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ORIGINAL ARTICLE

Dermatitis caused by arthropods in domestic environment: an Italian multicentre study

L. Stingeni,[1,*] L. Bianchi,[1] K. Hansel,[1] D. Neve,[1] C. Foti,[2] M. Corazza,[3] V. Bini,[4] I. Moretta,[5] M. Principato[5]

[1]Section of Clinical, Allergological and Venereological Dermatology, Department of Medicine, University of Perugia, Perugia, Italy
[2]Section of Dermatology, Department of Biomedical Science and Human Oncology, University of Bari, Bari, Italy
[3]Section of Dermatology, Department of Medical Sciences, University of Ferrara, Ferrara, Italy
[4]Internal Medicine, Endocrine and Metabolic Sciences Section, Department of Medicine, University of Perugia, Perugia, Italy
[5]Department of Veterinary Medicine, University of Perugia, Perugia, Italy
*Correspondence: L. Stingeni. E-mail: luca.stingeni@unipg.it

Abstract

Background Skin diseases caused by mites and insects living in domestic environments have been rarely systematically studied.

Objectives To study patients with dermatitis induced by arthropods in domestic environment describing their clinical features, isolating culprit arthropods and relating the clinical features to the parasitological data.

Methods The study was performed in 105 subjects with clinical and anamnestic data compatible with the differential diagnosis of ectoparasitoses in domestic environments. Clinical data and arthropods findings obtained by indoor dust direct examination were studied.

Results Indoor dust direct examination demonstrated possible arthropods infestation in 98 subjects (93.3%), more frequently mites (56.1%) (mainly *Pyemotes ventricosus* and *Glycyphagus domesticus*) than insects (43.9%) (mainly Formicidae and Bethylidae). Strophulus (46.9%) and urticaria-like eruption (36.7%) in upper limbs and trunk with severe extent were prevalent. Itch was mostly severe (66.3%) and continuous (55.1%). Ectoparasitoses occurred frequently with acute course in summer (44.9%) and spring (30.6%).

Conclusions Possible correlation between clinical and aetiological diagnosis of arthropods ectoparasitoses in domestic environments needs the close cooperation between dermatologist and parasitologist. This is crucial to successfully and definitely resolve skin lesions by eradicating the factors favouring infestation.

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Conflicts of Interest

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Introduction

Dermatitis induced by arthropods in domestic environments is an increasing health problem in industrialized countries. Nevertheless, systematic studies on skin diseases caused by mites and insects living in indoor environments have been rarely reported,[1–3] and only several single case reports of skin injuries induced by a large variety of different arthropods were described.[4–11]

The presence of arthropods in indoor environments is conditioned by microclimatic factors and by arthropod reservoirs, such as moulds on walls, plants, pets and worm-eaten wooden structures (furniture, parquet, beams, firewood). Moreover, reproductive cycle of several indoor arthropods is seasonally conditioned and their seasonal peaks increase risk of morbidity for humans.[12,13]

Excluding lice and scabies mite, numerous indoor arthropods can determine a great variety of skin lesions. The most frequent clinical picture is papular urticaria, characterized by small erythematous, urticarial papules capped by a tiny vesicle or with a central haemorrhagic punctum.[4,7,8] We prefer to name this clinical picture 'strophulus' (from ancient Greek στρόφος: 'turn of bowels'[14]) instead of papular urticaria, which is frequently used to indicate skin diseases with different aetiologic and pathogenetic mechanisms.[15] Other clinical features frequently reported are erythematous and excoriated papules, urticaria- and scabies-like lesions, erythematous papules and pustules.[5,6]

Rarely varicella-like, with large central vesicles or pustules, and erythema multiforme-like eruptions are described.[16] Regardless of their clinical appearance, skin lesions can be scattered or widespread, with a tendency to cluster in circumscribed areas or in linear arrangements. The lesions generally persist for 2–10 days are usually itchy and painless[17] and may result in temporary hyperpigmentation once they resolve; sequelae with necrotic, ecchymotic and hyperpigmented aspects are rare.[18,19] The histology is usually characterized by eosinophilic spongiosis, exocytosis and possible vesicle formation with dermal lymphocytic and eosinophilic perivascular infiltrate.[20] Pathological differential diagnoses include pseudolymphoma and some eosinophilic skin diseases, like urticarial vasculitis and Well's syndrome.[21]

Even if clinical picture and medical history are often suggestive for ectoparasitoses, there is actually no validated method to relate these diseases to specific arthropods.[22] Herein, we studied patients with dermatitis induced by arthropods in domestic environment describing their clinical features, isolating possible arthropods with high chance to be the aethiologic cause and trying to relate the clinical features to the parasitological data.

