

Medical Prominence of Solpugids (Arachnida: Solifugae) in Natural Surroundings

**Mahad Bin Zahid¹, Muhammad Farhan Sarwar¹,
Muhammad Haroon Sarwar¹, Muhammad Sarwar^{2, *}**

¹Mayo Hospital, King Edward Medical University, Lahore, Pakistan

²Agricultural Biotechnology, National Institute for Biotechnology & Genetic Engineering (NIBGE), Faisalabad, Pakistan

Abstract

Solifugae (solifuges, solifugids, solpugids) is an order of animals in the class Arachnida known variously as camel spiders, wind scorpions or sun spiders. The order includes more than 1100 described species in about 153 genera within 12 families. Solpugids arachnids occur in tropical and temperate deserts with large distinctive curved chelicerae, often as long as the cephalothorax. Despite of the common names, they are neither true scorpion (order Scorpiones) nor true spiders (order Araneae). Solpugids have lack of sting, are bigger than spiders and unlike spiders do not have any poisonous glands. They differ most obviously from their spider and scorpion relatives in three ways: their massive two-segmented jaws, which can be up to one-third of their body length and are armed with teeth and spine-like and horn-like processes of various sizes; the flagellum, found on the jaws of adult males in most species and thought to play a major role in reproduction; and the malleoli, racquet-shaped sensory organs on the underside of the first segment of the last pair of legs. Solifugae live in dry climates and feed opportunistically on ground-dwelling arthropods and other small animals. The largest species grow to a length of 12-15 cm, including legs. They are typically crepuscular or nocturnal, hiding during the day under stones and in crevices or burrowing in loose soil and habitats largely devoid of vegetation; while some species occur in grasslands and forests. They ruthlessly chase, hunt, stalk and scavenge using their leg-lengthed pedipalps to snatch prey while using their jaw-like chelicera, and process digestive juices to masticate their invertebrate and small vertebrate victims to a pulp. Despite of their formidable appearance and aggressive nature, solpugids lack venom glands and are relatively harmless to humans and most domestic animals (they can nip if grab them). Wind scorpions will only attack if they feel threatened or they are disturbed and this will result in a bite, but because they cannot produce venom, the bite is not serious. Apply an ice pack to reduce any pain or discomfort on the affected area by putting of ice in a plastic sealable bag. Bites by larger species, however, can puncture or lacerate the skin, occasionally requiring stitches to close the wound. A solpugid's access into the home can be greatly reduced by checking of caulking and weather stripping around windows and doors as well as sealing areas where utilities (water, electricity, gas, etc.,) come into the home. Periodically checking around these areas is a good practice and will limit entry by other nuisance pests such as ants, mice, rats, scorpions, centipedes and bugs. This article describes their general appearance, greatly enlarged chelicerae for capturing of insects and other prey, unique sensory structures called racquet organs, biology and behaviour, medical importance along with treatment and control.

Keywords

Arachnida, Chelicerata, Camel Spiders, Solpugid Fauna, Biodiversity

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* Corresponding author

E-mail address: drmsarwar64@gmail.com (M. Sarwar)

1. Introduction

Fear of poisonous animals is a routine or common practice since some of them are venomous and cause dangerous side effects or even death in human [1-14]. Solpugids are considered among arthropods that are of great importance in ecological balance. Solpugids are one of the smaller groups of arachnids, represented by 12 families with about 153 genera and more than 1,100 species worldwide. They are known by many common names, including camel-spider, sun-spider, wind-spider and barrel-spider in the family Solpugidae [15]. Camel spiders belong to the class Arachnida, but while all spiders are arachnids, not all arachnids are spiders. Another common name is wind scorpion (in recognition of their rapid movement), but it is not a scorpion. They are ferocious predators capable of rapid movement. The term 'camel spider' refers to a prominent arch-shaped plate on the prosoma. They are, however, more closely related to members of the order Pseudoscorpions [16].

