



# The Potential Cause of Allergy for Children: Soil Contamination with Mites, Bugs, and Geohelminths

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## Abstract

**Background:** Ectoparasitic infections are very important in poor countries. On the other hand, comprehensive information on the epidemiology of these parasites, especially in the North of Iran, remains scarce.

**Objectives:** The aim of this study was to assess soil contamination with mites, geohelminths, and bugs in residential areas of Sari city, north of Iran.

**Methods:** A total of 90 soil samples from 3 areas were collected via multistage, cluster, and random sampling in order to examine their contamination with mites, geohelminths, and bugs during summer, 2014. The results were analyzed using the SPSS 16 software.

**Results:** Of the 90 soil samples that were studied in different environmental areas of Sari, 30 (33.3%) were observed to be contaminated with mites, 10 (11.1%) had bugs, and 21 (23.3%) contained geohelminths. Mites were the most commonly seen parasite among the 3 studied region.

**Conclusions:** Based on the literature, North of Iran accounts for a high rate of allergic disorders. The current results showed high contamination rate of soil with ectoparasites in Sari. Thus, these organisms could be potential causes of allergic disorders and further studies on the subject is needed.

**Keywords:** Soil, Contamination, Mites, Bugs, Geohelminth, Iran, Allergic Disorders

## 1. Background

Scabies, pediculosis, cutaneous larva migrans, myiasis, ticks, and fleas are common and prevalent ectoparasitic infestations, yet are rather neglected. They are a serious threat for poor communities, especially in developing countries, with significant effects, such as morbidity. Also, there is no adequate authentic information on the epidemiology of the infestation with these parasites. Control of skin complications of infestation with these parasites in endemic areas is still a challenge (1).

Scabies or mange is one of the most common skin diseases around the world, and more than 300,000,000 people from all social classes are infested each year. The disease is common worldwide in tropical and humid regions and lack of personal hygiene, poor economy, and living in densely populated areas plays an important role in the spreading of the disease (2-4). Scabies and pyoderma are 2 risk factors for renal failure and other chronic morbidities

(5). It is believed that these mites could cause asthma or exacerbate complications when inhaled. In general, both body parts and proteins in the feces of mites could cause allergies (6). Mite's reproduction is very rapid, about 3 weeks for each generation, and this explains why house dust mite could cause significant problems for allergic people.

Geohelminths infections are one of the most important diseases in communities that have no access to safe water. Soil transmitted helminth (STH) are among the most important geohelminth, which infect approximately two billion humans all over the world (7). Infection with geohelminths effects feeding, growth and fitness, and also causes chronic infections in the population of endemic areas (7, 8). Soil provides the appropriate conditions for conversion of eggs to the infective stage. Also, presence of eggs in the superficial layers of soil could be considered as a factor affecting their transition to humans in each region (9). It seems that soil is the main source for human infection (8, 10). Evidence indicates that STH infections effect

children in developing and developed countries and is directly associated with growth retardation, physical activity reduction, and disorders in learning abilities (9, 11-13). Soil Transmitted Helminth infections are considered as neglected diseases, which in case of suitable conditions can cause serious problems (10, 14).

Bedbug infection is seen in crowded areas and communities that do not adhere to hygienic precautions. In the past few years, bedbug infection has been reported in travelers (15). Nowadays, a large number of infections are reported in the medical literature in different areas of the world (16). International journey, emigration, changes made in the pest control method, and resistance to insecticides may contribute to the development of this blood-sucking insect in developed countries (16-18). The prevalence of bedbugs is not known in Iran. It is not well known whether bedbug's bites lead to severe allergic reactions (19).

## 2. Objectives

Sari is subjected to a high prevalence of asthma, yet its exact cause is not completely clear (20). This research hypothesized that ectoparasites may be the cause and this study aimed at determining soil contamination with mites, geohelminths, and bugs as potential causes of allergic disorders in residential areas of Sari city, North of Iran.