Patients and methods

A prospective case series study was performed during a 1-year period (June 2015–May 2016) on consecutive patients in the Dermatology Clinics of Perugia, Bari and Ferrara, three cities located in the centre, south and north of Italy. Enrolled patients satisfied two major and one minor criteria or one major and three minor criteria listed in Table 1.

Table 1 Major and minor diagnostic criteria for dermatitis due to indoor arthropods

Major criteria
One of the following clinical pictures
Strophulus
Urticaria-like eruption
Erythematous papular and pustular lesions
Erythematous and escoriated papular lesions
Scabies-like eruption
Moderate-to-severe itch
One or more cohabitants presenting the same skin lesions
Remission with removal from home
Minor criteria
Presence of one or more environmental risk factors
Moulds on the walls
Pets
Plants
Worm-eaten wooden structures
Relapsing/remitting seasonal course
Recurrence or incomplete remission after therapy
Relapsing with returning home (after remission with removal)

Demographic data and personal history of atopy were collected. Cohabitants, if present, underwent a dermatological visit. Clinical history was defined as acute (disease onset lasting less than 30 days), chronic (more than 30 days), or relapsing (one or more relapses with disease-free time of at least 30 days in 1 year), with or without seasonal course. The skin lesions were classified with regard to their morphology as follows: strophulus, urticaria-like eruption, erythematous papular and pustular lesions, erythematous and escoriated papular lesions and scabies-like eruptions. Moreover, involved sites and lesions arrangement (isolated or grouped) were recorded. The extent of skin lesions, calculated using the 'Wallace's rule of nine',[23] was defined mild when ≤10%, moderate when 11–30%, and severe when >30% of the skin surface was involved. The intensity of itch (visual analogue scale: 0 = no itch, >0–<4 = mild, ≥4–<7 = moderate, ≥7–10 = severe) and its time trend (continuous or discontinuous) were also reported. Finally, patients were questioned about the presence of indoor environmental factors favouring arthropods infestation in their houses, such as moulds on the walls, pets, plants and worm-eaten wooden structures.

Indoor dust was manually collected by the patients themselves, after shaking the sheets, pillows, couch and chair upholstery, with an electrostatic cloth from the floor of each room of their house. The collected dust was placed into hermetic plastic jars, properly labelled with the name of each room. The dust was processed in the Parasitology Laboratory of Veterinary Medicine Department, University of Perugia, as follows.

Sifting

Two sieves (5 mm and 1 mm aperture meshes) were utilized to separate dust material into three fractions:

1 frustules of dust of large size (>5 mm) for prominent sized arthropods (e.g. ticks);
2 frustules of dust of medium size (1–5 mm) for medium sized arthropods (e.g. fleas, microhymenoptera);
3 frustules of dust of small size (<1 mm) for small sized arthropods (e.g. mites).

Dry examination

Dust direct observation in a Petri dish containing 80% lactic acid was performed in blinded fashion by two independent observers with a stereomicroscope (0.75×–4×).

Dust processing

The sieved material was flotated utilizing saturated solution of NaCl (20 min). The material was first observed under a stereomicroscope (0.75×–4×) and then under an optical microscope (4×–10×). Organic fragments were then taken by a curved pin adequately flattened on its extremity and placed in a Petri dish containing 80% acid lactic. This preparation was gradually heated up to 50 °C in 10 min to clarify arthropods fragments and organic material.

Preparation of specimens on microscope slide

Arthropods fragments were extracted under stereo microscope (0.75×–1×) using the tip of a flat pin adequately flattened on its extremity, and then placed in a drop of Berlese solution on a slide. A cover slip was placed on the slide, and the preparation was flamed for about 5 s and then cooled down (1 min). The slide was then placed, still warm, on the optical microscope (4×).

Identification

The slide was evaluated in blinded fashion with a light microscope by two independent observers to identify the species.

Assessment

Two parameters were specified as follows:

1 level of infestation: number of eggs, immature stages and adults of arthropods/g of dust: 1–3/g (+: mild), 4–10/g (++: moderate), >10/g (+++: severe).
2 living status: the presence of living arthropods or dead arthropods without dehydration signs in dry examination phase.

