

PEST IDENTIFICATION QUIZ

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Abstract The first step in every integrated pest management strategy is to inspect and identify the target pest. Most people distinguish between ants, cockroaches, mosquitoes and other pests, but lack a basic knowledge of their characteristics. It happens a lot that people are bitten or stung in their homes or yards, sometimes over period of months, without knowing the cause or reason of the nuisance. Without an accurate identification, no proper treatment can be done, the pest population increases and so does the suffering and sometimes the embarrassment of the residents. In order to help in those cases, we developed a 'What bites you?' quiz. It comprises 10 multiple choice questions that integrate data regarding the pest (behavior, color, size, etc...), the location, times, forms in which the people feel the nuisance. Seven common Israeli pests (fleas, little fire ants, bed bugs, Culex mosquitoes, asian tiger mosquitoes, mites and sand flies) were matched to each tested parameter by evaluating the matching relationships (unrelated/ neutral/ highly related).

Key words; Bites, pest identification, quiz, arthropods

INTRODUCTION

Arthropods are the most diverse and abundant group of multicellular life in homes. An individual house may have hundreds of arthropod species within it, with each house on average containing 62 families and a minimum estimate of 93 species (Bertone et al., 2016). Urban pests are present both inside and outside a home, involved in injuring, disabling human lives, damaging properties and sharing human resources. Blood feeders such as mosquitoes, bed bugs, fleas, ticks and insects stinging with venom such as ants are common urban pests world-wide (Acharya, 2016). Skin lesions resulting from arthropod exposure may arise via various pathologic pathways such as direct damage to tissue, hypersensitivity reactions to venom or saliva, or infectious disease. Even in the absence of allergic reactions to venom or saliva, much human morbidity is due to direct effects (injury) of arthropod biting/stinging. Direct injury can occur from mouthparts or stingers piercing the human skin. In addition, secondary infections may result from bacteria entering the skin via the bite/sting punctum. This is especially likely if the bite/sting site is scratched extensively. Vector-borne infectious diseases can produce skin lesions such as rash, ulcers, or eschar (Goddard, 1999).

Most people lack a basic knowledge of the life histories and characteristics of the most common insects (Kellert 1993). Many people may identify almost any terrestrial invertebrate (insects, spiders, millipedes, centipedes) as an insect as long as it crawls or is not brightly colored. Seven percent of the general public indicated that they believed Spiders to be insects. Some of the most frequently found arthropods in houses are unfamiliar to the general public despite their ubiquity (Bertone et al., 2016).

"Cuticle", Israeli Pest Control Magazine, received many calls over the years of people suffering from skin lesions caused by unidentified sources, looking for solutions to their problem. The nuisance, which could last months and even years might involve sleepless nights and restlessness. Physicians and other health care providers are frequently confronted with patients having skin lesions attributed to a mysterious arthropod bite. Diagnosis is difficult, but may be aided by asking the patient numerous questions about the event and any recent activity which might have led to arthropod exposure. Certain questions might provide useful information, such as: Did you see the offending arthropod? Was it worm-like? Did it fly? Where were you when these lesions occurred? (Goddard, 1999). Similarly, we found that by systematic questioning including data such as where and when the biting occurs and skin reaction pattern, accurate pest identification could be achieved.

In order to assist the public, we developed the 'What bites you?' quiz – an anonymous internet quiz composed of 10 multiple-choice questions. Every received answer is rated according to its matching level to each pest. The total rating introduces the best fitting pest, including name, picture and basic information about the pest's behavior and characteristics. After receiving the results, the user can make a rational decision in order to fight the pest by calling a professional pest control officer or by searching for information about 'do-it-yourself' methods. Whatever the results would be, it is not an alternative to a professional field diagnosis.

MATERIALS AND METHODS

The 'What bites you?' quiz is written in Hebrew for Israeli citizens by 'Quiz' platform on ex.co website (<https://ex.co>). Ten multiple choice questions diagnose the following 7 biting or stinging arthropods: fleas, little fire ants, bed bugs, asian tiger mosquitoes, *Culex* mosquitoes, mites and sand flies. The multiple-choice questions are detailed in Table 1. We set up the relationship between every single answer to each of the diagnosed arthropods by one of the following: unrelated, neutral or highly related. For example, the answer to the question 'where do the bites or stings occur?' are graded as 'highly related' if the answer is 'Indoors' for bed bugs, *Culex* mosquitoes and mites. Fleas, sand flies and little fire ants are graded as 'neutral' and the asian tiger mosquitoes is 'unrelated' if the bites or stings occurred indoors. On the other hand, we highly related the answer 'Outdoors' for the same question to Asian tiger mosquitoes, while fleas, *Culex* mosquitoes, sand flies and little fire ants got neutral relations and bed bugs and mites were unrelated. The quiz reliability was checked on a pilot group before it was published.

