

Miscellaneous Ways to Repel, Treat and Avoid Being Bitten by Sand Flies (Diptera: Psychodidae: Phlebotominae) on Human

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Abstract

Purposely, this article deals to control sand flies in human's habitation as well as how to treat and prevent their bites to avoid the problem in the future. Though both male and female sand flies feed on plant nectar, yet the females also feed on blood as they need protein from blood for egg laying and reproductive cycles. In general, sand fly bites are very painful and cause symptoms like pain, itching and unpleasantness. Most flies bite humans to feed during the evening and throughout night, but in some cases, can also attack in the daytime. Sand fly diseases are transmitted by the bite of infected female flies in many parts of the world. Direct impact on human health caused by biting flies is due to allergens in saliva reacting on peoples having varying degrees of sensitivity and immunity. Most peoples find the bites uncomfortable and distressing with the irritation leading to scratching and sometimes infected sores. Some of the more important sand flies transmitted diseases affecting to humans include cutaneous leishmaniasis, visceral leishmaniasis, sand fly fever, carrions disease, pappataci fever and vesicular stomatitis virus. The best defence against getting off sand fly bites is to dress well, wearing of long sleeve, and covering of legs, ankles and feet. Keeping of exposed skin covered by clothing, is helpful when venturing into sand fly habitats, and using of a repellent that is trust worthy. Preventing of sand fly bites can be accomplished by using of permethrin-treated nets, and irritation associated with bites may be alleviated with anti-pruritic preparations, but severe reactions may require medical treatment with antihistamines. There is no effective treatment process existing to prevent these insects breeding and travelling to the nearest blood meal, but the best remedies for such vectors appear to be keeping of residences away from being located close to breeding sites. Only topical repellents and screening of buildings can provide a measure of protection to humans. Synthetic pyrethroid barrier sprays, applied around vegetation and exterior walls may substantially reduce the numbers of adult around treated premises for many weeks. One of the best treatments used is heat therapy usually from a very hot shower, as hot as a person can take it for about 5 minutes, can neutralize toxin causing the histamine response. The possible infection of sand flies with pathogen Trypanosoma species should be taken into consideration in epidemiological studies of vector species in areas where leishmaniasis is endemic.

Keywords

Sand Fly, Phlebotomine Flies, Vector, Leishmaniasis, Sand Fly Fever

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1. Introduction

Sand flies also known as sand gnat, sand flea, punky or biting midges, have the most important ability to bite and suck blood from their hosts. Sand flies belong to the family Psychodidae and may refer to members of the subfamily Phlebotominae within the order Diptera. *Phlebotomus* spp., occurs in Africa, where it is an important vector in certain regions, Europe (particularly the Mediterranean region), and the Middle East and Asia (particularly the Indian subcontinent). A number of sand fly species are present in Europe, and in recent years, their range has been increased. *Phlebotomus mascittii* Grassi has been recorded in Switzerland, France, Belgium, Germany, Austria and Corsica. Sand fly's distribution is generally limited to areas that have temperature above 15.6°C for at least three months of the year. Below 10°C, sand flies must enter a dormant state in order to survive winter, thereby reducing the breeding population. In addition, sufficient moisture in the environment is required because humidity is an important factor for eggs survival. However, peaks in rainfall are followed by reductions in sand fly numbers as excess precipitation reduces the amount of suitable diurnal resting sites for adults and limits flight activity, as well as kills immature stages (Depaquit *et al.*, 2005; Naucke *et al.*, 2011).

Female sand flies are blood feeders and must consume a blood meal before they are able to develop eggs, but the males do not feed on blood. However, both males and females also consume sugar-related nutrients that come from plant nectar or honeydew. Sand fly's hosts vary a great deal in certain localities. Some species feed on both mammals and reptiles, while *Lutzomyia shannani* (Dyar), a common sand fly species feeds on white-tailed deer, horses, donkeys, mules, cattle, swine, raccoons, rodents, birds and humans (Ghazanfar and Malik, 2016). Their bites are very much severe as compared to mosquito bites, which are mostly red in color and bumpy, and might be itchy in some cases. As the name suggests sand flies love sandy areas, hence these are mostly found at beaches, coastal lagoons, mangrove swamps and tidal flats in the spring. In addition to this, these are capable of spreading a number of diseases like leishmaniasis and pappacti fever. Sand flies are worldwide in distribution, however, based on their genus, distribution is categorized as either old world or new world sand flies. The genera *Lutzomyia*, *Brumptomia* and *Warileya* occur in the new world countries, while the genera *Phlebotomus* and *Sergentiomyia* occur in the old world countries. They can cause severe skin problems, and typically bite the feet, ankles and legs because these body parts are closest to the ground. Sand flies can only jump around 20-40 cm, so there's much less chance of getting bitten on the upper body parts unless a

person is lying down on the sand (Bhutto *et al.*, 2003; Khan and Muneeb, 2005).