Chi-square test with Yates' correction or Fisher's exact test was used for statistical analysis. P value <0.05 was considered statistically significant. All the statistical analyses were performed using IBM-SPSS 22.0 (IBM Corp Armonk, NY, USA, 2013).

The study was approved by local Ethic Committees and conducted according to good clinical practice.

Results

A total of 105 subjects, 76 females and 29 males (ratio 2.6 : 1), median age of 44.9 years (range 3–94), were enrolled. Indoor dust direct examination demonstrated arthropod infestation in domestic environments of 98 subjects (93.3%), 72 females (73.5%) and 26 males (26.5%) (ratio 2.8 : 1; median age of 45.8 years, range 3–94). Personal history of atopy was observed in 22 patients (22.4%; skin atopy 12.2%, respiratory atopy 16.3%). Among the patients with cohabitants, 68 of 72 (94.4%) presented at least one cohabitant with the same clinical picture.

Isolated arthropods were more frequently mites (56.1%) than insects (43.9%) (Table 2). The highest class prevalence was observed for *P. ventricosus* Newport, 1850 (58.2%) among mites and *Solenopsis fugax* Latreille, 1798 (27.9%) among insects.

Table 2 Arthropods identified by direct indoor dust examination and their level of infestation in 98 subjects affected by ectoparasitoses

Arthropods	No (%)			Level of infestation*					
				+		++		+++	
				33	(33.7)	21	(21.4)	44	(44.9)
Class: Mites	55 (56.1)			15	(27.3)	12	(21.8)	28	(50.9)
	No.	Total prevalence 98	Class prevalence 55						
Pyemotidae *Pyemotes ventricosus*	32	(32.7)	(58.2)	9	(28.1)	6	(18.8)	17	(53.1)
Glycyphagidae *Glycyphagus domesticus*	11	(11.2)	(20.0)	2	(18.2)	2	(18.2)	7	(63.6)
Cheyletiellidae *Cheyletiella blakey*	5	(5.1)	(9.1)	1	(20.0)	3	(60.0)	1	(20.0)
Tydeidae *Tydeus molestus*	2	(2.0)	(3.6)	—		1	(50.0)	1	(50.0)
Others†	5	(5.1)	(9.1)	3	(60.0)	—		2	(40.0)
Class: Insects	43 (43.9)			18	(41.9)	9	(20.9)	16	(37.2)
	No.	Total prevalence 98	Class prevalence 43						
Formicidae	26	(26.5)	(60.5)	15	(57.7)	5	(19.2)	6	(23.1)
Solenopsis fugax	12	(12.2)	(27.9)	5	(41.7)	3	(25.0)	4	(33.3)
Monomorium destructor	10	(10.2)	(23.2)	7	(70.0)	2	(20.0)	1	(10.0)
Tetramorium caespitum	4	(4.1)	(9.3)	3	(75.0)	—		1	(25.0)
Bethylidae	9	(9.2)	(20.9)	2	(22.2)	3	(33.3)	4	(44.5)
Scleroderma domesticum	4	(4.1)	(9.3)	1	(25.0)	1	(25.0)	2	(50.0)
Cephalonomia gallicola	4	(4.1)	(9.3)	—		2	(50.0)	2	(50.0)
Allepyris ruficrus	1	(1.0)	(2.3)	1	(100.0)	—		—	
Pulicidae									
Ctenocephalides felis felis	5	(5.1)	(11.6)	1	(20.0)	—		4	(80.0)
Cimicidae									
Cimex lectularius	3	(3.1)	(7.0)	—		1	(33.3)	2	(66.7)

*+ = mild; ++ = moderate; +++ = severe.

†Trombiculidae: *Neotrombicula autumnalis* 1; Macronyssidae: *Ornithonyssus bacoti* 1; Tetranychidae: *Bryobia praetiosa* 1, *Schizonobia oudemansi* 1; Ascidae: *Proctolaelaps pygmaeus* 1.

Level of infestation was moderate/severe in 66.3% of all isolated arthropods, more in mites than insects (72.7% and 58.1%, respectively) (Table 2). *Glycyphagus domesticus* De Geer, 1778 among mites, and *Ctenocephalides felis felis* Bouché, 1835 among insects were the arthropods with the most severe grade of infestation. All the isolated arthropods were alive.

