

## HOUSE DUST MITES (ACARI: PYROGLYPHIDAE) IN THE CITIES OF GDAŃSK AND GDYNIA (NORTHERN POLAND)

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**Abstract:** 277 samples of house dust collected in 1996-1998 from 17 flats, three hospitals, two hotels and one students' hostel situated in the cities of Gdańsk and Gdynia were subjected to acarological examination. Acari were found in 50 (37.3%) of 134 samples from the flats, in 11 (15.5%) of 71 samples from the hospitals and in 13 (18.1%) of 72 samples from the hotels. The majority of mites (91.6%) was found in samples that originated from the private flats. 95.0% of mites from the flats, 35.0% mites from the hotels and 8.0% mites from the hospitals belonged to two dust mite species of the family Pyroglyphidae: *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*. *D. farinae* was significantly predominant and composed 82.8% of the whole pyroglyphid collection. Samples from private flats contained significantly more mites than those from hospitals and hotels: mean mites densities per 1 gram of dust were 13.07, 1.03 and 1.00, respectively. The authors suggest that only density of house dust mites in private flats may be clinically important.

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### INTRODUCTION

Tiny, free-living mites, mainly of the Pyroglyphidae family, have long been recognised as one of the most important sources of allergen of house dust responsible for the origin of atopic and bronchial asthma, rhinitis and dermatitis in susceptible persons [7, 16, 20, 28].

Among several species of the family Pyroglyphidae two, *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* have been found to be the predominant mites of household dust accounting for 80-90% of the total mite population and are important sources of allergens worldwide inside homes in humid geographic areas [1, 3, 9, 12, 26]. Moreover, studies from a number of countries have shown that also another pyroglyphid mite, *Euroglyphus maynei* is often detected and is numerous in household dust [3, 8, 27]. On the other hand, many species of storage

mites and plants or animal parasites are rather occasionally found in house dust.

Research on house dust mites, especially pyroglyphids, was initiated in Poland about 20 years ago starting with faunistic studies and studies on their distribution in human dwellings in the city of Bydgoszcz, northern Poland [21]. It was followed by investigations carried out in Upper Silesia (southern Poland) [15, 23, 26] in the city of Warsaw (central-eastern Poland) [22] and in the city of Poznań (western Poland) [10]. Three pyroglyphid species, *D. pteronyssinus*, *D. farinae* and *E. maynei* were commonly found there in houses and the first two were always the significantly prevalent mites.

The objective of this study was to determine the frequency and abundance of the occurrence of allergenic mites in house dust collected in private flats and public institutions in the area of Gdańsk and Gdynia (northern Poland).

## MATERIALS AND METHODS

The studies were carried out in the two adjoining cities of Gdańsk and Gdynia (northern Poland) during all four seasons in 1996-1998.

A total of 277 house dust samples from 17 flats in tenement buildings, three hospitals, two hotels, and one students' hostel were examined for the occurrence of dust mites. Both tenement and public buildings were modern, dry, well-built and centrally heated objects.

Dust samples were collected by sweeping up superficial dust or by vacuum cleaning from the major mite foci: floors, carpets, mattresses and padding from upholstered furniture. All samples were stored at 4°C until analysed.

Each sample was sieved and mites recovered by the floatation method using dichloromethane (CH<sub>2</sub>Cl<sub>2</sub>) [18]. The number of mites found in a single sample was extrapolated to mites per 1 gram of dust. The amount of dust collected in a single sample varied from 0.1–5 grams.

All specimens found were cleared with lactic acid and immersed in the Swan's medium on slides to determine stage and species or higher taxonomic mite group, with the use of a compound microscope.

Prevalence of mites in flats during the heating and non-heating seasons were analysed using  $\chi^2$  (chi-square) test.

