of clinical effects was shorter than adults, the frequency of severe pain was less than adults and systemic effects were less common in children.

Conclusions: Paediatric spider bite causes minor effects in the majority of cases, and is unlikely to cause necrotic ulcers, allergic reactions or infection. The severity and duration of effects differ from adults.

Key words: arachnidism; latroductism; spider; spider bite; venom.

Spiders are a common topic of fear, which is often instilled from a young age. Spider bite is associated with considerable mythology¹ resulting from media attention focused on the occasional severe or fatal case.² Most spiders are not of any medical significance² and their bites cause only minor effects in adults.³ Currently, there is little published data on spider bites in children. It is thus not possible automatically to assume that findings in adult studies will be the same in a paediatric population, and this supposition needs to be tested.

The effects of medically significant spider bites appear to be more severe in children. Spiders deliver the same amount of venom to adults and children when they bite, so children receive a greater venom mass per kilogram. This is confirmed in case reports and records of deaths.⁴ Seven of 13 recorded deaths due to bites of Australian Funnel-web spiders were in children⁵ and the only death in a study of bites by the Brazilian armed spider was in a child.⁶ Similarly with Widow and Red-back spiders the effects in single cases and one retrospective series appear to be worse than for adults,^{7,8} although that is not confirmed in another retrospective series of Red-back spider bites.⁹

The effects of the majority of bites of groups of spiders world-wide are thought to be minor and not to require medical attention.² However, the more severe effects of a small group of spiders in children have created a general fear of any spider. It is important to establish that most spiders cause only minor effects in children, not only for reassurance of patients and parents, but also so that health care resources can be focused on more severe envenoming and not be wasted on the majority of trivial bites.

This study reports a large prospective study of definite spider bite in children, with expert identification of all spiders. The identifications are reported to family level in most cases for clarity. The hypothesis was that the pattern of bites, the types of spiders and the clinical effects of spider bites in children differed from adults, but that the majority of cases were minor.

MATERIALS AND METHODS

Subjects were recruited prospectively for a 27-month period from February 1999 to April 2001 by two different processes. Only paediatric cases were included in this analysis and were defined as age less than 16 years.

1. The first group consisted of children or adolescents presenting to two Australian emergency departments, Royal Prince Alfred Hospital (Sydney) and Royal Darwin Hospital. Patients were all examined by the attending medical officer or the author. A parent or guardian was asked for permission for their child to participate in the study by providing the spider and allowing phone follow up. Written consent was obtained from the parents or guardians. All follow up was done over the telephone by the author after 1 week, or longer if required.
2. The second, much larger group consisted of phone referrals from three of the four state poison information centres (PIC) in Australia, including the Western Australian (WA) Queensland (QLD) PIC, and New South Wales (NSW) PIC,

Table 1 Comparison of the characteristics of excluded (spider not obtained) and included (spider obtained) definite bites

Characteristic	Included spider bites (163)	Excluded definite bite cases (119)	P-value
Female	61 (38%)	47 (41%)	0.619
Male	102 (62%)	72 (59%)	
Age (median and IQR)	7 (3–11)	5 (3–9.75)	0.287
Geographical distribution			
NSW	69 (42%)	37 (32%)	0.104
WA	33 (20%)	20 (18%)	0.643
Season			
Summer (Dec–Feb)	50 (31%)	48 (42%)	0.056
Winter (Jun–Aug)	10 (6%)	9 (8%)	0.632
Time of day			
Day time (0800–2000)	115 (71%)	75 (77%)	0.251
Night time (2400–0800)	16 (10%)	6 (6%)	0.364

the last of which provides an overnight service to the whole of Australia. Calls regarding spider bites in children or adolescents to these three PIC, where the spider had been caught, were included and the caller was asked to participate in the study. Verbal consent was obtained from the parents or guardians and their details were recorded. These subjects were all re-contacted and interviewed by the author, then followed up after 1–2 weeks, or until the clinical features had resolved. In some cases the initial call was received from a hospital to the PIC, but similar consent from the parents or guardians was obtained for follow up.