## 3. Methods

### 3.1. Study Area

Sari is the provincial capital of Mazandaran, which is located in the north of the Caspian Sea, south of Alborz Mountains, east of Neka and Behshahr cities, and west of Qaemshahr city. Sari is the largest and most densely populated city of the Mazandaran province. The human population of Sari is around 500,000. The city is located between the 53° 5' of the northern latitude and between 36° 4' of the eastern longitude. Sari has a Mediterranean climate with cold and rainy winters and humid and hot summers (21).

### 3.2. Sampling/Parasitological Procedure

A total of 90 soil samples were collected via multistage, cluster, random sampling method from 3 areas of the city from backyards during September to December, 2014 (30 samples per area). Each sample was about 200 grams of soil from a depth of 2 to 5 cm of the ground, in an area that was not exposed to direct sunlight. The soil samples were dried overnight at room temperature, and then screened through 150  $\mu\text{m}$  sieves, and finally about 2 g of soil was obtained. The sieved samples were transferred to a 10-mL

test tube, suspended in approximately 10 mL of Tween-80 (0.05%), and centrifuged at 1500 rpm for 5 minutes. After discarding the supernatant, the test tube containing the sediments was filled to approximately 1 cm from the top with sucrose solution (1.2 g/cm<sup>3</sup>) and the sediment was suspended, vortexed, and then centrifuged for 15 minutes at 1500 rpm. Finally, up to the upper edge of the tube was filled with sucrose solution and a cover slip was placed on the surface of the tube in contact with the sucrose solution for 30 minutes and then observed under a microscope using 10X and 40X objective.

## 4. Results

A total of 90 soil samples were examined, and mites (33.3%), geohelminths (23.3%) and bugs (11.1%) were observed in the studied samples (Table 1). In region 2, contamination rate with mites, bugs, and geohelminths was higher than that of region 1 and 3. Mites were the most commonly seen parasite among the 3 studied regions (Table 1).

## 5. Discussion

There are several reports on the prevalence of allergic diseases in different countries, and environmental factors, such as soil, also play an important role in the development of clinical inflammation (22, 23).

The role of mites as an important source of house dust allergen was introduced many years ago (24-27). So far, there is no evidence for the role of mite eggs in house dust mite allergies, yet Der p I, a protease, is one of the major known allergens in mites (28-30). It seems that mites could affect the host inflammatory processes and immune responses and lead to delay (31, 32). Mites are able to produce components, which can modulate their host's immune response (33-35). The arthropods are genetically endowed with immunological substances that neutralize the host immune response during their presence on the skin. Therefore, soil could be considered as a potential source for distribution of these allergens (36-39).

Living in places contaminated with dust mite particles and allergen agents causes asthma in children (40). The analysis of ecological and epidemiological studies has not been able to support the etiologic relationship of the disease.

The results of a recent survey from 16 countries that studied the relationship between allergy, asthma, and sensitization showed a high overall prevalence for asthma with house dust mite and sensitization. The ratio of asthma to each allergen is wide (4% to 61%) and heavily dependent on the diagnostic technique (41). This indicates

**Table 1.** The Frequency of Mites, Bugs and Geohelminthes Among Different Regions of Sari<sup>a</sup>

| Regions      | Samples | Mites     | Bugs      | Geohelminthes |
|--------------|---------|-----------|-----------|---------------|
| Region1      | 30      | 8 (26.7)  | 2 (6.7)   | 5 (16.7)      |
| Region2      | 30      | 12 (40)   | 4 (13.3)  | 10 (33.3)     |
| Region3      | 30      | 10 (33.3) | 4 (13.3)  | 6 (20)        |
| <b>Total</b> | 90      | 30 (33.3) | 10 (11.1) | 21 (23.3)     |

<sup>a</sup>Values are expressed as No. (%).

that the discrepancy in the use of diagnostic tools could lead to disruption of epidemiological studies (42).

