

Short communication

Are house dust mite allergen levels influenced by cold winter weather?

Background: Moisture is vitally important for house dust mites and they cannot survive in cold or hot-dry climates.

Aims of the study: To investigate the influence of two extraordinarily cold and dry winters in 1995/1996 and 1996/1997 on house dust mite levels in German homes.

Methods: Dust samples were collected between June 1995 and December 2001 on the mattresses of 655 adults and 454 schoolchildren living in five different areas of Germany. We compared house dust mite allergen *Dermatophagoides pteronyssinus* (Der p 1) levels before and during the winters of 1995/1996 and 1996/1997 with levels after these winters.

Results: *D. pteronyssinus* (Der p 1) levels in samples taken after the cold winters of 1995/1996 and 1996/1997 were approximately two times lower than Der p 1 levels in dust samples collected before or during these respective winters (Geometric means: Erfurt 89 vs 33 ng/g; Hamburg 333 vs 219 ng/g; Bitterfeld, Hettstedt, and Zerbst 296 vs 180 ng/g). Except for Hamburg, the decrease in Der p 1 levels was statistically significant. *D. pteronyssinus* levels measured in dust samples collected in 2001 (i.e. 3 years after the two cold winters) show a statistically non-significant increase (Geometric means: Erfurt 33 vs 39 ng/g; Hamburg 219 vs 317 ng/g), suggesting that it may take a long time for mite allergen levels to increase again after a sudden decrease.

Conclusion: We conclude that Der p 1 levels in German mattress dust samples have been approximately reduced by a factor of three to four by the two consecutive cold winters of 1995/1996 and 1996/1997.

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Exposure to house dust mites is considered to be a major cause of asthma and allergies in several areas of the world (1–3). Moisture is a very important factor for house dust mites (4, 5). Therefore, house dust mites are very prevalent in regions with a temperate climate that holds enough moisture for them to survive; but they cannot survive in cold or hot-dry climates and mountain areas. Inside our homes, mattresses, upholstered furniture and rugs or carpeted floors provide a perfect microclimate for house dust mites.

Although climatic conditions vary across Germany, and thus Der p 1 levels are not equally distributed across the country, Germany with its temperate climate all in all represents a suitable habitat for house dust mites. There is sufficient moisture, and in most parts of the country, cold winters with monthly mean temperatures below zero are rare. Nevertheless, every once in a while, we experience extraordinarily cold winters, which might have an impact on house dust mite allergen levels.

The last two cold winters were in 1995/1996 and 1996/1997. The present work uses mite allergen levels

measured in house dust collected between 1995 and 2001 (i.e. during, before and after the two cold winters) within the framework of a study on Indoor Factors and Genetics in Asthma (INGA) to evaluate the impact of the cold winters on house dust mite allergen levels. A companion paper from a Dutch birth cohort study (6) suggests that these winters may have been responsible for unusually low mite allergen levels found at baseline in that study.

Materials and methods

Study population

Details of the selection of the study population have been described elsewhere (7). In brief, a total of 405 adults living in the German cities of Erfurt (Thuringia) and Hamburg and 454 school children living in Bitterfeld, Hettstedt, and Zerbst (all situated in Sachsen-Anhalt) were visited between 1995 and 1998. A total of 362 adults and 415 school children were revisited after approximately half a year (median time between the two home visits was 7 months).

Another 373 adults' homes (Erfurt 197, Hamburg 176; including 152 of the 405 adults' homes mentioned above) were visited in 2001.

Home visits and collection of dust samples

The adults' homes were visited between June 1995 and May 1997 and between February and December 2001; the children's homes were visited between April 1996 and September 1998. Dust was sampled from the participants' mattresses as described previously (8). In brief, dust was collected on cellulose filters by vacuuming an area of 1 m² for 2 min. Dust filters were weighed before and after vacuuming. The samples were stored at -20°C until extraction.

Quantification of house dust mite allergens

The major allergens of the house dust mites *Dermatophagoides pteronyssinus* (Der p 1), and *Dermatophagoides farinae* (Der f 1) were measured by means of a two-site monoclonal enzyme-linked immunosorbent assay (ELISA) as described earlier (8). The limit of detection was 1 ng/ml. Allergen concentrations were expressed as nanogram per gram of dust (ng/g).

Climate data

Monthly average temperature and total precipitation for 1991–2002 were obtained from the German National Meteorological Service (DWD; <http://www.dwd.de>).

Statistical methods

Analysis was restricted to Der p 1, since Der p 1 is most commonly measured in epidemiological studies and was found to be more humidity-sensitive. Since the distribution of Der p 1 levels was right skewed, mean allergen levels are presented as geometric means with 95% confidence intervals. Der p 1 levels below the limit of detection were assigned a value of one-half of the detection limit. Mean Der p 1 levels for comparable periods (with regard to sampling month) during, before and after the cold winter were compared by means of linear regression using log-transformed allergen levels adjusting for season and taking into account that multiple dust samples were taken in some homes. All analyses were carried out using the statistical analysis package SAS for windows release 8.02 (SAS institute, Cary, NC, USA).