## RESULTS

Acari were found in 50 (37.3%) of 134 samples from the flats, in 11 (15.5%) of 71 samples from the hospitals and in 13 (18.1%) of 72 samples from the hotels (including a students' hostel). They inhabited 14 out of 17 flats and all public buildings. As much as 91.6% (n = 493) of all collected mites consisted of specimens found in dust originating from the private flats, 4.7% of mites (n = 25) were found in the hospitals and 3.7% (n = 20) in the hotels (Tab. 1).

Isolated mites were identified to order, family, genus or species. The majority of them, 95.0% (n = 468/493) of those recovered from samples of dust collected in the private flats, together with 35.0% (n = 7/20) and 8.0% (n = 2/25) of those originating from small collections from the hotels and hospitals respectively, belonged to two species of the family Pyroglyphidae: *D. pteronyssinus* and *D. farinae* (Tab. 2). The latter species was significantly predominant and composed 82.8% of the whole pyroglyphid collection. It was found in 31.3% of samples from the flats and 2.8% of those collected from hotels, but it was not detected in hospitals, while *D. pteronyssinus* was present in 6.0%, 1.4% and 2.8% of all samples, respectively (Tab. 2).

In general, twelve (70.6%) out of 17 flats and three (50.0%) out of six public buildings sampled contained at least one of these two pyroglyphid species. Six flats and one hospital contained exclusively *D. farinae* while the only one flat and one public building - *D. pteronyssinus*. Both species coinhabited five flats and one hotel. In three of these flats *D. farinae* was clearly most prevalent

comprising 68.4%–99.1% of the pyroglyphid population. Among pyroglyphids, 40.5% were in premature, nymphal stages (larvae were not found).

Other mites found belonged to the order Mesostigmata and families of Acaridae and Cheyletidae (Tab. 2, 3). They were found in six out of 17 flats, mostly in the same as pyroglyphid mites, and in all six public buildings sampled. In the total mite collection their percentages were low – 3.2%, 5.9% and 2.2%, respectively. In mites collection from flats all non-pyroglyphids mites consisted 5.0%. However, although the mite collection from public buildings was not high, Acaridae were visibly dominant and consisted 80.0% of Acari population in the hospitals. On the other hand, in the small mite collection from hotels their percentage (35.0%) was comparable to the percentages of Mesostigmata (25.0%) and Pyroglyphidae (35.0%) (Tab. 2).

The mean number of mites in the flats was rather low and consisted: for Pyroglyphidae – 12.03 specimens/g of dust for all samples and 32.25 specimens/g of dust for mites positive samples, while for all Acari – 13.07 and 35.04, respectively (Tab. 3). Only in 6/134 (4.5%) samples the density of mites exceeded 100 (110-280) specimens per gram. All these samples were collected in two flats in May (n = 2) and September (n = 4), in months when mites were the most numerous. In the other months, the number of mites/g of dust in those flats did not exceed 70 specimens.

In dust samples from hospitals and hotels the maximum densities of mites constituted 40.0 and 26.7 specimens per gram, respectively (Tab. 3), and were not clinically important, especially considering that the contribution of pyroglyphid species to the total mite collection was small.

In the flats, among 56 dust samples collected during the warm, non-heating season (May - September) as many as 24 samples (42.9%) were mite positive while among 78 dust samples collected during the cooler, heating season (October–April) 26 samples (33.3%) were positive (Tab. 4). The highest percentage of samples with mites was noted in September (52.9%). The majority of all pyroglyphids (76.7%) were found only in the non-heating season, including 97.5% of the total *D. pteronyssinus* collected (Tab. 4).

The average mite density per positive sample was about three times higher during the warm season (15.6 specimens) than during the cool season (4.6 specimens) (Tab. 4).

Significant differences were found between the numbers of mites belonging to dominant species *D. farinae* and *D. pteronyssinus*, recovered during the non-heating and heating seasons. In both cases the numbers were significantly greater during non-heating season ( $\chi^2 > 71.2$ ,  $p < 0.001$ ).

## DISCUSSION

The results of this study show that allergenic mites of the family Pyroglyphidae predominated in acarofauna of the flats in the cities of Gdańsk and Gdynia which is typical for temperate climate [20, 26, 30].

