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Original paper

Comparison of the domestic mites abundance in dwellings on selected urban and rural areas of the Zawiercie district (south-west Poland)

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ABSTRACT. Mites are found in all types of environments, inhabiting also the immediate human environments, including dust from sleeping accommodations, upholstered furniture or carpeted floors. It is commonly known that house dust mites are sources of potent inhalant allergens. *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* belong to the most common species in the temperate climate zone. Samples were collected by using a portable vacuum cleaner, into trap-filters installed onto the cap for dusting. Then, mites were isolated by a flotation method with saturated NaCl solution. The Petri dishes were screening under a stereoscopic microscope for presence of mites, then isolated mites were mounted on microscopic slides in Hoyer's medium. Mites were identified to species under the light microscope using phase contrast optics. A total of 724 mites were isolated from 46 of the examined samples, including 666 (91.9%) members of the family Pyroglyphidae. Among them *D. pteronyssinus* was predominat (62.8% of the total count, with average number 211.22 specimens per 1 gram of dust), followed by *D. farinae* (24.03%, averagely 150.07 specimens per 1 gram of dust) and *Euroglyphus maynei* (4.42%, 118.11 specimens per 1 gram of dust).
Higher density of house dust mites was associated with the following factors: higher age of building, higher number of roommates, higher washing frequency per week, presence of carpeted floor in bedrooms, wooden floors in kitchens, closed kitchen, upholstered furniture, absence of pets and unemployed housewives.

Keywords: house dust mites, allergenic mites, domestic acarofauna, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Euroglyphus maynei*

Introduction

The dust mites dominate the immediate human environments, including beds and other sleeping accommodations in bedrooms, upholstered furniture or carpeted floors in living rooms. Therefore, they belong to the most important indoor risk factors of allergic diseases all over the world [1–6]. Typical representatives of the house dust mite fauna in temperate climates are three species from the Pyroglyphidae family (Acari: Astigmatina) – *Dermatophagoides pteronyssinus*, *D. farinae* and *Euroglyphus maynei* [7–12]. These species belong to the best known mites of medical concern, as well as they are the most numerously and most frequently detected acarines in samples of house-dust in Poland [4,13]. They exhibit a strong allergenic properties, similarly to some other species of this family, e.g. *Dermatophagoides siboney*, *D. microceras* and *Gymnoglyphus longior* [14–17].

Abundance of house-dust mites and other domestic mites in dwellings as well as their distribution among various indoor places are different in particular European countries [1,3,4,9]. In Poland, the knowledge about the occurrence of dust mites in houses and flats is still limited [17,18].

In order to reduce dust, including number of mites as well as allergens level, a regular cleaning is required. To achieve goal of effective prevention against house dust mite, one must identify the optimal conditions for their development, which is influenced by many factors, i.e.: relative humidity, temperature, altitude or age of the buildings,

Table 1. Species list, dominance and frequency of mites found in the examined house dust samples from dwellings on the territory of Zawiercie district (south-west Poland)

Mite taxa	Dominance		Frequency		
	N	(%)[1]	n	(%)[2]	(%)[3]
Pyroglyphidae	666	91.99	40	86.96	40.0
Dermatophagoides pteronyssinus	455	62.85	30	65.22	30.0
Dermatophagoides farinae	174	24.03	21	45.65	21.0
Dermatophagoides sp. (unidentified)	5	0.69	3	6.52	3.0
Euroglyphus maynei	32	4.42	5	10.87	5.0
Acaridae	5	0.69	3	6.52	3.0
Tyrolichus casei	5	0.69	3	6.52	3.0
Glycyphagidae	5	0.69	4	8.69	4.0
Glycyphagus domesticus	2	0.28	2	4.35	2.0
Lepidoglyphus destructor	3	0.41	2	4.35	2.0
Chortoglyphidae	2	0.28	2	4.35	2.0
Chortoglyphus arcuatus	2	0.28	2	4.35	2.0
Cheyletidae	20	2.76	13	28.26	13.0
Cheyletus eruditus	19	2.62	12	26.09	12.0
Cheyletus sp.(unidentified)	1	0.14	1	2.17	1.0
Eucheyletidae	1	0.14	1	2.17	1.0
Eucheyletia sp. (unidentified)	1	0.14	1	2.17	1.0
Bdellidae	3	0.41	2	4.35	2.0
Bryobinae (Tetranychidae)	2	0.28	1	2.17	1.0
Pygmephoridae	1	0.14	1	2.17	1.0
Other Prostigmata (unidentified)	1	0.14	1	2.17	1.0
Oribatida (sensu lato)	8	1.10	7	15.22	7.0
Mesostigmata	8	1.10	4	8.69	4.0
Other Acari (unidentified)	2	0.28	2	4.35	2.0
Total mites	724	100	46	100	46.0