The solifuges body is divided in two parts: a prosoma (carapace) and the opisthosoma (abdomen). Otherwise, their bodies are composed of two parts, cephalothorax and abdomen. The prosoma is divided into three sections: propeltidium (head) contains the chelicerae, eyes, pedipalps and first two pairs of legs; the mesopeltidium holds the third pair of legs; and metapeltidium comprises the fourth pair of legs. The body of solpugids is often covered with short hairs and divided into two distinct body segments - a cephalothorax (head) with two distinct eyes and four pairs of legs and a 10 segmented abdomen. Their characteristics include: enlarged articulated chelicerae, often bearing tooth-like serrations; a rostrum or beak-like mouth; long pedipalps, used as sensory organs; a reduced first pair of legs; and mallet-shaped sense organs called 'malleoli' on the basal segments of leg 4, more pronounced in males. In males, heavily modified bristles (flagella) are on the fixed chelicerae-finger except in members of the family Eremobatidae [17].

Most species of Solifugae are nocturnal predators, emerging from relatively permanent burrows to feed upon a variety of arthropods. They are generalist predators and attack a wide variety of arthropods, as well as small lizards, birds and mammals, and their immature stages feed extensively on termites. Some solifuges sit in the shade and ambush their prey, while others run their prey down and once they catch it, they eat while the prey is still alive with vigorous ripping and cutting actions of the powerful jaws. Though camel spiders appear to have ten legs, they actually have eight. The two extra leg-like appendages are sensory organs called pedipalps. Camel spiders can reach up to 15 cm in length and weigh about 56 gm [18].

Camel spiders are carnivores and they eat other bugs, lizards, small birds and rodents. Their heads come to a point, which is interesting and it is where their chelicerae meet. Chelicerae are essentially jaws, used to catch prey. Their jaws are their primary weapon and after seizing a victim, they turn it to pulp by chopping or sawing the bodies with their jaws. Camel spiders utilize digestive fluids to liquefy their victims' flesh, making it easy to suck the remains into their stomachs. Unlike spiders, camel spiders breathe with a trachea, which allows for fast oxygen intake and helps them to move quickly. When a person runs, the camel spider will chase the shadow. If a person stands still, the camel spider will, too, enjoying the cool. Though camel spiders seek to avoid the sun during the day, they are attracted to light at night, and will run toward it. Camel spiders can run up to 16 kph and jump up to 1 meter high. Many solifuges are able to run at extremely fast speeds (53 cm/ sec) for short bursts, but like most arachnids, cannot sustain such rapid locomotion for long periods [19, 20].

They feed on insects and worms, scorpions and small animals. They have very large pedipalps that are very effective sensory organs and play an important role in detecting prey or food. The pedipalps of these animals have different papillae and hairs that are various in different families. They play a basic role as mechanical and chemical receptors. Solpugids have so powerful chelicerae that they can easily hunt preys larger than themselves. Of course, the power of each species is different from that of others, therefore, their ability in hunting preys is different, too [21].

Despite of their reputation and frightening appearance, solpugids are of negligible threat to humans. They are not dangerous and threatening and only in rare cases such as being threatened by humans, they may bite or produce voice. These animals bite, which like other poisonous and non-poisonous animals, increases the risk of infection. These animals are not poisonous and only in one case, it has been reported that one species of the Solpugids is poisonous and that its poison has led to the rat's death. Of course, no other reports have been presented in confirming this report. Given the importance of solpugids in terms of causing fear and discomfort and the possibility of biting humans and their abundance in tropical zones, the identification of different species of these arthropods is of the foremost significance in various regions [22].

They have the largest jaws for their size of any terrestrial invertebrate. Each chelicera consists of a fixed upper portion and an articulated bottom joint forming the equivalent of a nutcracker or pair of pliers. Armed with teeth and filled with muscle, they are formidable weapons. Each one moves independently, allowing the solifuge to rip and tear its prey [23].

Reality is far more interesting when it comes to camel spiders. They are highly adapted to the arid environments, covered with fine hairs, they are insulated from the desert heat and sparse, longer setae act as sensors which help to find prey by touch. There are also rows of sensory organs on the underside of the hind legs. These stubby, hammer-shaped appendages are called 'racket organs' or malleoli. They are basically chemoreceptors, literally sniffing out information about the substrate the animal is traversing. Solpugids can even detect subterranean prey at a shallow depth, through the malleoli and tapping movements of the pedipalps [24].