2. Appearance of Sand Fly

Studies of the vector and disease are impossible without correct identification of the sand fly species, which are epidemiologically very important. Sand fly adults are small flies, the length ranges from 1.5 mm to 5 mm and these are golden, brownish or gray in color. These have dense growth of hair all over their head, thorax, abdomen and legs. The antenna is long, beaded and covered with hair. These have large black compound eyes. Their wings make them easily distinguishable from other small flies, being pointed upwards in a vertical V-shape characteristic above the body when at rest. Their mouth-parts are short and pointed downwards, and have piercing and sucking mouthparts that are well adapted for sucking blood from their selected hosts. Also, the six legs on the adults are extremely long, being longer than the insect's body (Lane, 1993).

The life cycle of a sand fly begins at a dry area having a humid environment. The humid environment prevents the eggs from dehydration. Also the environment needs not be too cold else it might lead the eggs to stop developing. Sand flies develop by complete metamorphosis, which means they go through four developmental stages such as eggs, larvae (grub), pupae (cocoon) and adults. The female sand fly deposits 30 to 70 eggs at the breeding site and the breeding site has to be a dry area having not too cold, but a humid weather. After the eggs are laid by the female fly, these take 1- 2 weeks to hatch after being deposited and subsequently hatching eggs become larvae. Adult females fly lay eggs singularly in small batches on moist surfaces like soil in protected areas with high humidity and high organic matter. The larval stage may take no longer than three weeks to mature, but may also be longer if the larvae is in an area where it must survive cold weather. Larvae have a distinct black head and about 12 segments. Their body is entirely covered with thick hair and they have a pair of caudal setae at the end, which remains attached to them till the pupa stage. Before entering the pupal stage, the larvae stop feeding on the organic matter in their habitat and seek out a pupation site that is drier than its larval habitat. Depending on the temperature and food availability, the length of larvae can range from 1 to 3 mm. The development of pupae takes place in 5 to 10 days. After 5 to 10 days of pupae development, the adults emerge from pupae, usually before the dawn. Sand flies complete their life cycle within 1-3 months, normally the overall life cycle takes 20 to 40 days depending on the sand fly species and their environmental conditions. After emerging from the pupal case, the adults disperse at night

with the males dispersing before the females. After mating, the female needs a meal of blood to produce eggs, while males do not bite (Kasap and Alten, 2006; Durrani et al., 2012).

3. Sand Fly's Bites

There are two types of sand fly bites on humans. The first one looks like a mosquito bite and happens when the flies suck blood and then move on to another host. They inject saliva to prevent blood from clotting as these are feeding, and this saliva irritates the skin and may cause allergic reactions. The second one bite is a little worse and caused by breeding female sand flies. The flies burrow themselves into the skin and stay there until their eggs hatch. Look out for swollen areas with black spots in the middle because these may be breeding sand flies. Both bite types will cause symptoms like itching, pain and unpleasantness. When the breeding flies burrow into the skin, a person may also experience fever and infections in the area and it can develop into a condition called tungiasis, which is an inflammatory skin disease that needs to be treated for preventing of secondary infections. The females attack vertebrates such as humans, birds, bats, seals and domestic animals. As soon as a female sand fly bites a human being, it injects its saliva containing anti-coagulant. As the human's blood has a coagulating property because of that it is not easy for the sand midges to suck blood. Hence, the saliva containing anti-coagulant makes it easier to extract blood. Other than the anti-coagulant, the saliva of sand fly also has allergens that cause red, bumpy and itchy lesions (Bari and Rahman, 2008).

Some of common damages caused by sand flies are itchy red bumpy lesions (sometimes might be accompanied with pain), leishmania (kala-azar) causing cutaneous sore on human body, oraya fever, carrison's disease, sand fly fever virus, toscanca virus, chagres virus and punta toro virus, although it might vary from person to person depending on the body's immune system. Sand fly species are responsible for the transmission of human pathogens such as flagellate protozoa of the genus *Leishmania*. Some sand fly species are reported to transmit non-pathogenic flagellates of *Endotrypanum* species, originally identified as intraerythrocytic parasites of sloths in the new world. In addition, some *Trypanosoma* species of mammals, lizards, snakes and toads are transmitted by phlebotomine sand flies (Bates, 2008; Kato et al., 2010).