Explanations: N=number of mite specimens; n=number of samples positive;
(%)[1]=percent of the total number of isolated mites; (%)[2]=percent of isolated mite in relation to positive samples (n=46); (%)[3]=percent of isolated mites for all tested samples (n=100).

heating, ventilation efficiency, type of furniture, the presence of carpets as well as the residents themselves [19–21].

The aim of this study was to investigate the possible occurrence, prevalence and species composition of allergenic acarofauna from beds, upholstery furniture and floors in dwellings on selected urban and rural areas in south-west Poland (Zawiercie district). Moreover, we would like to assess the differences in domestic acarofauna between rural (village) and urban localities, and also show the levels of house dust infestation with mite populations in particular sites of the examined dwellings. During this study the main habitats of house dust mite occurrence and breeding were also identified, and an influence of some abiotic and biotic environmental factors on abundance and occurrence of particular taxa of domestic mites was shown.

Materials and Methods

A total of 100 dust samples were collected from 20 dwellings of the Zawiercie district, both from urban (Poreba, Zawiercie, Ogrodzieniec) and rural (Kroczyce, Wierbka, Kidów, Rudniki, Wola Libertowska) areas. The material was collected in autumn 2014. The samples came from five places, including sleeping accommodations, bedroom floors, upholstered furniture from living rooms, living room floors and kitchen floors. The temperature and humidity were measured by thermometer and hygrometer in each examined apartment. All samples were collected by using a

Table 2. Density of mites from particular taxa in the examined house-dust samples collected in dwellings on the territory of Zawiercie district (south-west Poland)

Mite taxa	The number of mites per 1 gram of dust	
	mean ± SD	M
Pyroglyphidae		
Dermatophagoides pteronyssinus	211.22 ± 406.21	100
Dermatophagoides farinae	150.07 ± 343.43	25
Dermatophagoides sp. (unidentified)	50.83 ± 44.74	40
Euroglyphus maynei	118.11 ± 64.84	88.89
Acaridae		
Tyrolichus casei	19.05 ± 13.26	16.67
Glycyphagidae		
Glycyphagus domesticus	28.57 ± 30.31	28.57
Lepidoglyphus destructor	37.5 ± 17.68	37.5
Chortoglyphidae		
Chortoglyphus arcuatus	4.68 ± 0.46	4.68
Cheyletidae		
Cheyletus eruditus	16.95 ± 15.16	13.81
Cheyletus sp. (unidentified)	5.88	5.88
Eucheyletidae		
Eucheyletia sp.(unidentified)	8.33	8.33
Bdellidae	10.05 ± 2.43	10.05
Bryobinae (Tetranychidae)	11.76	11.76
Pygmephoridae	16.67	16.67
Oribatida (sensu lato)	11.03 ± 5.89	8.33
Mesostigmata	74.31 ± 84.72	37.50