The most frequent clinical pictures and their causative arthropods are reported in Fig. 1. In particular, the most frequent was strophulus (46.9%), followed by urticaria-like eruption (36.7%), erythematous escoriated papular lesions (9.2%), scabies-like eruption (4.1%), and erythematous papular and pustular lesions (3.1%) (Fig. 2a). Skin lesions were similar in mites and insects ectoparasitoses. Upper limbs (71.4%), back (67.3%) and chest and abdomen (56.1%) were the most involved sites in the whole study group. Upper limbs were mostly involved in mites ectoparasitoses (85.5%), while back and chest and abdomen resulted in the most involved sites in insects ectoparasitoses (62.8% and 58.1%, respectively) (Fig. 2b). Regarding upper limbs, they resulted more affected in spring (65.2%), summer (68.6%) and autumn (71.4%) than in winter (30.0%). Skin lesions were more frequently grouped (55.1%) than isolated (44.9%), regardless type of culprit arthropods (mites: 54.5% vs. 45.5%; insects: 55.8% vs. 44.2%).

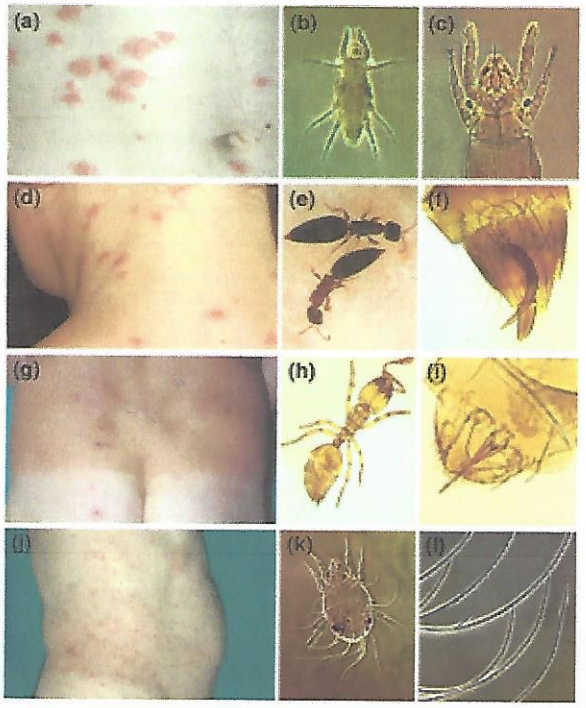

Figure 1 (a) Strophulus by *Pyemotes ventricosus* (Acarina: Pyemotidae); (b) adult female (10×) and (c) its propodosoma (40×) with two stylet-shaped chelicerae. (d) Urticaria-like eruption by *Sclerodermadomesticum* (Hymenoptera: Bethylidae); (e) adult female and (f) its sting (10x). (g) Erythematous escoriated papular lesions by *Solenopsis fugax* (Hymenoptera: Formicidae); (h) worker insect and (i) its sting (10x). (j) Scabies-like eruption by *Glycyphagus domesticus* (Acarina: Glycyphagidae); (k) tritonymph mite (10×) and (l) its pelose dorsal setae (40×).

As regards to extent of skin lesions, ectoparasitoses involved >30% of skin surface in 60.2% of the patients, without statistical significance between mites and insects (Fig. 2c). Moreover, the extent of skin lesions did not relate to arthropods infestation levels (Fig. 2d).

Ectoparasitoses occurred mostly in summer (44.9%) and spring (30.6%) than in autumn (16.3%) and winter (8.2%). In summer, mites cases were more frequent than insects cases (49.1% and 39.5%, respectively), without statistical significance. Clinical course was acute in 64 patients (65.3%); only 12 patients (12.2%) suffered from chronic dermatitis. The remaining 22 patients (22.5%) reported a recurrent course, with three or more relapses during the previous year.

Itch was present in all patients, more frequently severe (66.3%) than moderate (26.5%) and mild (7.1%). When severe, itch was mostly caused by mites (74.5%) than insects (55.8%). Daily itch trend was referred as continuous in more than half of the patients (55.1%), especially in mites dermatitis (61.8%); discontinuous itch (44.9%) was more frequent in insects (53.5%) than in mites ectoparasitoses (38.2%).

Clinical data and indoor factors favouring infestations induced by the four most frequent arthropods families (Pyemotidae, Glycyphagidae, Formicidae and Bethylidae) are reported in Table 3. Among these, upper limbs were more involved with statistical significance ($P < 0.01$) when *P. ventricosus* was isolated.

