

Prevention of mite infestation of bedding by means of an impregnated sheet

A randomized controlled trial

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A randomized controlled trial was conducted to test the effect of a sheet impregnated with benzyl benzoate in preventing mite infestation of new bedding. Impregnated sheets were placed on the mattresses of 17 subjects, while 19 subjects received placebo sheets. Over the following 2 years infestation occurred more commonly, and tended to be heavier, in the beds with inactive sheets than in those with impregnated sheets; among the 27 beds with three items of new bedding sampled on four occasions, a mite count of five or more occurred significantly more often where the sheet was inactive than where it was active (11 of 13 and 5 of 14 respectively). The application of a sheet impregnated with benzyl benzoate appears to prevent mite infestation and may be useful for patients with mite allergy who obtain new bedding as part of a mite-avoidance regimen.

Key words: allergy; asthma; mite

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The house dust mite *Dermatophagoides pteronyssinus* is a major cause of symptoms in persons suffering from asthma and allergic rhinitis (5). Mite-allergic asthmatic children tend to improve if they are given mite-free bedding, but the new bedding gradually becomes infested with mites (3). It is therefore desirable to prevent infestation of new bedding. A trial was set up to test the effect of a sheet impregnated with benzyl benzoate.

MATERIAL AND METHODS

The study was conducted on the bedding of 36 persons. Thirty-one had been advised to obtain new bedding because of asthma or rhinitis; another 5 were residents of homes for the elderly. Dust samples were taken from the original bedding, using a suction method (1), and the samples were examined for the presence of mites (6). The subjects were then given new interior-sprung mattresses, polyester-filled pillows and acrylic blankets, and randomly allocated to two groups.

One group was supplied with cotton sheets (registered trademark "Acasheet", manufactured by Morgan Ward Critchley Ltd., London, U.K.) impregnated with benzyl benzoate, a contact acaricide which is not toxic to human skin. A special formulation was employed which prevented evaporation of the active ingredient by reducing its vapour pressure. The other group was given non-impregnated sheets of similar appearance and texture. In each case the sheet was placed on the upper surface of the new mattress and covered by at least one undersheet so as not to be in contact with the subject. Sheets that became soiled were replaced by new sheets of the same type. Samples were taken from the new mattresses, pillows and blankets for repeat mite counts at 4 months, 8 months, 12 months and 2 years, the relative humidity in the room being recorded on each occasion. Neither the subjects nor the persons sampling the bedding and counting the mites knew which were the active and which the inactive sheets.

The reproducibility of the methods of sampling and counting mites was examined in the data obtained from a previous study (2); mite counts of samples taken 8 weeks apart from adjacent squares on 26 mattresses gave a Spearman rank correlation coefficient of 0.84, which is remarkably high considering that the mattresses were vacuum-cleaned repeatedly during the interval.

RESULTS

The mites found were mostly *Dermatophagoides pteronyssinus* and the antigenically similar *Euroglyphus* species. Table 1 summarizes the mite counts from 17 beds with active sheets, and 19 with inactive sheets. One bed in each group was not sampled before the new bedding was obtained; other variations in numbers are due to missing items of bedding and subjects leaving the study. Only 3 beds (two active, one inactive) had no mites

in any item of bedding prior to randomization, and they all acquired mites later on. Of the 5 residents in long-stay accommodation for the elderly, 2 were in the active and 3 in the inactive group; none of them was confined to bed. Two successive sheets were used by 5 and 8 subjects in the active and inactive groups respectively, and 3 successive sheets by 1 and 3 subjects respectively. The seasonal distribution of the replacement of bedding was similar in the two groups: it occurred during the warm part of the year (May–October) for 9 of the 17 “active” and 10 of the 19 “inactive” beds. Relative humidity at the time of sampling was also comparable in the two groups (Table 1).

At 4 months the new bedding contained few mites, and thereafter the mite counts tended to rise, especially in the beds with inactive sheets.

The distribution of mite counts was extremely skewed throughout the study, as shown by the high standard deviations and low median values.

Table 1
Mite counts and relative humidity at intervals throughout trial

	Active sheets				Inactive sheets					
	No.	Mite counts			RH % Mean (SD)	No.	Mite counts			RH % Mean (SD)
		Mean	(SD)	Median			Mean	(SD)	Median	
Previous bedding										
Mattress	16	104.1	(264.7)	14	89.1	18	42.8	(102.4)	7.5	87.2
Pillow	16	11.6	(17.4)	2.5	(7.9)	18	5.7	(11.2)	2	(7.9)
Blanket	16	14.7	(22.8)	1.5		18	141.0	(469.0)	2	
4 months										
Mattress	17	1.4	(1.3)	1	85.8	19	1.6	(3.1)	0	83.4
Pillow	16	0.6	(1.1)	0	(8.2)	18	1.6	(4.7)	0	(8.9)
Blanket	17	0.9	(2.0)	0		19	2.3	(3.5)	1	
8 months										
Mattress	17	1.4	(2.5)	1	85.6	19	4.1	(6.5)	1	85.7
Pillow	16	0.4	(1.1)	0	(8.9)	18	0.9	(2.4)	0	(7.1)
Blanket	17	1.6	(3.5)	0		19	9.4	(26.9)	1	
12 months										
Mattress	17	1.5	(2.3)	0	85.2	18	5.6	(11.9)	0.5	86.3
Pillow	16	0.6	(1.4)	0	(9.5)	18	1.7	(3.9)	1	(9.6)
Blanket	17	0.6	(1.3)	0		18	24.1	(74.7)	1	
2 years										
Mattress	15	2.1	(3.8)	0	86.1	15	6.5	(13.3)	1	89.7
Pillow	15	0.9	(2.6)	0	(8.6)	15	4.7	(10.6)	0	(6.2)
Blanket	14	5.5	(14.7)	0		13	39.5	(80.2)	2	