Explanations: SD = standard deviation; M = Median

portable vacuum cleaner, into trap-filters measuring 5×5cm installed onto the cap for dusting. At each sampling site a surface area of 1 m² was vacuumed for 1 minute. All dust samples were placed in properly labelled test plastic tubes. Nextly, the dust sample (on the trap-filter) was weighted on analytical balance, and then placed in a 250 ml beaker. Mites were isolated by a flotation method with saturated NaCl solution. The sample was poured with a small amount of 70% ethanol, and then the resulting thick slurry was poured with saturated NaCl solution with a small amount of detergent. Nextly, the solution was mixed and the sample was incubated at room temperature for about 24 hours. The solution over sediment was filtered through a funnel with a filter paper in order to mites' isolation. Filter papers and deposited materials were placed in Petri dishes and floated with the saturated NaCl solution. Nextly, Petri dishes were screening under a stereoscopic microscope for the presence of mites. The isolated mites were mounted on microscopic slides in Hoyer's medium, and then the slides were desiccated for 3 or 4 weeks. Mites were identified to species under the light microscope Olympus CH 40 using phase contrast optics. Keys by Colloff [9], Fain et al. [1], Krantz and Walter [2] and Solarz [17] were used for identification of mites. The relative abundance and occurrence of collected mites, as well as categories of dominance and frequency were calculated according to Solarz and Seńczuk [22]. Frequency of the particular mite taxa was compared using the Yates corrected χ^2 test (CSS – Statistica for Windows, version 12). Significance was declared at a P value of less than 0.05. Information on various parameters which could influence on mite numbers were obtained by questioning the residents and analysed using the Spearman's rank correlation test.

Results

Overall results

From a total number of examined house dust samples (n=100), 46 were positive for mites. The majority of mites were collected from bedroom floors, sleeping accommodations and upholstered furniture, respectively. A total of 724 mites were isolated and identified, including 666 members of the family Pyroglyphidae (91.99%) (Table 1). *D. pteronyssinus* was the predominant species (62.85%), followed by *D. farinae* (24.03%) and *E. maynei* (4.42%). Among the non-pyroglyphid mites members of families Cheyletidae (mainly *Cheyletus eruditus*), Acaridae (*Tyrolichus casei*), Glycyphagidae (*Lepidoglyphus destructor*, *Glycyphagus domesticus*) and Chortoglyphidae (*Chortoglyphus arcuatus*) were collected. All these species are known as allergenic. The remaining part of mites consisted of the following taxa - Eucheyletidae, Bdellidae, Bryobinae, Pygmephoridae, Oribatida sensu lato (non-astigmatic oribatids) and Mesostigmata (Table 1). *D. pteronyssinus* and *D. farinae* were also the most frequent species and they were found in 65.22% and 45.65% of the total number of samples examined, respectively (Table 1).

D. pteronyssinus was significantly more frequent in the examined dwellings than *D. farinae* and *E. maynei* (Yates corrected χ^2=6.56 and 59.61; p= 0.0104 and $p \le 0.00001$, respectively). Furthemore, *D. farinae* was significantly more frequent than *E. maynei* (Yates corrected χ^2=28.36; $p \le 0.00001$). Generally, pyroglyphids were significantly more frequent in the examined dust samples than cheyletids (Yates corrected χ^2=68,83; $p \le 0.00001$). Moreover, glycyphagids were more frequent than acarids or chortoglyphids, and acarids were more frequent than chortoglyphids. But all these differences are statistically nonsignificant (Yates corrected χ^2=0.07, 1.32 and 0.38; p=0.794, p= 0.2513 and p=0.535, respectively).