Results

Monthly mean temperatures and total precipitation for December and January of 1991/1992–2001/2002 are presented in Figs 1 and 2. While mean temperatures were extraordinarily low in Erfurt and Hamburg in the 1995/1996 and 1996/1997 winters, only Hamburg had much less precipitation than usual in these winters. However, Erfurt always has little precipitation compared to Hamburg.

Season adjusted geometric mean Der p 1 concentrations in mattress dust samples collected between 1995 and 1997 and in 2001 are presented in Fig. 3. Der p 1 levels were much lower in Erfurt compared to Hamburg and Bitterfeld, Hettstedt, and Zerbst. No major differences were

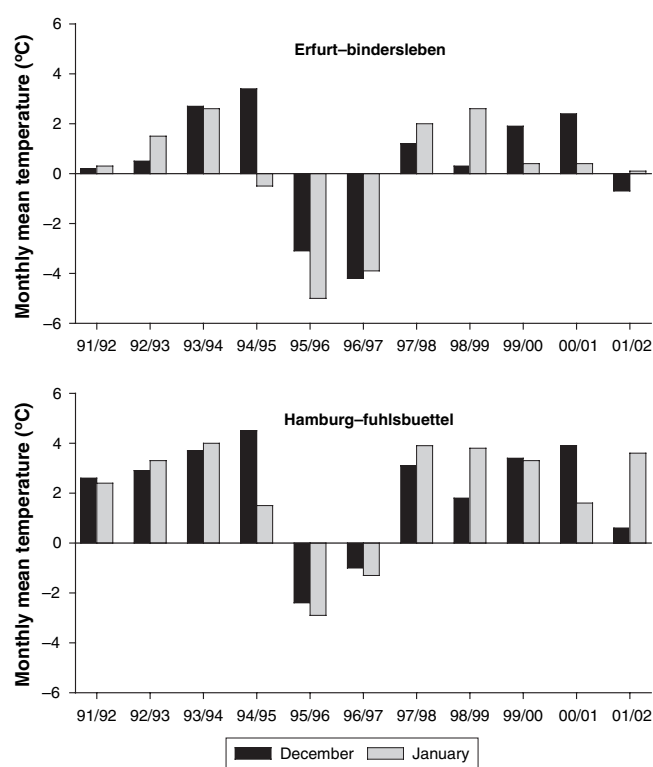


Figure 1. Monthly mean temperature in December and January months of the winters 1991/1992–2001/2002 in Erfurt and Hamburg.

found between Bitterfeld, Hettstedt, and Zerbst, which are situated in relatively close vicinity (data not shown). Mean Der p 1 levels in samples taken after the cold winters of 1995/1996 and 1996/1997, respectively, were 1.5–2.7 times lower than Der p 1 levels in dust samples collected before and during these winters. Except for Hamburg, the decrease in Der p 1 levels was statistically significant ($P < 0.05$). *Dermatophagoides pteronyssinus* levels measured in dust samples collected in 2001 indicate that levels slightly increase again after the two cold winters. However, differences with 1996/1997 levels are not statistically significant, suggesting that it may take a long time for mite allergen levels to increase again after a sudden decrease.

Discussion

Mattress dust Der p 1 levels in the present study were low compared to another German study (9). At least part of the difference might be explained by the warm and humid climate in Freiburg, situated in the south of Germany (9). Climatic differences may also account the big difference between Erfurt and Hamburg in the present study: Erfurt has lower winter temperatures and less precipitation.

Mite allergen levels in house dust samples have been analyzed by several groups worldwide. However, data on variability of mite allergen levels over periods of one or

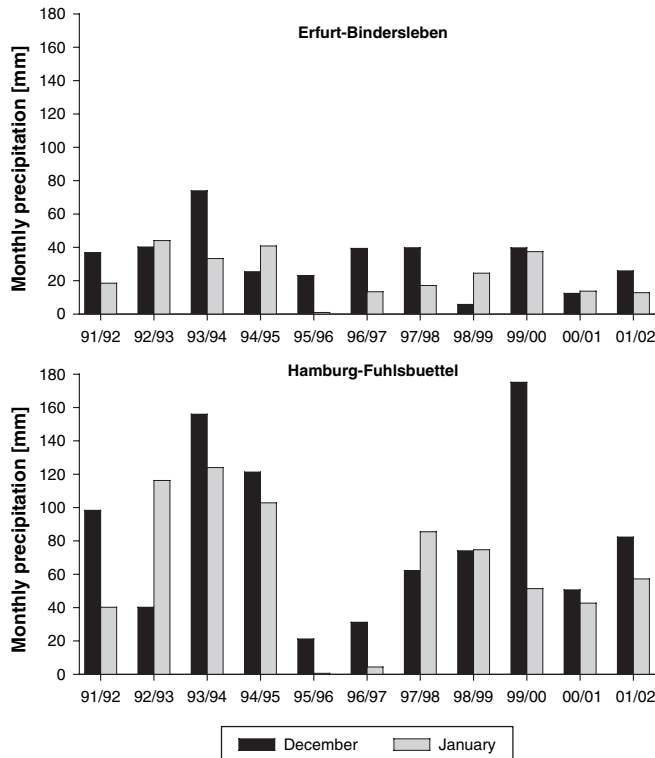


Figure 2. Monthly total precipitation in December and January months of the winters 1991/1992–2001/2002 in Erfurt and Hamburg.