Means and medians were therefore considered to be inappropriate for making comparisons between the two groups. Table 2 shows the ranges of the mite counts, together with the proportions in which the mite count was 5 or more, a level indicating likely breeding of mites and established infestation. The inactive group showed a greater tendency to become infested than did the active group. There were 27 beds whose 3 items of new bedding were sampled on all 4 occasions; Table 3

shows that the beds with inactive sheets were significantly more liable to have a mite count of 5 or more at some time, in any item of bedding, than were those with active sheets ($P < 0.05$, Fisher's exact test). By 2 years 6 individuals in the inactive group had at least one item of bedding with more than 20 mites per sample (indicating moderate to heavy infestation), while only one in the active group had a mite count over 20. There was some tendency for infested items of bedding to occur in

Table 2
Ranges of mite counts and percentages with 5 mites or more

	Active sheets				Inactive sheets			
	No.	Mite counts			No.	Mite counts		
		Range	% (n)	≥ 5		Range	% (n)	≥ 5
Previous bedding								
Mattress	16	0-1064	75 %	(12)	18	0- 441	56 %	(10)
Pillow	16	0- 59	44 %	(7)	18	0- 44	22 %	(4)
Blanket	16	0- 56	38 %	(6)	18	0-2005	39 %	(7)
4 months								
Mattress	17	0-5	6 %	(1)	19	0-12	11 %	(2)
Pillow	16	0-4	0 %	(0)	18	0-20	6 %	(1)
Blanket	17	0-7	6 %	(1)	19	0-14	16 %	(3)
8 months								
Mattress	17	0-10	6 %	(1)	19	0- 22	26 %	(5)
Pillow	16	0- 4	0 %	(0)	18	0- 10	6 %	(1)
Blanket	17	0-14	12 %	(2)	19	0-118	26 %	(5)
12 months								
Mattress	17	0-8	6 %	(1)	18	0- 49	33 %	(6)
Pillow	16	0-5	6 %	(1)	18	0- 17	6 %	(1)
Blanket	17	0-5	6 %	(1)	18	0-320	39 %	(7)
2 years								
Mattress	15	0-12	13 %	(2)	15	0- 51	33 %	(5)
Pillow	15	0-10	7 %	(1)	15	0- 39	20 %	(3)
Blanket	14	0-54	14 %	(2)	13	0-283	46 %	(6)

Table 3
Number of beds with 5 or more mites in any article of bedding (3 items of new bedding sampled 4 times)

	Active sheets	Inactive sheets	All beds
Mite count ≥ 5	5	11	16
Mite count < 5	9	2	11
Total	14	13	27

Fisher's exact test (2-sided): $P = 0.026$

the same beds, but little relationship between preliminary and final mite counts.

The study was conducted largely among patients with asthma and rhinitis because they were obtaining new bedding as part of a mite-avoidance regimen. The numbers were too small for any investigation of clinical effects, especially as most subjects had only mild symptoms and did not take regular treatment.

DISCUSSION

The house dust mite is an important provoking cause of asthma and is often found in bedding. Efforts to remove mites from infested bedding tend to be ineffectual (2). It is therefore important to prevent infestation of new bedding.

This study examines the effect of a sheet impregnated with a long-lasting formulation of benzyl benzoate on the colonization of new bedding in comparison with an inactive sheet. The two groups were fairly similar in regard to the degree of infestation of their original bedding, and therefore supposedly to their risk of reinfestation, although in fact there was little relationship between preliminary and final mite counts. All the subjects lived in the same part of South Wales, an area with a damp climate conducive to mite infestation. Relative humidity was similar in the two groups, suggesting that there was no major bias in the allocation of houses within the trial as regards humidity. Benzyl benzoate was chosen as an acaricide because it combines effectiveness *in vitro* (4) with absence of toxic effects even when directly applied to the skin. The sheets were all well tolerated by the subjects, although a few remarked on a slight odour.

The results suggest that the likelihood and severity of mite infestation can be reduced by means of an impregnated sheet. Admittedly this finding does not necessarily imply clinical benefit to allergic patients. A controlled trial has shown that asthmatic children tend to improve in mite-free bedding (3), and it seems reasonable to suppose that this improvement is more likely to be maintained if the beds remain relatively free from mites than if they become re-infested.

The effectiveness of the impregnated sheet probably declines gradually over time, the rate of

decline being affected by various factors including temperature and ventilation. Further work is being undertaken to determine the persistence of benzyl benzoate in the sheet at different intervals of time in various conditions. The formulation that was used reduced vaporization of the active ingredient, and the mite counts suggest that each sheet remains active for at least 12 months of use. Annual replacement of the sheet should therefore ensure continuity of anti-mite activity.

Sheets impregnated with benzyl benzoate may contribute usefully to a regimen of mite-avoidance for allergic patients who obtain new bedding. Further work is needed to assess the clinical value of their use.

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