The study had strict inclusion criteria so that analysis was made only of definite bites, where the spider was collected for identification. For inclusion as a definite bite there needed to be a clear history of the spider biting and collection of the spider at the time of the bite.¹⁰

The following information was recorded for each spider bite: demographics (age, gender, geographical location), circumstances of the bite (location, time, date, activity at the time, season), bite site, local and systemic effects (onset, duration, severity), and past medical history (full details available from the authors). Systemic effects included: nausea, vomiting, headache, lethargy, malaise, abdominal pain and diaphoresis. In patients seen in an emergency department, other features indicative of systemic effects were included (e.g. tachycardia, hypertension). Duration of effects was defined as the length of clinical signs and symptoms of the bite. The duration of a mark alone at the bite site was insufficient, and other symptoms such as pain or swelling needed to be present, for this to be included in the duration of effects. Severe pain was defined as pain greater than a bee sting or equivalent.

A cohort of spider bites in adults (16 years and older) was used for comparison. This included all spider bites after the exclusion of paediatric spider bites and contained identical information as the paediatric spider bites.

The spider was collected directly from the patient or parents, or mailed to the authors for identification. Spiders were stored in 70% ethanol and kept at the Australian Museum. Spider identification was done by an expert arachnologist, Dr Mike Gray. In this study, spider identification is analysed at family level, except for the family *Theridiidae* and mygalomorph spiders.

Ethics approval was obtained from the Central Sydney Area Health Service Ethics Review Committee (RPAH Zone), the Joint Institutional Ethics Committee of the Royal Darwin Hospital and the Menzies School of Health Research and the Ethics Committee of Royal Children's Hospital and District, Brisbane to cover all institutions involved.

For descriptive statistics median and interquartile ranges (IQR) are used for data not normally distributed. For comparison of proportions of two groups Fisher's exact test was used. 95% confidence intervals (CI) were calculated. All statistical analysis was done using GraphPad Instat (Version 3.05, 32 bit for Win 95/NT created September, 2000).

RESULTS

A total of 1474 subjects were recruited during the 27-month period: 182 cases were suspected bites with no stated age and 979 were adult cases (age ≥16 years), leaving 313 definite paediatric cases (nine were seen in an emergency department and 304 were calls to a PIC).

There were 163 definite paediatric spider bites where the spider was obtained by the authors and identified. 150 of the 313 cases were excluded, 119 of these were definite spider bites (90 where no spider was received and 29 where the spider was lost) and 31 (9.9%) were excluded for other reasons (no actual bite or reaction (7), unable to contact subject (2), suspected bites not fulfilling inclusion criteria (19)¹⁰ the creature was not a spider (2), and the spider sent was not the culprit (1)). No parents or guardians refused consent to the study. Baseline characteristics of subjects with included bites compared to those with excluded definite bites are detailed in Table 1.

Table 2 lists the families of spiders and the number of bites/reactions they caused. The majority of bites occurred in the warmer months and throughout all of Australia. The majority occurred between 0800 and 2400, with only 10% occurring outside this time. Of the 163 patients 21 patients (13%) were seen in hospital, nine were recruited from emergency departments and 14 were calls from hospitals to the PIC (three from children's hospitals).

Of the 163 subjects with definite spider bites, there were 102 males (62%) and 61 females (38%). Age ranged from 1 to 15 years with a median age of 7 years (IQR: 3–11 years). Bites occurred to all parts of the body, with 47% distal (hand or foot), 30% on the proximal limb, 16% on the trunk and 7% on the head/neck (Table 3). The activity at the time of the bite is included in Table 3 and is compared to bites in adults.