Symptomatic therapies (corticosteroid ointments, oral antihistamines), disinfestation of domestic environment (mainly based on ciflutrin and ciphenothrin) and elimination of specific trophic sites or reservoirs led to complete healing of all patients. No recurrences were observed in 1-year follow-up.

Discussion

In our study, we demonstrated the pathogenic role of isolated arthropods in the houses of 98 of 105 enrolled patients (93.3%), showing high sensitivity of indoor dust direct examination. Negative results probably depended on incorrect sample collection, performed by the patients themselves. This standardized modality to examine domestic dust allowed us to perform a parasitological screening of the entire house. In other reports, when detection method was specified, causative arthropods were researched and identified only on focally collected dust.[6,8,9,24]

We observed a higher prevalence of ectoparasitoses in females (73.5%), as reported by other Authors.[25] Gender distribution is influenced by the kind of work done, typically domestic in our study, as showed by the prevalent male involvement in occupational ectoparasitoses.[5,8,20,26] Moreover, cohabitants were

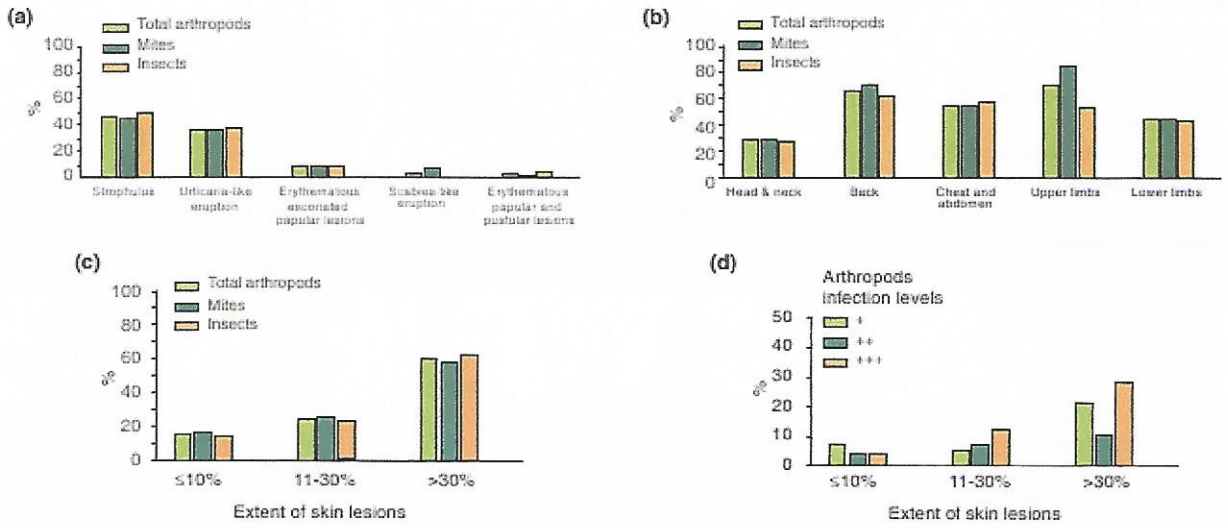

Figure 2 Dermatitis due to arthropods in domestic environment: (a) clinical features and (b) involved sites. Extent of skin lesions in relation to (c) isolated arthropods and (d) their infestation level (+, ++, +++).

affected regardless of gender, suggesting that arthropods indiscriminately attack humans in indoor environments. Personal history of atopy was not a risk factor for ectoparasitoses, being similar to general population.[27]

Isolated arthropods were mainly mites (56.1%) (Table 1). Among these, *P. ventricosus* and *G. domesticus* were the most frequently isolated species. *Pyemotes ventricosus* is reported as cause of single cases as well as of small outbreaks in farmers, bakers, dockworkers, packers and in subjects working in domestic environments.[8,19,28–31] When *P. ventricosus* is isolated, it is necessary to research the presence of worm-eaten wooden structures, because this mite is a parasite of larvae of woodworm. *Glycyphagus domesticus* is frequently isolated in indoor environments with moulds on walls or on the backs of furniture.[32,33] Concerning insects, ectoparasitoses were mainly caused by Formicidae, particularly *S. fugax* and *Monomorium destructor* Jerdon, 1851. Both species are common in dust rich in organic material or can be introduced in domestic environment by plants.[34] Bethylidae, the second insects isolated family, are microhymenoptera frequently associated with worm-eaten wooden structures,[35] as well as Pyemotidae. In our study, worm-eaten wooden structures and the other environmental factors favouring infestation were not statistically significant (Table 3). These data are probably underestimated because referred by patients themselves, often not able or reluctant to correctly report the presence of worm-eaten wood and moulds on walls in their houses.