The pedipalps, which in solpugids are easily mistaken for the first pair of legs, are long, stout, and tipped with 'suctorial' organs that are useful to the animal when it needs to ascend vertical surfaces or pin down struggling prey. The first pair of legs, immediately behind the pedipalps, is very slender and also used as sensors, waving constantly along with the pedipalps. A cornered camel spider may rear up, waving both pairs of appendages menacingly and opening its jaws. Solpugids are covered in bristles and fine setae (hairs), some of which are very long and keenly sensitive to air currents and other tactile stimulation. Denser coatings of hair help to insulate the creatures against the extreme heat of the desert environment. The order reaches its zenith of diversity in the Middle East. However, some families are too arbitrarily defined and lump genera, while others are too narrowly defined and split genera creating a phylogenetic cobweb [16, 25].

2. Reproduction and Development

Solifugae are typically univoltine (reproducing once a year). Reproduction can involve direct or indirect sperm transfer; when indirect; the male emits a spermatophore on the ground and then inserts it with his chelicerae in the female's genital pore. To do this, he flings the female on her back. Although mating has been observed in just a few species, in some solifuges, sperm transfer is direct, though there is still precopulatory behaviour and the male inserts his chelicerae into the female orifice before and after sperm transfer [26].

Solifugae mating is very interesting and in general, mating takes place in three phases; the attack phase, the contact phase and the release phase. Once the male and female sense one another they assume an attack posture. The female may become more submissive and the male moves forward to initiate the contact phase. The male calms the female by chewing on it lightly and gradually. Males apparently do not make a spermatophore. Indeed, the attack phase during courtship can be mistaken for an attempt at cannibalism by a male intent on mating. The female repels its advances and flees or assumes a submissive posture. The male then grasps

it at mid-body and massages her with his jaws while stroking her with his pedipalps and first pair of legs. He may lift and carry her to a short distance or simply continue courting at the initial spot of contact. When the female is sufficiently calm the male places the female into various positions and stimulating it with its chelicerae. He eventually secretes a droplet of sperm from his genital opening, cradles it in his jaws and uses his chelicerae to force the sperm into the female's genital opening, and then seminal fluid is transferred directly from the male to the female. If mating is successful, the release phase follows where the individuals may immediately leave or enter into direct combat. Mating rituals vary among the different families of camel spiders, but these basics are consistent [16, 27, 28].

The female then digs a burrow, into which she lays 50 to 200 eggs – some species then guard them until they hatch. Because the female does not feed during this time, she will try to fatten herself beforehand, and a species of 5 cm has been observed to eat more than 100 flies during that time in the laboratory. The female lays eggs at the end of a burrow then seals the burrow and leaves it. Solifugae undergo a number of stages including, egg, postembryo, 9-10 nymphal instars and adults. The eggs hatch after a few weeks and after a second moult the immatures leave the burrow. Immatures apparently feed extensively on termites [29].

What little is known about the growth and lifespan of solpugids is cobbled together from studies of a wide range of species. Captive specimens may not always be representative of wild individuals, either. At least two members of the family Eremobatidae have been shown to lay eggs, deposited by the female in her burrow. Females *Eremobates durangonus* Roewer put batches of 20-264 eggs under laboratory conditions, about eleven days after mating. The young that hatch go through eight instars before reaching to sexual maturity as adults. An instar is the interval between moults. Like all arthropods, solpugids must periodically shed their exoskeleton in order to grow. Solpugids probably live fast and die young, with the average lifespan of hardly exceeding one year [30].

3. Natural History

Camel spiders are part of the order Solifugae (solpugids), which are mainly found in dry places. It is tan in colour, with a segmented abdomen that is a bit darker and typically rounded. The camel spider has four pairs of legs and no stinger. This creature also has pedipalps, which are appendages that sense vibrations and catch prey. Their pedipalps lack pincers and probably notice the enormous jaws as an identifying characteristic. The body commonly has short hairs [31].