Pain or discomfort occurred in all 163 definite bites, was mild to moderate in 130 cases (80%) and severe in 33 cases (20%). Puncture marks or localized initial bleeding occurred in 36% of bites. Swelling occurred in 11% and redness or a red mark in 73% of cases. Systemic effects occurred in nine of 163 bites (6%), including nausea (4), vomiting (1), headache

Table 2 Numbers of spiders responsible for definite bites in children according to spider family. The common name of the family is included where its use is reasonably consistent and members of the family are noted if they are medically important

Common name and important members	Spider family	Number	%
Huntsman spiders (see figure) including <i>Heteropoda</i> spp.	<i>Sparassidae</i> ^{†,‡}	31	19
Orb weavers	<i>Araneidae</i> ^{†,‡}	31	19
White-tail spiders, including <i>Lampona</i> spp.	<i>Lamponidae</i> [§]	23	14
Wolf spider including <i>Lycosa</i> spp.	<i>Lycosidae</i> ^{†,‡}	16	9.8
Lace web spiders including <i>Badumna insignis</i> (Black house spider)	<i>Desidae</i> [§]	10	6.1
Darting spiders	<i>Corinnidae</i> [†]	8	4.9
Spotted or ant spiders	<i>Zodariidae</i> [†]	7	4.3
Jumping spiders	<i>Salticidae</i> ^{†,‡}	6	3.7
Large jawed-spiders	<i>Tetragnathidae</i> [†]	5	3.1
Comb-footed spiders, including: Widow spiders (<i>Latrodectus</i> spp.) (see figure); Cupboard spiders (<i>Steatoda</i> spp.)	<i>Theridiidae</i> ^{†,‡}	5	3.1
Mouse spiders (<i>Missulena</i> spp.)	<i>Actinopodidae</i> ^{†,‡}	4	2.5
Funnel-web spiders	<i>Hexathelidae</i>	4	2.5
<i>Atrax</i> spp. and <i>Hadronyche</i> spp.			
Sac spiders including <i>Cheiracanthium</i> spp.	<i>Clubionidae</i> ^{†,‡}	3	1.8
Trapdoor spiders	<i>Nemesiidae</i> ^{†,‡}	3	1.8
Crab of flower spiders	<i>Thomisidae</i> [†]	2	1.2
Ground spiders	<i>Gnaphosidae</i> [†]	2	1.2

Families from the mygalomorph group (primitive spiders) are marked in bold. The following three families of spider caused only one bite: *Miturgidae*, *Idiopidae*, *Nicodamidae*. [†]Spiders with a wide distribution outside Australasia; [‡]Spiders known to cause bites in countries other than Australia;^{11–17} [§]Spiders limited to Australasia.

Table 3 Comparison of the circumstances and clinical effects of definite bites in children and in adults

Features/Circumstance	Paediatric (163)	Adult (587)	P-value
Gender (%)			
Male	62%	40%	< 0.0001
Female	38%	60%	
Bite region (% hand/foot)	47%	50%	0.594
Outdoors (%)	32%	38%	0.193
Activity at the time:			
Dressing	20%	14%	0.066
Playing	18%	0%	–
In bed/sleeping	8%	8%	1.00
Putting on shoes	8%	7%	0.601
Catching/touched/picked up spider	12%	17%	0.115
Median duration of effects	2 h (IQR 0.25–12 h)	4 h (IQR 0.5–48 h)	0.005
Local effects:			
Severe pain	20%	29%	0.02
Fang marks or blood	36%	32%	0.301
Redness or red mark	73%	67%	0.183
Swelling	11%	13%	0.509
Systemic effects	6%	15%	0.0013

The adult data are taken from the remaining data set of 750 definite spider bites after removing the paediatric bites (163 definite paediatric spider bites and 587 definite adult spider bites).³

(3), malaise (2), abdominal pain (2) and tachycardia (1). The frequency of local and systemic effects was less in children compared to adults (Table 3). The median duration of effects was 2 h (IQR 0.25–12 h) which was significantly shorter than for adults (Table 3).

There were no necrotic lesions or ulcers as a consequence of any spider bites (0%; 97.5% CI 0.0–2.2%). There were no early allergic reactions to spider bites (0%; 97.5% CI 0.0–2.2%), despite one of 48 cases (2.1%) who gave a comprehensive allergy history, reporting bee sting anaphylaxis. There were no cases of confirmed infection. Fang marks and bleeding occurred more commonly with larger spiders, including Huntsman spiders (*Sparassidae*) and mygalomorphs (Funnel-web spiders, mouse spiders and trapdoor spiders).