more years is limited and in the majority of cases does not cover the periods preceding and succeeding the two cold winters of 1995/1996 and 1996/1997. Kuehr et al. (10) analyzed stability of house dust mite allergen levels over a one-year period from 1990/1991 to 1991/1992 and found mite allergen levels to be rather stable despite slightly higher levels in the second year compared to the first year. Topp et al. (11) analyzed stability of dust mite allergens

over a period of about 6 years (1995/1996–2001) within the INGA study, and found only moderate correlations between repeated measures. One might speculate that correlations were weakened by the cold winters between these measurements.

A British group compared Der p1 levels in mattress dust samples taken 10 years apart and found 1979/1980 levels to be almost twice as high as 1989/1990 levels (geometric means 18 400 vs 10 600 ng/g). Several studies on mite allergen exposure were performed in the Netherlands. The first study started in 1990, and it included approximately 500 schoolchildren (12). At that time, mattress dust Der p1 levels were high (geometric mean 5075 ng/g). Three years later, another study was performed in The Netherlands, and Der p1 levels were measured in dust samples collected on mattresses of infants aged 3–15 month (13). *D. pteronyssinus* levels reported for this study were somewhat lower than levels reported for the previous study, but still high (geometric mean 2373 ng/g). In 1996 the Dutch group started a birth cohort study (PIAMA) to evaluate mite allergen prevention for childhood asthma (14). They collected dust samples on infants' and parents' mattresses when the infants were 3 month and 1 year old and found that mite allergen levels irrespective of the intervention were much lower than mite allergen levels found in earlier studies (15, 16). The authors hypothesize that overrepresentation of subjects who actively practice mite allergen avoidance measures already or seasonality (in the PIAMA study dust samples were taken all year round, while dust samples in previous studies have been taken in fall when mite allergen levels are high) might explain their findings (15). However, when they studied seasonality in more detail, Der p1 levels in fall were only 20% higher in fall compared to the rest of the year. Since collection of the PIAMA data coincides with the winters of 1995/1996 and 1996/1997 and climate in the Netherlands follows a similar pattern as climate in Germany, we hypothesize

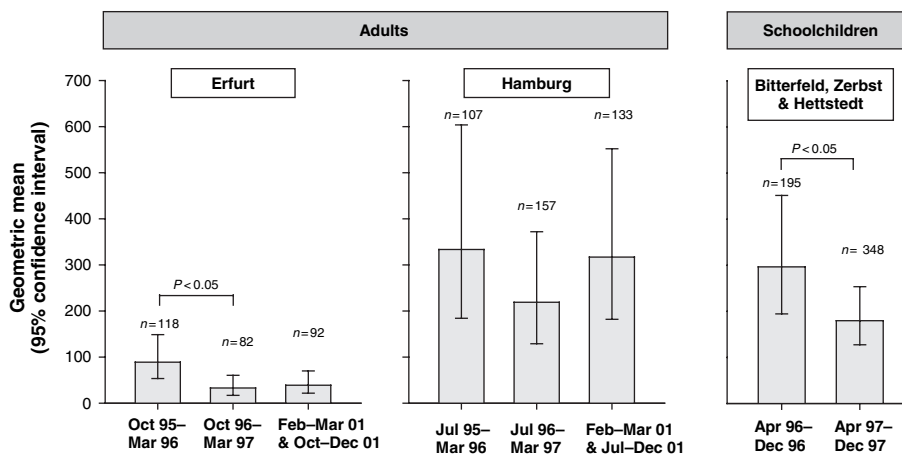


Figure 3. Geometric mean Der p1 concentrations (ng/g) in mattress dust samples for consecutive years in dust samples collected between 1995 and 2001 by study area.

that at least part of the decrease in Der p 1 levels in the Netherlands is attributable to climatic differences.

We think that the similarity between the Dutch and the German data is particularly noteworthy since levels of Der p 1 are higher in The Netherlands in comparison to Germany in general and in particular in comparison to Erfurt, where house dust mites are not very prevalent. Furthermore, German and Dutch study populations differ with regard to age, but nevertheless, temporal patterns are comparable.

Conclusion

We conclude that Der p 1 levels in German mattress dust samples have been approximately reduced by a factor of three to four by the two consecutive cold winters of 1995/1996 and 1996/1997.

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