In a case-control study carried out to determine the prevalence of allergic disorders, such as asthma, allergic rhinitis, and eczema in primary schools of Sari, out of the 1,818 studied cases, 35% had allergic disorder; 12% had asthma, 17% allergic rhinitis, and 6% had eczema. Also, allergic disorders were more frequently observed to occur among males (65%) than females (40%) (20).

As mentioned previously, mites and dust are factors responsible for allergy and asthma (43). Based on a meta-analysis study that was conducted in Iran, the prevalence of asthma in primary schools was 3.9% (44).

Soil transmitted helminthes are the most prevalent geohelminth infections. Also, there are several reports on the relationship between geohelminth infections and atopy and wheeze symptoms (45). These soil transmitted helminthes are among major causes of physical and mental retardation around the world. However, despite the economic, educational, and health importance of these parasites, they have been largely forgotten (10).

Evidence from epidemiological studies suggests that aeroallergens are environmental risk factors in relation to allergic disorders in industrialized countries (46). Contamination with geohelminths, infection with the pulmonary form of visceral migratory larvae, leads to anti-inflammatory responses and prevents inflammatory responses to airways. In a study in a rural area of Ecuador, results indicated an intense protective effect against atopy with higher parasite burden of ascariasis and trichuriasis (47). It seems that infection with geohelminths is associated with a lower prevalence of symptoms of allergy. In general, there is no evidence of any difference between these parasites in the effectiveness of allergen skin test reactivity (48).

Insect bites and stings are very common and could cause a variety of skin reactions. These reactions are often local, and their evolution depends on the host immune response (49).

In a study of dust particles at home involving babies aged 12 to 18 months old, the effect of mite allergen (Der

p1) in dust was evaluated. At the age of 18 to 36 months, stool specimens were collected for examination of geohelminths and study of the relationship with allergy. Exposure to more 10  $\mu\text{g/g}$  of dust allergen (Der p1) was 31.8%. Geohelminths were reported in 25% of children and was most related to *Ascaris lumbricoides*. In one case, a hookworm infection was reported due to wheezing and medical diagnosis at the hospital. Hospitalization due to wheezing was significantly observed in children in contact with 2 to 10  $\mu\text{g/g}$  of dust. Helminthic infections were not associated with mite allergy as a risk factor for wheezing.

This study suggested that hookworm infection and mite allergen was an independent risk factor for wheezing, and there was no evidence of significant interaction between them (50).

Bite of bed bugs cause very itchy local reactions after repeated exposure with hemorrhagic or bullous bites, but systemic allergic reactions are rare (15). Kissing Bugs are known as a vector of Chagas' disease. Anaphylaxis caused by this insect's sting has been proven for more than 100 years (19). Unfortunately, there is no exact information available about the prevalence of anaphylaxis caused by kissing bug bites.

In most northern areas of Iran, because of the climate and geographical location and exposure to the edges of forests, buildings are mostly made by wood. Rainy season, wooden buildings and temperature are positively associated with populations of bugs, especially head bugs. Thus, according to the suitable ecology of this area for reproduction of these ectoparasites, their relatively high prevalence in soil, and high prevalence of allergic diseases in the North of Iran with unknown etiology, further studies on the association between allergic disorders in people with these ectoparasites seems necessary. While these outcomes indicate that the residents in this region were at high risk for allergic disorders, health education is essential for disease prevention.

## Footnotes

**Authors' Contribution:** Mohammad Ali Mohaghegh and Mehdi Azami were responsible for the experimental design of the study; Mohammad Ali Mohaghegh, Mohsen Ghomashlooyan, and Hamed Kalani were responsible for the execution techniques and parasitological examination of soils. Seyed Hossein Hejazi was responsible for the statistical analysis and Mojtaba Azimi Resketi for the collection of the samples. All authors reviewed and contributed to the writing of this manuscript.

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