Mite exposure: density of mites

Densities of mites expressed as numbers of mites per 1 gram of dust are presented in tables 2 and 3. Densities of mites per gram of dust varied between particular indoor sites examined (Table 3). *D. pteronyssinus* was also the most abundant species per 1 gram of dust (average 211.2), followed by *D. farinae* (average 150.1) and *E. maynei* (average 118.1). For other mite species, the average number of mites per 1 gram of dust was significantly lower, as indicated in table 2. Densities of different species of mites in the particular sampling sites (beds, upholstery furniture and floor samples) from the examined dwellings are compared in table 3. Number of mites per 1 gram of dust was highest in dust samples from bedroom floors, sleeping accommodations and upholstered furniture in living rooms. *D. pteronyssinus* was most abundant in dust samples collected from bedroom floors, where the average number of this species constituted 330.91 specimens per 1 gram of dust. Moreover, this mite species was also very abundant in beds or other sleeping accommodations (with average number 276.27 specimens per 1 gram of dust) and floors of the living rooms (224.71 specimens per 1 gram). In other types of places examined this mite was present in much smaller numbers (on upholstered furniture – 112.16 and on kitchen floors – 51.33 specimens per 1 gram of dust) (Table 3). *D. farinae* was also most abundant in dust samples collected from bedroom floors, where the average number of this species was 263.62 specimens per 1 gram of dust, and then in samples collected from sleeping accommodations (177.06 specimens per gram). In remaining samples, collected from other sites examined, *D. farinae* was present in much smaller amounts – 75.0, 59.5 and 22.2 per 1 gram of dust from kitchen floors, upholstered furniture and living room floors, respectively (Table 3). *E. maynei* was most abundant in dust samples collected from upholstered furniture in the living room, where the average number of this species was 200 specimens per 1 gram, and in dust samples from the bedroom floors (175.0 specimens per gram). In other places *E. maynei* occurred in much smaller numbers (in sleeping places – 88.9 specimens per gram, on living room floors – 66.7 specimens per gram and on floors of kitchens – 60 specimens per gram) (Table 3).

Ch. eruditus was most abundant on bedroom floors whereas *T. casei* on upholstered furniture in living rooms. *G. domesticus* occurred with highest density per gram of dust on kitchen floors, whereas *L. destructor* on bedroom floors. *Ch. arcuatus* occurred in small numbers and it was found only in beds and on bedroom floors (Table 3).

Differences between rural and urban acarofauna

Samples from urban areas were dominated with *D. farinae* (D=21.13), whereas samples from rural areas with *D. pteronyssinus* (D=56.63). Moreover non-pyroglyphid domestic mites (Acaridae,

Table 3. Densities of allergenic mites in particular indoor places examined in dwellings on the territory of Zawiercie district (south-west Poland).

Mite taxa	Sleeping area (n=9) Mean ± SD [M]	Bedroom floor (n=10) Mean ± SD [M]	Upholstered furniture in the living room (n=9) Mean ± SD [M]	Living room floor (n=9) Mean ± SD[M]	Kitchen floor (n=9) Mean ± SD [M]
Sarcoptifomes, Astigmatina,					
Pyroglyphidae					
Dermatophagoides pteronyssinus	276.27 ± 417.39 [90.28]	330.91 ± 667.78 [100]	112.16 ± 82.34 [116.67]	224.71 ± 327.08 [133.33]	51.33 ± 30.42 [50]
Dermatophagoides farinae	177.06 ± 403.20 [15.54]	263.62 ± 519.85 [32.5]	59.48 ± 47.78 [65.39]	22.22 ± 15.71 [22.22]	75 ± 108.33 [16.67]
Dermatophagoides sp. (unidentified)	26.25 ± 19.45 [26.25]	NF	NF	NF	100 [100]
Euroglyphus maynei	88.89 [88.89]	175 [175]	200 [200]	66.67 [66.67]	60 [60]
Acaridae					
Tyrolichus casei	33.33 [33.33]	7.14 [7.14]	16.67 [16.67]	NF	NF
Glycyphagidae					
Glycyphagus domesticus	NF	7.14 [7.14]	NF	NF	50 [50]
Lepidoglyphus destructor	NF	50 [50]	NF	NF	25 [25]
Chortoglyphidae					
Chortoglyphus arcuatus	5 [5]	4.35 [4.35]	NF	NF	NF
Trombidiformes, Raphignathina,					
Cheyletidae					
Cheyletus eruditus	13.43 ± 1.69 [13.81]	34.29 ± 31.62 [25]	11.86 ± 4.99 [11.86]	4.42 ± 1.19 [4.42]	NF

Table 4. Comparison of the species composition, dominance and frequency of mites found in the examined house dust samples from the urban and suburban areas of the Zawiercie district (south-west Poland)