**Table 1.** Number of samples examined from private flats, hospitals and hotels, and number of mites isolated.

Sampling sites	Samples			Mites			
	Number of samples		Percentage of positive samples	Number of mites isolated	Percentage of total count of mites	Mean number of mites	
	Examined	Positive for mites				Per examined sample	Per positive sample
Private flats	134	50	37.3	493	91.6	3.7	9.9
Hospitals	71	11	15.5	25	4.7	0.4	2.3
Hotels	72	13	18.1	20	3.7	0.3	1.5
Total	277	74	26.7	538	100	1.9	7.3

**Table 2.** Frequency and dominance of mites found in dust samples from private flats, hospitals and hotels.

Mite species	Private flats (n* =134)			Hospitals (n* =71)			Hotels (n* =72)		
	Frequency (samples positive for mites)		Dominance (percent of total mites collected)	Frequency (samples positive for mites)		Dominance (percent of total mites collected)	Frequency (samples positive for mites)		Dominance (percent of total mites collected)
	Number	Percent		Number	Percent		Number	Percent	
<i>Dermatophagoides farinae</i>	42	31.3	78.9	0	-	-	2	2.8	30.0
<i>Dermatophagoides pteronyssinus</i>	8	6.0	16.1	2	2.8	8.0	1	1.4	5.0
Total Pyroglyphidae	44	32.8	95.0	2	2.8	8.0	3	4.2	35.0
<i>Tyrophagus putrescentiae</i>	4	3.0	0.8	8	11.3	72.0	3	4.2	20.0
<i>Tyrophagus</i> spp.	0	-	-	1	1.4	8.0	1	1.4	10.0
Unidentified Acaridae	1	0.7	0.2	0	-	-	1	1.4	5.0
Total Acaridae	5	3.7	1.0	8	11.3	80.0	5	6.9	35.0
<i>Cheyletus trouessarti</i>	3	2.2	0.6	0	-	-	0	-	-
<i>Cheyletus eruditus</i>	2	1.5	0.4	0	-	-	0	-	-
<i>Cheyletus</i> spp.	2	1.5	0.4	1	1.4	4.0	0	-	-
<i>Cheyletia</i> spp.	0	-	-	0	-	-	1	1.4	5.0
Unidentified Cheyletidae	1	0.7	0.6	0	-	-	0	-	-
Total Cheyletidae	7	5.2	2.0	1	1.4	4.0	1	1.4	5.0
Total Mesostigmata	4	3.0	2.0	2	2.8	8.0	4	5.6	25.0
Total Acari	50	37.3	100	11	15.5	100	13	18.1	100

n\* - number of dust samples

Among multiple and variable factors, outdoor and indoor, relative humidity appears to be the principal determinant of the prevalence and population densities of *Dermatophagoides* mites [13, 14, 17, 29]. Availability of water vapour as well as inter-specific differences in water balance and water requirements seem to play a key role in the prevalence of particular species [2]. Temperature is another important factor that influences their development. *Dermatophagoides pteronyssinus*, for instance, is known to be associated with higher relative humidity (75-80% RH) and lower temperature (15-20°C). It is often found in seaside and lowlands regions with a humid climate. On the other hand, *D. farinae* is better adapted to lower humidity (50-75% RH) and higher temperature (25-

30°C), and therefore occurs more often in areas of dry or alpine climate [9].

Although our studies were conducted at the sea-coast, in a zone of humid climate where a predominance of *D. pteronyssinus* should be expected, they included, however, new buildings with central heating that created suitable microclimatic conditions only for *D. farinae* growth. This is probably why the latter species was so abundantly noted and, on the other hand, why *Euroglyphus maynei* was absent as the species which exhibits even higher sensitivity to humidity decrease than *D. pteronyssinus* [3, 8, 25, 27].