Table 1. 'What bites you?' Quiz - multiple-choice questions

Question	Answers
Where do the bites/stings occur?	Indoors/ Outdoors/ At a pool/ In certain rooms/ Unknown
On what floor is your apartment?	Ground/ Floor 1-3/ Floor 4 and above
When do the bites/stings occur?	Day/ Night/ Day and night/ Unknown
In which part of the body do the bites/stings occur?	Mostly below the knees/ Waist/ All over the body/ Under the clothes
What is the bites/stings pattern?	Scattered/ Line/ Half circle cluster
What is the size and shape of the bite/sting?	Small circle/ Big circle/ Asymmetrical
Are there any pets inside or nearby your house?	Dog/ Cat/ Rodents or birds/ Pigeons/ No animals/ Different animals
What is the skin reaction to the bites/stings?	Significant and prolonged irritation-scratching/ Painful prolonged itching/ Light irritation
What do you know about the pest?	Flying/ Jumping/ Crawling-climbing/ Black/ Reddish-brown/ Smaller than 1mm/ Transparent/ Unknown
Do you recognize dark spots on the bedding?	Yes/ No

RESULTS AND DISCUSSION

We received 144 results from the internet quiz 'What bites you' between September to December 2019. The results (Figure 1) showed that 37% of the participants suffered from fleas, 26% from bed bugs, 17% from the Asian tiger mosquitos, 9% from mites, 6% from *Culex* mosquitos and 6% from little fire ants. No results were compatible for sand flies. The participants' profile is mostly ground level residents, no animal rearing, bitten or stung at home, all

over the body, mostly at nights, the bites/stings are small in size circle - shaped and scattered patterns which causes strong and prolonged irritation and scratching.

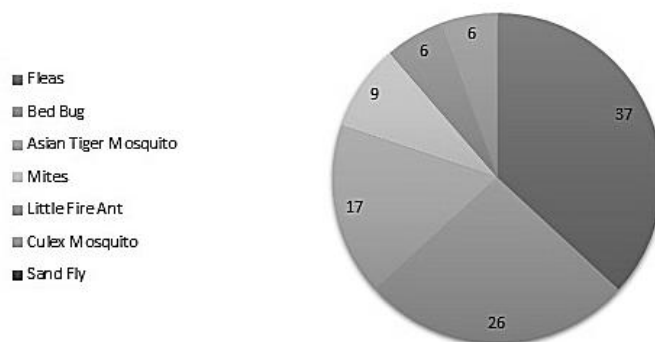


Figure 1. The percentage of bites/sting sources (%).

CONCLUSION

Unidentified biting or stinging by pests is a fairly common phenomenon in Israel, proved by the many inquiries that the Israeli Pest Control Magazine received over the years. This phenomenon hurts human quality of life – 69% of the participants reported a significant and prolonged irritation or itching. Basic information on the biting/stinging pest is a crucial part of the IPM (integrated pest management) process. Surprisingly, fleas, which are common and known to pet owners, were the main source of the unknown bites (37% of the participants).

When trying to confront the biting and stinging, receiving basic information about the pest is an important and crucial step. This information helps to treat the skin lesions and the infected area and provides guidance for professional pest control. The relatively high results received for bed bugs (26%) are not surprising, since there are many new infestations in hotels and people in Israel are not aware of this pest.

Sand flies may infect people with leishmaniasis, but probably do not cause immediate nuisance (no results were received for sand flies).

This quiz does not identify the mental disorder 'insect delusions', in which individuals incorrectly believe they are infested with pests, whereas in reality no such infestation is present. These days we are developing a more advanced English version, that will enable contacting the participants and receiving feedback in order to learn more and to constantly improve the questionnaire. The 'What bites you?' quiz is not a survey. In order to fully characterize the extent of unidentified biting, a more detailed survey should be performed.

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