4. Prevention and Treatment of Sand Fly's Bites

Sand fly's control is similar to that used for mosquito because both vectors share some similar characteristics. There are

various methods for getting rid of sand flies, although the method will strongly depend on personal needs and infestation area. Below is the list of methods to get rid of sand flies depending on the infested area. Accordingly, it appears that the best cure is prevention of vector. Sand flies cluster down low on the outward branches and limbs of vegetation waiting for passing of prey. Consequently, the first areas of attack are exposed legs and ankles followed by other extremities like the hands and arms, and neck and face. So, covering of these areas can help to reduce biting although sand flies are, of course, found in hot coastal surroundings where the wearing of light summer clothing is preferable. For initial surveillance on the presence and abundance of various sand fly species, a variety of sampling methods are available; the most commonly used devices are light traps to catch host-seeking females, and sticky traps and aspirator collections to catch resting flies. Emergence traps can be used to catch flies as they leave resting sites such as animal burrows. Animal-baited traps are another option useful for sampling of host-seeking flies, and human landing catches represent a productive method for sampling anthropophilic species. Variation in climatic conditions such as temperature, humidity and wind speed can affect sampling success (Lawyer and Perkins, 2000).

When indoor places like houses, offices, pet-houses, etc., have been infested by sand flies, the subsequent steps are need to be followed. Vacuum every nook and corner of the house, especially the carpets. If householders come across any cracks in walls, floors, ceiling, window panels, etc., then vacuum these places as well. It has been proven that the vacuuming kills adults and eggs of sand flies. Steam cleaning is another most powerful way to kill eggs, larvae, pupae and adults sand flies. Reason being that sand flies cannot sustain in very high temperatures and while steam cleaning the temperature will rise to several degrees eradicating the sand flies. If householders have come across any cracks or gaps in walls, floor, ceiling, window panels and door panel, then it would need to close them after vacuuming properly. This will prevent sand flies for future infestation as they love to breed in cracks. After cleaning the house properly, spray the DEET insect repellent and householders can easily purchase it in the shopping store near to their houses. Insecticide applications against adults is the only option available and householders can also buy insecticides having d-limonene and linalool as contents (Sarwar, 2016 a; 2016 b).

When outdoors places such as garbage can, garden, lawn, etc., have been infested by sand flies, then succeeding steps are needed to be adopted. If the sand flies have infested the garbage container then just put some boric acid on the floor near to garbage container. If the infested area is sand, soil or any moist area then peoples can sprinkle diatomaceous earth

or insecticides, however peoples would need to sprinkle it again in case of a shower or rain. Bacterium *Bacillus sphaericus* is used to control sand fly larvae. In this innovative technique, bait-fed adults are used to carry the bacterial control agent to larval habitats, resulting in larval mortality in burrows up to 10-30 m away from the baited solution (Sarwar, 2016 c). For control of vector biologically, *B. sphaericus* when is applied to sugar solutions, it can be used at fly habitats, which has been shown to reduce survival and fecundity of phlebotomine sand flies (Robert *et al.*, 1997).

4.1. Prevention of Sand Fly from Human Attacking

It has always been a great admirer of preventing fly bites on human rather than treating them. If peoples want to avoid getting bitten, simply follow the subsequent tips to have greatly decrease in the chance of being bitten. If persons are going out on a stroll or walk in area prone to sand fly bites, then it is really mandatory to keep oneself completely covered, and wear socks, full sleeve shirts or tops, full length trousers or pants, hats or caps. Sand flies seem to dislike windy areas, so keep oneself moving and congregate in the breeze. It has been reported that this insect has a preference for darker colors, which contain and radiate more heat and help sand flies to track victims through infrared detection. So, wearing of light colored clothing which are also cooler in hot weather, is a reasonable defense against fly's bites. Thus, it is suggested to wear light-colored clothes to keep them away as sand flies are attracted towards dark shades. Apply any repellent on exposed body parts before going outdoors including eucalyptus oil, coconut oil, avocado oil mixed with Dettol, Chinese herbal oil, orange peel, Listerine, tiger balm, eucalipto, viks vapor rub, lemon juice, lime juice, any citrus juice, the inside of banana peel- applied by rubbing, vinegar, essential lavender oil, 1 part methylated spirits mixed with 1 part baby oil and 1 part Dettol, tea tree oil, coconut oil, vitamin B, marmite, promite, vegemite- anything with high vitamin B content, vitamin B1, vitamin B6, garlic- taken orally and applied locally, berocca, and crushed leaves from the ngaio tree. Do not visit the beach when it has been raining. Sand flies seem to be more aggressive when the air is cool and moist. Peoples should stay away from the beach in the morning and in the evening for that same reason. Most of peoples go to the beach when it is warm and dry outside anyway, so that is good. When peoples do go to the beach when it is cool outside, remember to pack insect repellent. Cover oneself up when sitting or lying down to avoid getting bitten on personal back, legs and feet. Be aware that dawn and dusk are the high risk times for fly biting. By taking cover for an hour at twilight, peoples may avoid days of irritation. The consumption of vitamin B can prove to help in

repel of sand flies, but if peoples are enjoying a holiday in an infested region then their lifestyle may benefit from a few additional vitamins anyway. DEET with the scientific name N,N-Diethyl-meta-toluamide, in 90% to 100% concentration seems to be the chemical that continually raises its head as the best defense against fly type biting insects (Sarwar and Salman, 2015; Sarwar, 2015 a; 2015 b; 2015 c).