There were 11 bites by mygalomorph spiders and four of these were by Australian Funnel-web spiders. Three of the four Funnel-web (*Hadronyche* and *Atrax* spp.) spider bites were managed in hospitals and one was requested to attend hospital, but did not attend. There were no major envenomings and no systemic effects in any of these cases. Four bites were by three species of Australian mouse spiders (*Missulena* spp.). In two cases the child had mild systemic effects including headache in one and tachycardia in the other, but no major envenoming.

There were only five bites by theridiid spiders, one was a Red-back spider (*Latrodectus hasselti*) bite, two were *Steatoda* spp. (Cupboard spiders), one was *Achaearanea* spp. and one could not be identified past family. Three of the five (one each of *Latrodectus*, *Steatoda* and *Achaearanea*) caused moderate to

severe pain persisting for at least 12 h, with the most severe pain for 2 days in the *Latrodectus* bite. None of these bites caused systemic effects and antivenom was not used.

DISCUSSION

Often assumptions are made about spider bites in children based on both the fear of spiders and by extrapolation from evidence available from adult studies. In this large study of paediatric spider bites, cases were recruited and contacted prospectively, with follow-up and expert identification of all spiders. It provides the most accurate information on spider bite in children to date and gives comprehensive information on paediatric spider bites in Australia. It also provides information on bites by important groups of spiders occurring worldwide² including *Sparassidae* (Huntsman spiders), *Araneidae* (Orb weavers), *Lycosidae* (Wolf spiders) and *Salticidae* (jumping spiders) and *Latrodectus* (Widow spiders).

The analysis was done on 163 definite bites with expert spider identification. All cases were followed up for at least one week by contacting the parents. This clearly defined the time course of clinical effects. Although a number of biases were introduced in the recruitment of definite cases, the sample is a good representation of paediatric cases of spider bite presenting to health care facilities in Australia.

Eighty one percent of bites were caused by eight families of spiders. Six of these have world-wide distribution and are known to be responsible for bites occurring outside Australia.^{11–17} The majority of bites caused only minor effects, and did not require treatment in a health care facility. The commonest biting families of spiders were Huntsman, Orb weavers and Wolf spiders which are similar to those involved in adult bites.³ This study demonstrates that these large and common spiders cause minor effects only.

There is one previous large study of spider bites in children,⁹ which was retrospective without follow up or formal identification of spiders. Some larger series have included children with adults^{6,12,13,18} but again all of these were retrospective and only a few had formal spider identification. The only previous direct comparison of paediatric and adult spider bites was in a study of bites by the armed spiders in Brazil.⁶ This study showed no difference in overall severity of effects between patients under 10 years of age and adults, but the only two severe cases (one death) occurred in children.⁶ Three series of Widow spider bites in children provide conflicting evidence about the severity of bites in children.^{8,9,19}

This study demonstrates that there are some differences between bites by adults and children (Table 3). The main limitation of this comparison is that more adults were bitten by Widow spiders, that have been shown to cause more significant effects.³ However, if this group of spiders is removed from the analysis, systemic effects still occur significantly more commonly in adult spider bites (data not shown).

Relatively more bites occurred in boys than in adult males. This is most likely due to a reporting bias for female adults, and young boys being more adventurous in their play activities. The circumstances of the bites were not too dissimilar, although more bites occurred when children were playing. The incidence of redness and fang marks was not different between adults and children, and severe pain was less frequent in children. This is most likely due to subjective interpretation of the pain because no validated instrument for the measurement of pain could be used over the phone. Different daytime pattern of bites shows more occurring during the day. This would be expected compared to adults where a larger proportion were in the evening.³

