



Effectiveness of bedding control instruction for patients with respiratory allergies: A randomized controlled trial

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Abstract

Background: Allergic patients need effective environmental control to avoid the allergen that initiates the hypersensitive reaction.

Objectives: To examine the effectiveness of bedding control in reducing the concentration of house dust mite (HDM) allergens and relieving symptoms of patients with respiratory allergies.

Design: A randomized controlled trial of an untreated control group design with pre-test and post-test was used.

Settings: The subjects were recruited from patients receiving treatment at the allergy clinics of four university hospitals in Seoul.

Participants: Allergy clinic nurses selected 80 respiratory allergy patients with rhinitis and bronchial asthma revealing higher than strong positive (+3) for HDMs at skin prick test and radioallergosorbent test. They were assigned randomly to experimental ($n = 40$) and control ($n = 40$) groups. Of the initial 80 subjects, 71 (88.8%) completed the study, 36 as experimental and 35 as control; nine failed to complete the experiment due to illness or work.

Method: The experimental group received bedding control instruction that consisted of using cotton outer covers, washing them in boiling detergent water for 10 min and disinfecting bedding stuff by exposure to sunlight for 3 h, every 2 weeks for 4 weeks. Outcome measures were the concentration of HDM group I and group II allergens in the dust sample, and symptoms of respiratory allergy in patients.

Results: The experimental group had a significant decrease in concentration of HDM group I and group II allergens, and relief of symptoms of rhinitis, including sneezing and nose blowing.

Conclusion: The bedding control described in this study may have potential for relieving symptoms of respiratory allergy patients through reducing the concentration of HDM allergens, and may be a useful and beneficial intervention for respiratory allergy patients.

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Keywords: House dust mite (HDM); Environment; Allergy

What is already known about the topic?

- House dust mites (HDMs) are the most important respiratory allergens, and most of them are discovered in bedding.

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- Various physical and chemical environmental control measures have been tried to reduce the amount of HDM allergens in bedding.
- There has been a decrease in the concentration of HDM group I allergens and respiratory allergic symptoms after physical or chemical environmental control.

What this paper adds

- The results of this study showed a reduction of the concentration of HDM group I and group II allergens, which is important for respiratory allergy sufferers.
- Bedding control based on the traditional Korean method of treating bedding may be a useful nursing intervention and beneficial for respiratory allergy sufferers, especially those with allergic rhinitis.

1. Introduction

With changes in the living and working environments following economic development and industrialization, the incidence of respiratory allergic diseases such as rhinitis and bronchial asthma is increasing worldwide. Most allergic diseases are caused by house dust mite allergens (HDMA). The main HDMA-causing asthmatic reactions are group I and group II antigens of *Dermatophagoides pteronyssinus* (Der p I) and *Dermatophagoides farinae* (Der f I). For Korean respiratory allergic patients, group II allergens are more important than group I allergens (Hong and Lee, 1992). The cornerstones of the management of respiratory allergy, allergen immunotherapy, are environmental controls, such as HDMA avoidance and drug therapy (Bousquet et al., 1998). The goal of avoidance measures is to make the environment as hostile as possible for the house dust mites (HDMs). However, environmental control can become complicated, involving much expense or alteration in lifestyle. Many studies have addressed various methods of controlling the environment to decrease the number of HDMs and the level of HDMA. A significant variation in efficacy is seen in the extent to which these methods are followed, due to various factors such as cost, that introduce procedural or methodical difficulties when the patient or family members are trying to control the environment (Chapman et al., 2000).

As primary care providers, nurses should give instruction on inexpensive and simple environmental control measures that are physically practical and cost-effective for the patient and family.

Bed and bedding are an important source of HDMA. They are prime breeding areas and a good habitat for

mites and, for this reason, they have been the principal focus of many trials of the effects of HDMA avoidance.

We adopted a bedding control method based on the traditional Korean method of treating bedding, judged to have a high potential for removing heat-resistant group II allergens, and examined its effect on the level of HDM group I and group II allergens, peak expiratory flow (PEF), and symptoms of allergic rhinitis.

2. Methods

2.1. Design

A randomized controlled trial of an untreated control group design with pre-test and post-test was used to assess the effectiveness of bedding control instruction on the concentration of HDMA and respiratory symptoms of patients.