Most camel spiders are nocturnal, though some are active by day (hence 'sun spider' as an alternative name). They can be seen around outdoor lights at night where they prey greedily on insects that have fallen to the ground. By day, they hide under boards, flat stones, cow patties and other objects. Some species actively excavate burrows where they weather the daytime heat [32].

Solpugids seem to behave much like shrews, frantically searching for any animal of their own size or smaller to kill and consume. Most other arachnids, insects and other invertebrates are on the menu, though termites may make up the bulk of their diet, especially in the case of young solpugids. Adults may occasionally scavenge larger animals like small lizards and snakes that are road-killed or the victims of larger predators. Several raptors, owls and small mammals consume solifuges in their diets including the bat-eared fox, small-spotted genet, cape fox, african civet and black-backed jackal. Various other predators, such as the large slit-faced bat, scorpions, toads and insectivores, may also prey on Solifugae [33].

4. Medical Status of Solifugae (Solpugids)

Camel spiders are not deadly to humans (though their bite is painful), but they are vicious predators that can visit death upon insects, rodents, lizards and small birds. These hardy desert dwellers boast large powerful jaws, which can be up to one-third of their body length. They use them to seize their victims and turn them to pulp with a chopping or sawing motion. Camel spiders are not venomous, but they do utilize digestive fluids to liquefy their victims' flesh, making it easy to suck the remains into their stomachs. Camel spiders can bite if handled or restrained. The good thing is that they will likely not cause major damage; however, the bite does hurt. As always, if anyone is dealing with severe symptoms after being bitten, get medical help right away.

Because of their unfamiliar spider-like appearance and rapid movements, Solifugae have startled or even frightened many people. The Solifugae apparently have neither venom glands nor any venom-delivery apparatus such as the fangs of spiders, stings of wasps, or venomous setae of caterpillars. Though they are not venomous, the powerful chelicerae of a large specimen may inflict a painful nip, but nothing of medically significant [34].

Solpugids are not dangerous and threatening, and only in rare cases such as being threatened by humans, they may bite or produce voice. The bites of these animals, like other poisonous and non-poisonous animals increase the risk of infection. These are not poisonous and only in one case, it

has been reported that one species of the Solpugids is poisonous and that its poison has led to the rat's death. Of course, no other reports have been presented in confirming this report. Given the importance of solpugids in terms of causing fear and discomfort, and the possibility of biting humans and their abundance in tropical zones, these have medical importance [35].

Solpugids are considered predatory arthropods that easily feed on different animals including scorpions and these two animals usually live in common habitats, and considering the point that these animals can enter the house in the urban fringe areas and rural areas, they may cause panic and discomfort or probably bite the people [36]. Solpugids sometimes become aggressive and produce sounds. They may bite for self-defence. Since their chelicerae are very powerful and cause wound, like all other bites by other animals including poisonous and non-poisonous snakes, the infection of these wounds causes infection with microbial agents of the soil or oral flora. Thus, through solpugids biting like other animals, it is possible that the wound be infected with viruses, bacteria and fungi [37].

People believe that when solpugids move on the ceiling, they drop themselves down and bite to people through their abdomen and cause death. In some cases revenge malice are attributed to these animals and people say that this animal hides itself inside a large hole beside old wooden doors and awaiting for the body of the victim to be transferred outdoors and then the solpugids returns to its nest, or after biting it goes to the cemetery and waits for the victim. These beliefs are certainly superstitious that root in people's ignorance or lack of awareness and does not have scientific basis [38].

Sometimes they take aggressive style and generate some voices for defence. It is also possible that solpugids bite for defence and cause the ulcer. This wound contamination may cause infection with soil microbial agents. Prey is located with the pedipalps, and killed and cut into pieces by the chelicerae. The prey is then liquefied and the liquid ingested through the pharynx. Although they do not normally attack humans, their chelicerae can penetrate human skin and painful bites have been reported [39].

Solpugids will readily attack humans and other animals when provoked. Despite of their terrible look and aggressive posturing, their bites usually are not serious. However, the larger species can inflict severe wounds with their powerful chelicerae. In one case, an individual has been bitten on the lip and required 10 stitches to close the wound. The greatest concern is usually preventing of secondary infections, which can lead to painful swellings, necrosis of tissues surrounding the bite site and gangrene [40].