Our results are in agreement with those reported by Horak [15]. She also observed that in new, centrally-

**Table 3.** Number of mites collected and mean mites' concentration per 1 gram of dust in samples from private flats, hospitals and hotels.

Mite species	Private flats (n* =134)			Hospitals (n* =71)			Hotels (n* =72)		
	Total mites collected	Concentration per 1 gram of dust (mean, range)		Total mites collected	Concentration per 1 gram of dust (mean, range)		Total mites collected	Concentration per 1 gram of dust (mean, range)	
		All samples	Samples positive for mites		All samples	Samples positive for mites		All samples	Samples positive for mites
<i>Dermatophagoides farinae</i>	389	8.97 (0–260.0)	24.03 (0–260.0)	0	-	-	6	0.41 (0–26.7)	2.32 (0–26.7)
<i>Dermatophagoides pteronyssinus</i>	79	3.06 (0–280.0)	8.22 (0–280.0)	2	0.11 (0–5.0)	0.75 (0–5.0)	1	0.01 (0–1.0)	0.08 (0–1.0)
Total Pyroglyphidae	468	12.03 (0–280.0)	32.25 (0–280)	2	0.11 (0–5.0)	0.75 (0–5.0)	7	0.42 (0–26.7)	2.35 (0–26.7)
<i>Tyrophagus putrescentiae</i>	4	0.10 (0–5.0)	0.27 (0–5.0)	18	0.65 (0–25.0)	4.19 (0–25.0)	4	0.12 (0–5.0)	0.69 (0–5.0)
<i>Tyrophagus</i> spp.	0	-	-	2	0.14 (0–10.0)	0.90 (0–10.0)	2	0.18 (0–13.3)	1.02 (0–13.3)
Unidentified Acaridae	1	0.04 (0–5.0)	0.12 (0–5.0)	0	-	-	1	0.02 (0–1.4)	0.11 (0–1.4)
Total Acaridae	5	0.14 (0–5.0)	0.37 (0–5.0)	20	0.79 (0–35.0)	5.10 (0–35.0)	7	0.33 (0–13.3)	1.82 (0–13.3)
<i>Cheyletus trouessarti</i>	3	0.07 (0–5.0)	0.19 (0–5.0)	0	-	-	0	-	-
<i>Cheyletus eruditus</i>	2	0.04 (0–2.5)	0.10 (0–2.5)	0	-	-	0	-	-
<i>Cheyletus</i> spp.	2	0.04 (0–2.9)	0.10 (0–2.9)	1	0.01 (0–1.0)	0.09 (0–1.0)	0	-	-
<i>Cheyletia</i> spp.	0	-	-	0	-	-	1	0.03 (0–2.5)	0.19 (0–2.5)
Unidentified Cheyletidae	3	0.04 (0–6.0)	0.12 (0–6.0)	0	-	-	-	-	-
Total Cheyletidae	10	0.19 (0–6.0)	0.52 (0–6.0)	1	0.01 (0–1.0)	0.09 (0–1.0)	1	0.03 (0–2.5)	0.19 (0–2.5)
Total Mesostigmata	10	0.71 (0–60.0)	1.90 (0–60.0)	2	0.11 (0–5.0)	0.68 (0–5.0)	5	0.20 (0–6.7)	1.10 (0–6.7)
Total Acari	493	13.07 (0–280.0)	35.04 (0.7–280.0)	25	1.03 (0–40.0)	6.63 (1.0–40.0)	20	1.00 (0–26.7)	5.52 (1.0–26.7)

n\* – number of dust samples

heated buildings *D. farinae* was the predominant species and made up more than 62% of the total mite population in the homes, while *D. pteronyssinus* and *E. maynei* constituted 30.4 and 1.6%, respectively.

On the other hand, Solarz [26], who carried out studies in Upper Silesia both in new and old age dwellings heated with stoves, observed that the occurrence and dominance of *D. farinae* was associated with lower humidity (50–65%) and temperature of 18–27°C whereas the dominance of *D. pteronyssinus* with humidity of 65–84% and the temperature of 10–24°C. This latter species was the most abundant (64.3%) among 31 species of mites collected in homes in Glasgow, Scotland, of which over 47%, especially unmodernized flats in old tenement buildings, showed signs of disrepair associated with damp [6].