There were less paediatric bites by spiders of the family *Theridiidae* (includes Widow spiders) (3%) (Table 2) compared to adults (11%)³ of all Australian spiders. It is unclear why this difference occurred, and whether it was due to fewer children being bitten by Widow spiders compared to others, or whether they were more likely to attend hospital than phone a PIC. The majority of the cases in the study were recruited from PIC calls which may explain this difference. However, there were more bites by the Australian Funnel-web spider (2.5%) (Table 2) in children than in adults (1.1%)³ which goes against this hypothesis since this spider is the most venomous in Australia and far more likely to cause death. The difference may be explained by the fact that more Widow spider bites occur in adults due to occupational exposure, which does not occur in childhood. Despite this, the effects of the few *theridiid* spider bites in this study were significant, with severe pain for 48 h in the one definite Red-back spider bite.

There were no cases of necrotic ulceration in this series, another feared complication of spider bite. This included 23 bites by White-tail spiders that caused only minor effects. Various spiders have been implicated in necrotic arachnidism,^{20,21} although firm evidence only exists for *Loxosceles* spp.¹⁸ which have only been introduced to a small part of South Australia.²² This study demonstrates that necrotic arachnidism is unlikely to occur in Australian children, including bites by other groups that have previously been implicated in necrotic arachnidism, Wolf spiders, White-tail spiders (*Lampona* spp.) and sac spiders (*Cheiracanthium*).^{20,21}

There were no cases of allergic reaction to spider bites in this study, which is consistent with previous reports in children. There were also no cases of confirmed secondary infection although bites are commonly implicated in these. This is similar to adult bites where only seven out of 587 cases consistent with infection were reported.³

There were a number of limitations of this study. The first was the bias created by recruiting children only if they had caught the spider, and were willing to send it to the investigators. This is less biased than including cases only from hospital admissions, which would exclude the majority of minor bites. The study included 21 cases from hospitals, three of these Funnel-web spider bites, suggesting that the study included a reasonable sample of patients presenting to hospital. In addition, the results are more applicable to health professionals looking after children, because of the inclusion of both hospitalized patients and calls to PIC.

The inclusion of the majority of subjects from calls to PIC meant that the majority of children were not examined by the investigator. However, the major outcomes of the study, including pain and duration of pain, necrotic ulcers, allergic reactions, subjective systemic effects, and local effects, were able to be obtained over the phone from the parents using a standardized questionnaire. The parent or older child was asked to carefully describe well defined local effects, including redness, swelling, bleeding and fang marks, and the symptoms that they suffered. This was equivalent to a medical history obtained in an emergency department. The majority of negative findings and minor local effects (e.g. redness) meant that there was little bias introduced into the results by all children not being examined.

Finally there are difficulties in distinguishing between non-envenoming spiders and potentially venomous spiders that have a low envenoming rate. There is no doubt that Funnel-web spiders cause life-threatening effects in children and the reason for minor effects in all four bites in this study is due to those particular bites not causing envenoming and confirms the suspected 10–20% envenoming rate.²³ Conversely, it is highly unlikely that Huntsman spiders are ever dangerous to humans²⁴

and the 31 bites in this study by Huntsman spiders that caused no effects or minor effects, confirms this in children. Therefore, care should be taken in interpreting the results of this study where only a few cases by a particular species/family are reported. The relatively small sample size means some groups are not well represented, such as the unusually small number of Red-back spider bites.

This study demonstrates that the majority of effects of spider bites in children are minor, and the severity is the same or less than that of spider bites in adults. These children could be rapidly discharged from medical care, reducing pressure on health care resources. However, the study did not include enough cases of Red-back spider bites or bites by Funnel-web spiders to confirm or deny this conclusion in these groups of spiders. It is still appropriate to assume that Red-back spiders may cause significant effects in children, based on the few cases in this report and previous studies.^{7,8,13,19,25}

Contributors

Geoffrey Isbister, the chief clinical investigator, designed the study, made all ethics submissions, interviewed and followed up every patient in the study, did all data analysis and interpretation, and wrote the paper. Mike Gray identified all spiders in the study.

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