As we stated in Table 2, we diagnosed only three cases of ectoparasitoses induced by *Cimex lectularius* Latreille, 1802, observing nymphal exuviae and neanic stages with dust direct examination. Even though in some countries, this infestation is one of the most worrying phenomenon actually seen with ectoparasites, in Italy, its frequency is low in domestic environment, but more frequent in hotel rooms and in means of transport (trains, ships).[36]

Level of infestation, higher in mites than in insects (50.9% and 37.2%, respectively) (Table 2), depends on the arthropod reproductive index. For example, *P. ventricosus* has a very high reproductive index: one pregnant female delivers up to 400 adult and sexually mature individuals.[37]

Five clinical pictures were observed in our patients (Table 3). Strophulus was the most frequent clinical picture both in insect (48.8%) and mite cases (45.5%), as reported by others.[5,8,9,11,19,22,28,30] Urticaria-like eruption was the second one, while scabies-like eruption and erythematous papular and pustular lesions (4.1% and 3.1%, respectively) were rarely observed in our study (Fig. 2a).[38] We did not observe statistically relevant relationships between clinical features and arthropods families (Table 3), suggesting that mites and insects belonging to different families can cause similar skin lesions.

Pathogenetic mechanisms involved in the skin lesions caused by arthropods are not well investigated. It was postulated that *P. ventricosus* produces salivary proteins deposited in the skin through its mouth during feeding, but salivary components responsible for skin responses are unknown.[38] Regarding *G. domesticus*, irritation by its faecal or secretory products was suggested.[33] The liquid produced by its cuticle and contained in pelose dorsal setae could be involved in skin lesions, such as the setae of Lepidoptera.[39] As regards to aculeate Hymenoptera (Bethylidae and Formicidae), their sting is a modification of the female ovipositor and it injects venoms that paralyse small prey or induce pain in large predators.[40] These venoms contain many

Table 3 Clinical features and indoor factors of patients with ectoparasitoses caused by Pyemotidae, Glycyphagidae, Formicidae and Bethylidae

	N	Pyemotidae 32 (%)	Glycyphagidae 11 (%)	Formicidae 26 (%)	Bethylidae 9 (%)
Clinical pictures					
Strophulus	34	16 (47.1)	3 (8.8)	12 (35.3)	3 (8.8)
Urticaria-like eruption	31	10 (32.3)	5 (16.1)	10 (32.4)	6 (19.3)
Erythematous excoriated papules	6	3 (50.0)	1 (16.7)	2 (33.3)	—
Scabies-like eruption	4	2 (50.0)	2 (50.0)	—	—
Erythematous papules and pustules	3	1 (33.3)	—	2 (66.7)	—
Sites of localization					
Upper limbs*	52	26 (50.0)	8 (15.4)	16 (30.8)	2 (3.8)
Chest and abdomen	55	24 (43.6)	8 (14.6)	17 (30.9)	6 (10.9)
Back	48	22 (45.8)	5 (10.4)	16 (33.3)	5 (10.4)
Skin extent					
Mild	12	4 (33.3)	2 (16.6)	5 (41.7)	1 (8.4)
Moderate	16	6 (37.5)	3 (18.7)	4 (25.0)	3 (18.8)
Severe	50	22 (44.0)	6 (12.0)	18 (36.0)	5 (10.0)
Seasons					
Winter	7	3 (42.9)	—	3 (42.9)	1 (14.2)
Spring	38	16 (42.1)	6 (15.8)	11 (28.9)	5 (13.2)
Summer	27	12 (44.4)	4 (14.9)	9 (33.3)	2 (7.4)
Autumn	6	1 (16.7)	1 (16.7)	3 (50.0)	1 (16.6)
Clinical trend					
Acute	54	26 (48.1)	5 (9.3)	17 (31.5)	6 (11.1)
Chronic	9	2 (22.2)	2 (22.2)	3 (33.3)	2 (22.2)
Recurrent	15	4 (26.7)	4 (26.7)	6 (40.0)	1 (6.6)
Itch grade					
Mild	6	2 (33.3)	1 (16.7)	2 (33.3)	1 (16.7)
Moderate	19	7 (38.8)	1 (5.3)	7 (38.8)	4 (21.1)
Severe	53	23 (43.4)	9 (17.0)	17 (32.1)	4 (7.5)
Indoor factors					
Moulds on walls	29	12 (41.4)	7 (24.1)	8 (27.6)	2 (6.9)
Pets	27	15 (55.5)	1 (3.7)	7 (26.0)	4 (14.8)
Plants	37	18 (48.7)	5 (13.5)	10 (27.0)	4 (10.8)
Worm-eaten wooden structures	41	16 (39.0)	3 (7.3)	15 (36.6)	7 (17.1)