5. How to Get Rid of Camel Spiders

Due to their predatory activity, camel spiders are actually seen as helpful. However, as they look for insects, they can enter homes. There is no cause for alarm, but anyone may wish to usher the arachnid into a container and take it back outdoors. Meanwhile, prevent the entry of all kinds of unwelcome arachnids and insects by repairing worn weather stripping on the bottom of doors, mending holes in window screens, and sealing cracks and crevices. Carefully inspect objects anyone brings indoors from outside. This includes firewood, children's toys and garden equipment [41]. Follow these subsequent tips to get rid of camel spiders:-

Try to restrict how many spots are available to enter the home; caulk and weather stripping can help to prevent the entry into homes.

Make sure that windows and doors fit tightly and spots where utilities enter to home are sealed.

When find a camel spider inside, try to capture it with a jar and then take it outside. To catch a wind scorpion, place a jar over it, and then slip a piece of paper beneath the jar to form a seal over the opening. Carry the jar outside and release the wind scorpion.

It is also a good idea to get rid of debris in a yard as well as woodpiles or sources of protection from the sun.

Outdoors, these highly effective predators are considered beneficial and may even kill an occasional scorpion or centipede. If they are found indoors, they are either feeding on insects such as crickets or other insects prey available within the house. Otherwise, they are probably looking for a way to get back outside. Since they are fast, they can be difficult to trap, but they can be caught under a jar or glass and moved outdoors. Pesticides are not recommended to manage solpugids (or scorpions and centipedes). If solpugids are regularly found indoors, one should carefully assess the situation and look for pests living indoors and locate the material providing to solpugids with a steady food source. They can also be accidentally brought indoors with firewood and other materials stored outside or in outbuildings [42].

Finding and treating of the solifugids can be challenging, especially if they are spread throughout a yard. No chemical control measures are suggested for wind scorpions. A pest management professional has the education, equipment and skills necessary to effectively address a solifugid problem.

The wind scorpion does not have pincers like a real scorpion, nor does it have the ability to secrete venom or create webs. Wind scorpions will only attack to a person if they feel threatened or they are disturbed. This will result in a bite, but

because they cannot produce venom, the bite is not serious.

Cold numbs (anesthetizes) the affected area, which can reduce pain and tenderness. Cold can also reduce swelling and inflammation. For ice pack or cold compress, put ice in a plastic, sealable bag, fill partially with water, seal the bag and squeeze the air out of it. Wrap the bag in a damp towel and put it on the affected area.

6. Conclusion

Given the importance to solpugids in terms of causing fear, discomfort and the possibility of infection in case of biting, need for determining of their importance is felt. Solpugids are in an order of hunter arthropods, and the order comprises over 1100 described species in 153 genera assigned to the 12 families: Solifuges vary in size (10-70 mm body length) and can have a leg span up to 160 mm. These do not have poison glands or sting, but they can hunt animals larger than themselves using their powerful and large chelicerae. Due to their aggressive behaviour and scary look, solpugids cause fear and horror in humans. Solifuges catch their prey with their forward stretched pedipalps using the distal suctorial organs to fasten onto the prey. The suctorial organ is usually not visible as it is encased in a dorsal and ventral cuticular lip. Once the prey has been caught and transferred to the chelicerae the suctorial gland is enclosed. The haemolymph pressure is used to open and protrude the suctorial organ. Due to having powerful chelicerae, in case of biting they may cause deep wounds that become infected. Bites by bigger species, on the other hand, can cut or tear the skin, which seldom require stitches to close the wound. Through training, the biological characteristics and behaviour, their probable losses could be presented to the people. Since public awareness about the behaviours and characteristics of these animals are low, therefore, education through the mass media can reduce people's ignorance about these animals. By reducing of public Solpugidophobia or Archnophobia, mental health of people can be increased. Future work on this order should focus on obtaining DNA barcode data from all taxa including the suspected new species.

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