Mite taxa	Urban areas			Suburban areas		
	mean	D (%)	F (%)	mean	D (%)	F (%)
Pyroglyphidae	147.40	32.04	58.69	195.35	59.94	69.56
Dermatophagoides pteronyssinus	63.03	6.21	23.91	297.02	56.63	41.30
Dermatophagoides farinae	268.34	21.13	21.74	42.54	2.90	23.91
Dermatophagoides sp. (unidentified)	12.5	0.28	2.17	70.00	0.41	4.35
Euroglyphus maynei	118.11	4.42	10.87	–	–	–
Acaridae	25	0.55	4.35	7.14	0.14	2.17
Tyrolichus casei	25	0.55	4.35	7.14	0.14	2.17
Glycyphagidae	50	0.14	2.17	27.38	0.55	6.52
Glycyphagus domesticus	50	0.14	2.17	7.14	0.14	2.17
Lepidoglyphus destructor	–	–	–	37.5	0.41	4.35
Chortoglyphidae	–	–	–	4.68	0.28	4.35
Chortoglyphus arcuatus	–	–	–	4.68	0.28	4.35
Cheyletidae	29.16	1.24	10.87	10.44	1.52	17.39
Cheyletus eruditus	29.16	1.24	10.87	11.09	1.38	15.22
Cheyletus sp.(unidentified)	–	–	–	5.88	0.14	2.17
Eucheyletidae	–	–	–	8.33	0.14	2.17
Eucheyletia sp. (unidentified)	–	–	–	8.33	0.14	2.17
Bdellidae	–	–	–	10.05	0.41	4.35
Bryobinae	–	–	–	11.76	0.28	2.17
Pygmephoridae	16.67	0.14	2.17	–	–	–
Other Prostigmata (unidentified)	50	0.14	2.17	–	–	–
Oribatida (sensu lato)	17.17	0.55	6.52	6.43	0.55	8.7
Mesostigmata	90.74	0.97	6.52	25	0.14	2.17
Other Acari (unidentified)	16.67	0.28	4.35	–	–	–

Explanations: D = percent of the total number of isolated mites (n=724); F = percent of isolated mite in relation to positive samples (n=46)

Glycyphagoidea, cheyletids) were distinctly more numerous in suburban or rural areas (Table 4).

Environmental factors influencing density and prevalence of mites

Table 5 shows the effects of temperature, relative humidity and other recorded environmental factors on the densities of mites per gram of dust in the examined houses, including particular mite species. The results of Spearman's rank correlation test between some abiotic and biotic indoor environmental factors (housing conditions) and the mite prevalence and density in the examined dwellings suggest associations between the total mite density (per 1 gram of dust) and the following both abiotic or biotic factors – localization (rural or urban), higher age of building, presence of pets, higher number of rooms, higher number of inhabitants (family size), unemployed housewife, kitchen (open or closed), wooden floor in kitchen, higher washing frequency, type of upholstery furniture, type of covers of upholstery furniture in living rooms, lower relative humidity and higher temperature (Table 5). Density of *D. pteronyssinus* was associated with type of localization (village), higher age of building, absence of pets, higher number of inhabitants, higher washing frequency per week, presence of unemployed housewives, carpeted floor in bedrooms, kitchen closed, type of kitchen floor (wooden floors in kitchens), type of upholstery furniture covering and higher temperature. Density of *D. farinae* was associated with higher age of building, absence of pets, using of beds as sleeping accommodations, kitchen closed, type of upholstery furniture covering and lower relative humidity. Presence and abundance of *E. maynei* was influenced by higher age of building, smaller family, lower number of rooms, higher washing frequency, unemployed housewife, wooden kitchen floor, higher cleaning frequency per week, type of upholstery furniture (armchairs in living rooms), type of the upholstery furniture covering (plush) and higher temperature. Abundance of cheyletids was associated with type of localization (village), higher age of building, absence of pets, higher washing frequency per week and wooden floors in kitchens. Generally density of house dust mites and all domestic mites was influenced with type of localization (village), higher age of building, absence of pets, higher number of inhabitants, higher washing frequency per week, carpeted floor in bedrooms, kitchen closed, type of kitchen floor (wooden floors in kitchens) and type of upholstery furniture (armchairs). Moreover density of house dust mites was associated with a house-wife not employed. Other correlations were nonsignificant ($p > 0.05$) (Table 5).