*$P < 0.01$.

pharmacologically active constituents such as histamine, serotonin, acetylcholine, dopamine, noradrenaline and phospholipase.[41] Among Bethylidae, detailed composition and possible pathogenetic mechanisms of *Scleroderma domesticum* Klug, 1809 and *Cephalonomia gallicola* Ashmead, 1887 venoms still remain unclear.[42,43] Among Formicidae, venom of fire ants (*Solenopsis* spp.) contains mostly piperidine alkaloids causing histamine release from mast cells with localized burning sensation typical of a fire ant sting.[44]

Upper limbs (71.4%), back (67.3%) and chest and abdomen (56.1%) were the most involved sites in all patients. This trend was confirmed in mite cases, while back (62.8%) and chest and abdomen (58.1%) were the most involved sites in insect cases (Fig. 2b). Genitalia and interdigital spaces of hands are usually unaffected.[7] Upper limbs were mainly attacked by Pyemotidae ($P < 0.01$) (Table 3), probably depending on the mode of exposure of arms and hands on armrests of chairs or sofas, tables and other worm-eaten furniture. According to some Authors who suggest that the distribution of the eruption depends on the heaviness of the clothing,[8] we observed less involvement of upper limbs in winter. Regarding the lesions arrangement, more frequently grouped than isolated, it probably depends on the capacity of a singular arthropod to repeatedly sting its victim, as Pyemotidae and Bethylidae.

Severe involvement of dermatitis was documented in 60.2% of patients (Fig. 2c). However, we did not find any relationship between the extent of skin involvement and level of arthropods infestation (Fig. 2d). Also this aspect may be caused by the capacity of some mites and insects to induce a large number of lesions through multiple stings.[45] Conversely, *G. domesticus*

needs high level of infestation to cause severe dermatitis because its pathogenicity depends on irritant and exuvial liquids and on faeces issued mainly by its larvae and protonymphs.[33,38]

As reported by other Authors,[30] clinical manifestations were more frequent during summer (44.9%) and spring (30.6%). The reproductive peak of several mites and insects occurs mainly during these seasons, when they increase their metabolic activities and attack their victims.[12] The clinical trend of the skin lesions depends on the degree of exposure to the culprit arthropods.[22] The majority of our patients (65.3%) were affected by an acute episode, coinciding with the arthropods reproductive peak. In the remaining subjects with recurrent and chronic trends (34.7%), clinical courses were conditioned by the presence of reservoirs in all their houses, mainly worm-eaten wooden structures and moulds on walls (Table 3).[46]

Our study confirmed that itch is always present in human ectoparasitoses,[5–11,24–26,30] especially of severe grade and with continuous time trend. The latter two findings were more frequent in ectoparasitoses caused by mites (74.5% and 61.8%, respectively) than in those caused by insects (55.8% and 46.5%, respectively), probably due to the higher levels of mites infestation.

Limitations of our study include small sample size compared with the large variety of arthropods species potentially cohabiting with humans and potentially able to attack them. Moreover, the pathogenic mechanisms with which arthropods attack humans are complex and only partly known. This could explain the lack of correlations between clinical features and parasitological data.

In conclusion, nowadays dermatitis caused by arthropods in domestic environment is a topic of greater importance in dermatology than was previously believed. Frequently the dermatologist encounters patients showing clinical and anamnestic data suggesting ectoparasitoses, but the responsible arthropods are often unknown. In these cases, frequently 'ex juvantibus' diagnosis is made by aspecific disinfestation of domestic environment, leading to the recurrence of skin lesions when arthropod reservoirs, such as worm-eaten wooden structures and moulds on walls or birds, persist in houses. Further investigations on larger study groups are needed in this complex field of environmental dermatology with close cooperation between dermatologist and parasitologist.

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