Results presented in this paper confirmed the suggestion of several acarologists that the dominance of one or another *Dermatophagoides* species in house dust is caused rather by the microclimate (mainly relative humidity and temperature) of mite habitats within individual homes than by regional climatic conditions [9, 17, 26].

A comparison of the results of mite prevalence in the flats showed differences in Acari density during the year. Almost all *D. pteronyssinus* (97.5%) were found in dust samples collected in May–September, in the period of relatively higher humidity in flats rather than in October–April, in the so-called “heating season” when humidity decreases.

The age structure of the pyroglyphid population examined, with the predominance of the mature stage

**Table 4.** Prevalence of mites in flats during the heating and non-heating seasons.

Season	Dust samples			Mites (total collected, percent)												
	Examined	Positive for mites		<i>Dermatophagoides farinae</i>			<i>Dermatophagoides pteronyssinus</i>			Total <i>Pyroglyphidae</i>			Other Acari		Total <i>Acari</i>	Average number of mites per positive sample
		Number	Percent	A	N	Total	A	N	Total	A	N	Total	Number	Number		
Non-heating*	56	24	42.9	141	141	282 (72.5%)	69	8	77 (97.5%)	210	149	359 (76.7%)	15 (60.0%)	374 (75.9%)	15.6	
Heating**	78	26	33.3	66	41	107 (27.5%)	2	0	2 (2.5%)	68	41	109 (23.3%)	10 (40.0%)	119 (24.1%)	4.6	
Total	134	50	37.3	207	182	389	71	8	79	278	190	468	25	493		

\* from May to September; \*\* from October to April; A - adults; N - nymphs

over the immature forms, was in agreement with the results of other authors [3, 23, 26].

Apart from pyroglyphids, other mites were found in the dust acarofauna in private and public buildings surveyed during the present studies. They were members of the order Mesostigmata and families of Acaridae and Cheyletidae. Both storage mites of the family Acaridae and predatory mites of the family Cheyletidae are quite common among mites inhabiting houses [3, 24, 26, 28]. In our investigations these latter mites constituted 2.0% and 4.0% of the mite population from the flats and public institutions, respectively, and were comparable to percentages (2.7 and 2.5%, respectively) noted by Solarz [26] in the Upper Silesia region.

In the dust samples from hospitals, mites were seldom found and they were much less numerous than in samples collected in flats, i.e. on average 0.4 specimen per sample in comparison to 3.7 specimens, respectively. Also, Solarz [26] isolated in southern Poland fewer numbers of mites from hospital samples (avg. 0.3/sample) than from those from flats (7.8/sample). In England, in three Birmingham hospitals (general, geriatric and dermatologic) the total number of mites was also small compared to those found in house dust, and hospital mites did not constitute a serious problem for asthmatics [5]. Moreover, Babe *et al.* [4] found in Delaware, USA, no *D. farinae* or *D. pteronyssinus* in hospital dust samples obtained during the winter season while in the summer dust collection mites were present but their average density was insignificant. Such a lack or low density of mites in hospitals world-wide results probably from the use of low-pile carpets or lack of carpets and upholstered furniture in wards, as well as from repeated routine cleaning practices, i.e. washing the floor, frequent changing of bed-clothes, and good laundering practices [19, 20] which reduce mite infestation. The latter, as well as maintenance of low relative humidity, could also explain the small number of mites in the hotel rooms and in the other public buildings such as schools, cinemas, child-minding centres, and senior citizens centres [11].

In general, barely in six (2.5%) out of all 277 dust samples examined, the density of mites exceeded 100 specimens per gram (min. 110 – max. 280) - the threshold value for mite density recognised as clinically important, above which the risk of allergy occurrence increases considerably [20].

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