Discussion

The results obtained in our study are consistent with the majority of publications in this area. According to a number of scientific reports, 32–100% of the examined dwellings usually are positive for house dust mites and/or other domestic mites [1,9,18,23–26]. Our research presents that 46% of examined apartments were positive for mites.

Pyroglyphidae specimens usually represent about 90% of the total amount of mites collected in apartments in countries with temperate climate [1,5,15,18,23–27]. *D. pteronyssinus*, *D. farinae* and *E. maynei* belong to the most often and most abundant pyroglyphids occurring in dwellings and houses, both in our results, as well as in many others [6,8-9,11,18,25,28–31]. In Poland, *D. pteronyssinus* dominated in many other regions, like Warsaw [32], Poznan and surrounding areas [33], Cracow, Wodzislaw, Lodz, Bielsko-Biala and Katowice [5–6,34]. Comparable results were also obtained in Galicia (Spain), where *D. pteronyssinus* was the most common and abundant species in all studied provinces and was present in 97.6% of the examined samples [35]. On the other hand, the researches from Gdansk and Gdynia (West Pomerania) and from majority of the cities in Upper Silesia showed the dominance of *D. farinae* [3–5,11–13,17–18,22, 25,36]. This species has occurred also as predominant in Korean houses [37–38].

It should be stressed, that the domination of *D. pteronyssinus* in one-family houses appears to be the characteristic tendency at many of agricultural or subagricultural localities in Poland [5,18,39]. This tendency was also confirmed in our analyzes in case of dwellings, what may indicate that these localities in our country become more favourable for this mite species [5]. Generally, the older buildings and stoves are more favourable for the occurrence of both *D. pteronyssinus* and the domestic non-pyroglyphids, whereas new buildings, with central heating systems, for the higher abundance of *D. farinae* [13,18,40,41]. Thus, the differences in the geographic distribution of particular pyroglyphid house dust mites and domestic non-pyroglyphid mites, as well as the mite population densities, both within and between dwellings and localities, are attributed to variations in the biotic and abiotic factors of the indoor environment or ecological requirements of the different mite species.

In the analyzed samples we observed the highest occurrence and abundance of house dust mites in sleeping accommodations, as well as on bedroom floors. Similar results were obtained by Sander et al. [42] in Germany and by Sidenius et al. [43] in Copenhagen. In our study, many allergenic dust mites were found on the upholstered furniture in living rooms, while significantly fewer specimens were isolated from dust samples taken from floors in living rooms and kitchens.

It is commonly known, that the differences in abundance and prevalence of mites between dwellings are a reflection of associations between the environmental requirements of particular mite species or its biological characteristics. It is especially noticeable in relation to degree of indoor humidity influenced mainly by household activities, number of inhabitants, number and size of rooms, washing and cooking frequency, cleaning frequency, and many others [40,44–47]. Hart [48], Solarz [40], Kasprzyk et al. [44], Solarz and Pająk [39] reported the following environmental factors positively influencing on the density of mites: indoor and outdoor humidity, temperature, type of heating (coal stoves), type of sleeping accommodation (especially typical beds), type and age of mattresses (springs), type of bedding (without impermeable covers), carpeted floor (including type and age of carpets), soft furnishings, higher frequency of washing and cooking and lower frequency of cleaning, lower number of inhabitants (family size), lower number of rooms, presence of employed housewives, open

Table 5. Relationships observed between housing conditions and the abundance of mites in dust samples from the dwellings of the Zawiercie district (south-west Poland). Results of the Spearman rang correlation test analysis (*p< 0.05).