4.2. Treatment of Sand Fly's Bites

If any person has been bitten by these blood sucking vectors, then it is important to know how to treat sand fly bites on human's body. First of all do not scratch the bites as it increases the chance of getting infections in the wound. Check the bite for breeding sand flies as these can live under human's skin and suck blood for weeks. Apply calamine lotion or hydrocortisone cream on the bites to control the itching, and take some painkillers to reduce the pain and swelling. Peoples should contact a physician to help if the symptoms get worse and medical expert may also advise to treat bites with an antihistamine cream. Baking soda mixed with water may give some relief, so just put it on the affected area and let it to work for treatment. Make oneself with an oatmeal bath (3 teaspoons extra virgin olive oil, 1 tablespoon baking soda and 2 tablespoons finely ground oats, add ingredients to bath water tub and mix well) and soak body in it for 15-20 minutes to reduce the itching. *Aloe vera* is greatly helpful for all kinds of wounds and it also has a soothing effect on sand fly bites. Essential oils like lavender, eucalyptus, and cedar wood may also help to get rid of the discomfort. When sand flies become a problem, the best thing for a homeowner is to contact pest management professional who can perform an inspection and then develop a plan to conduct small scale sand fly's control around home or business sites (Trigg, 1996; Podaliri *et al.*, 2011; Sarwar, 2015 d; 2015 e; 2015 f; 2015 g).

Try whatever natural remedy works the best for victim from the list as stated above. If remedy work is performed by a person while others get bitten, then it is more likely that he or she should have a better natural resistance to sand fly. If anyone of the unlucky people gets bitten by sand fly and reacts badly then there is a hope that resistance can really will develop and in the meantime avoid being bitten and quickly clean and disinfect any bite sites. A list of remedies includes soap, calamine lotion, rub with garlic, baking soda and water- make a paste and spread it over bites, topical anaesthetic, application of ibuprofen gel, hydrocortisone cream 1%, xylocaine gel 2%, vinegar, steroid cream, essential lavender oil, antihistamine, hydrogen peroxide and betadine-equal parts to dissolve scabs, tea tree oil- dab on bites, toothpaste, onion- rub bites for 30 mins before having a shower, hydrocortisone cream, salty water- allowed to air dry

and form a crust, moist aspro tablet- rub affected areas, and turmeric root- apply by rubbing (Carroll and Loye, 2006; Sarwar, 2015 h; 2015i; 2015j; 2015 k).

5. Conclusion

In conclusion, the sand fly species present a public health nuisance, however, they are not a public health risk, as the species that bite do not always carry any infectious or transmittable diseases. Flies become a public health issue when residential property developments occur close to fly-breeding sites resulting in an increased human-fly interaction. Sand flies bite humans and suck blood giving rise to itchy swollen lumps on their skin. Sand flies are very much attracted to shiny surfaces, moving objects, warmth and carbon dioxide. On the contrary to other flies, they are attracted to darker shades of colors than lighter shades. Sand flies always travel in swarms (a group of sand flies), so, if peoples have just noticed a single fly, then fairly do not ignore it as the other members of the swarm are somewhere near to the victim. Sand flies are not so fast in movement, travelling with a characteristic short hopping flight, most species fly horizontally near to ground level and usually disperse no more than a few hundred meters from their breeding sites. Hence, these are easily going to surrender on human, if persons are running or fast walking as they would not be able to keep it up on human's pace. But, this does not mean that human can get rid of these by hitting them due to the reason being that by the time persons are going to get rid of one sand fly by slapping it, then few more adult flies may start sucking of human's blood. Preventative measures against sand fly comprise bathing of the affected area with salted cool water, avoiding of swampy and wet sand during dawn and dusk, and covering of skin with clothing. Before going outside, use tropical strength insecticide lotions non-toxic on the skin, or apply baby oil mixed with Dettol, and take high doses of vitamin B12 [1000 mg] daily, at least two months before going to an infected location. Showering before bed, applying of SOOV cream to the affected area as the "cool" in the gel takes relieves from the itch, calamine lotion is good enough for kids but may not be the most suitable option for adults, and numbing of spray instantaneously for short term relief makes much more sense. Take tree oil, stop itch or stingose lotion from the pharmacy and use antihistamine specific for bites. The use of protective clothing, insect repellents and insecticide-impregnated bed nets are effective in reducing of human-sand fly contact. For severe or even allergic reactions, seek an opinion from a qualified medical professional to diagnose allergies instead of trying to self-diagnose.

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