Variable	Mites						
	DP/1g	DF/1g	EM/1g	ChE/1g	HDM/1g	DM/1g	TM/1g
Village/city	0.47*	0.15	-0.13	0.27*	0.37*	0.36*	0.31*
Age of building	0.61*	0.27*	0.38*	0.41*	0.56*	0.56*	0.54*
Type of building	0.19	-0.05	0.02	0.02	0.09	0.09	0.07
Type of position	0.04	0.16	0.004	0.18	0.12	0.08	0.07
Pets	-0.25*	-0.26*	-0.16	-0.26*	-0.34*	-0.32*	-0.25*
Family size	0.36*	0.12	-0.27*	0.18	0.26*	0.23*	0.21*
Number of rooms	0.001	0.09	-0.31*	-0.08	-0.009	-0.02	-0.02
Type of heating	0.18	0.03	-0.14	0.07	0.13	0.14	0.11
Cooking frequency (per week)	0.07	-0.02	0.10	0.10	0.06	0.07	0.10
Washing frequency (per week)	0.50*	0.07	0.39*	0.38*	0.40*	0.40*	0.38*
House wife (employed or not)	-0.32*	0.005	-0.28*	-0.13	-0.20*	-0.18	-0.17
Type of place to sleep	0.03	0.25*	-0.04	-0.05	0.12	0.07	0.05
Type of floor in the bedroom	0.24*	0.14	-0.11	0.19	0.20*	0.22*	0.14
Kitchen (open or closed)	-0.35*	-0.25*	0.11	-0.19	-0.33*	-0.32*	-0.35*
Type of kitchen floor	0.48*	0.18	0.47*	0.31*	0.42*	0.44*	0.41*
Cleaning frequency	-0.03	0.12	0.29*	0.05	0.06	0.09	0.11
Type of cooking oven	0	0	0	0	0	0	0
Type of upholstery furniture	-0.17	-0.07	-0.41*	-0.18	-0.23*	-0.25*	-0.28*
Type of covering upholstery furniture (plain or plush)	-0.08	-0.23*	0.40*	-0.07	-0.16	-0.14	-0.08
Type of covering upholstery furniture (derma/leather or material)	0.22*	-0.005	0.08	0.12	0.14	0.15	0.15
Humidity (%RH)	-0.003	-0.34*	0	0.18	-0.08	-0.09	-0.09
Temperature (°C)	0.24*	-0.10	0.23*	0.09	0.07	0.04	0.07

Explanations: DP/1g = *Dermatophagoides pteronyssinus* per 1 gram of dust; DF/1g = *Dermatophagoides farinae* per 1 gram of dust; EM/1g = *Euroglyphus maynei* per 1 gram of dust; ChE/1g = *Cheyletus eruditus* per 1 gram of dust; HDM/1g = house dust mites per 1 gram of dust; DM/1g = domestic mites per 1 gram of dust; TM/1g = total mites per 1 gram of dust; * = p< 0.05

kitchens, wooden floors in kitchen, armchairs in living rooms, presence of smoking persons, presence of pets, age and type of buildings (one-family houses, old houses), wallpapers on walls, or signs of moulds. It should be stressed, that only some of these factors correspond with the results actually obtained. In our study, the higher density of house dust mites was associated with the type of localization (suburban areas), higher age of building, higher number of inhabitants, lower washing frequency per week, carpeted floor in bedrooms, kitchen closed, type of kitchen floor (wooden floors in kitchens), type of upholstery furniture (armchairs in living rooms), but also with absence of pets and unemployed housewives. During studies performed by the third author in southern Poland [13,18,39–40], the mite populations on floors are more dependent on environmental factors (as the type of building, type of heating, relative humidity or temperature), than those from the other examined places. Moreover, some sampling methods (sweepings, car vacuum cleaners) are more effective for collecting of the non-pyroglyphid domestic mites than for pyroglyphids.

Summarizing, many of the identified mites are known as allergenic species, what may indicate to a potential risk of sensitization to humans in examined urban and rural areas of the Zawiercie district (south-west Poland). *D. farinae* was the most common species in urban, and *D. pteronyssinus* in suburban areas of the Zawiercie district. In our study, the higher density of house dust mites was associated with the following factors: higher age of building, higher number of roommates, lower washing frequency per week, presence of carpeted floor in bedrooms, wooden floors in kitchens, closed kitchen, upholstered furniture, absence of pets and unemployed housewives.

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