2.2. Participants

The subjects of the study were drawn from patients receiving treatment at the allergy clinics of four university hospitals in Seoul, the capital city of South Korea. Allergy clinic nurses selected 80 patients (30 with allergic rhinitis, 50 with bronchial asthma) who met all the acceptance criteria and agreed to participate in this study. They were assigned randomly to one of two groups; (1) experimental ($n = 40$); and (2) control ($n = 40$). All the patients satisfied the following acceptance criteria: respiratory allergy with rhinitis and bronchial asthma with higher than strong positive (+3) of HDMs at skin prick test and radioallergosorbent test, while skin tests for other common inhalant allergens are negative. Subjects were rejected if they were under similar environmental control measures. Of the initial 80 subjects, 71 (88.8%) completed the study; 36 as experimental and 35 as control; nine failed to complete the experiment due to disease or work. According to power analysis (for repeated measures), the sample size of 33 patients in each group yields 80% power, using the effect size = 0.44, correlation = 0.7 and a one-sided type I error level of 5% (Machin et al., 1997). The effect size is the result of a meta-analysis of HDM control measures for asthma (Göttsche et al., 2006).

2.3. Intervention

The bedding control used in this study consisted of using cotton outer covers (bed cover, top sheet and pillow case), washing them in boiling detergent water (above 208.4 °F) for 10 min and disinfecting bedding by exposure to sunlight for 3 h, every 2 weeks. We developed this method on the basis of the traditional Korean way of treating bedding before the advent of

industrialization. Koreans traditionally used a bed cover and top sheet of cotton, washed in boiling detergent water, while non-washable bedding stuff is exposed to sunlight to freshen it. Washing at 212 °F is effective for killing mites in bedding (McDonald and Tovey, 1992), will wash out allergens, and is normally recommended every 2 weeks.

The control group received only routine care from a nurse in an allergy clinic. Telephone contact was made with the experimental group to encourage bedding washing and exposure of bedding stuff to sunlight every 2 weeks.

2.4. Outcome measures

To determine the effects of bedding control, we measured the concentration of HDM allergen as an objective parameter that is the most sensible and valid indicator, and the morning PEF, the most commonly used outcome related to the severity of asthma, and nasal symptoms as an indicator reducing quality of life in allergic rhinitis patients.

Dust samples were collected from each subject's bedroom floor and bedding by a researcher before and after the instigation of bedding control. To prevent bias in the sample collection, all the procedures were conducted under the same conditions: the same researcher collected dust for 2 min/m² in the morning before cleaning the room with an electric vacuum cleaner (V-C601AQ, LG Electric Co, Seoul, Korea). Different filters were used for the bedding and the bedroom floor. The filters were stored in sealed plastic bags at –10 °F before measuring the concentration of HDMA.

The concentration of HDMA was measured by a university hospital laboratory. The amount of the collected sample was measured using a Chapman kit, up to the maximum of 48 mg. Sample amounts of up to 24 mg were combined with 1.2 ml of borate-buffered saline (pH 8.5) and 2.4 ml of borate-buffered saline was used for sample amounts of 25–48 mg. The sample solutions were shaken at room temperature for 18 h to extract the antigen. The supernatant was collected and the amount of the major antigens Der f I, Der p I, Der f II and Der p II was determined by enzyme-linked immunosorbent assay. The total amount of antigen, derived by adding the amount of Der f I and Der p I for HDM group I allergens, and the amount of Der f II and Der p II for HDM group II allergens, was used to calculate the amount of antigen in units of ng/g.

Patients with asthma were asked to measure their PEF using a peak-flow meter each morning, recording the best reading from three attempts.

The symptoms of rhinitis were assessed using the scoring scheme for nasal symptoms proposed by Okuda et al. (1984) (Table 1). The subjects were asked to record

Table 1
Scoring of allergic rhinitis symptoms

Sneezing

- 0 No sneezing attacks
- 1 1–5 sneezing attacks
- 2 6–10 sneezing attacks
- 3 more than 10 sneezing attacks

Nose blowing

- 0 No nose blowing
- 1 1–5 nose blowing
- 2 6–10 nose blowing
- 3 more than 10 nose blowing

Nasal obstruction

- 0 No nasal obstruction
- 1 Nasal obstruction without mouth breathing
- 2 Nasal obstruction with sporadic mouth breathing
- 3 Nasal obstruction with predominant mouth breathing

Adopted from Okuda et al. (1984).

the PEF and symptoms described above in a diary for the first 7 days, starting on day 1 of the study treatment and for the last 7 days of the study.

2.5. Procedure

The study was conducted from July 2003 to January 2004. Allergy clinic nurses contacted patients meeting the study acceptance criteria and gave them a brief explanation of the study purpose; verbal consent to participate was obtained. The dust-collecting method, not cleaning the bedroom before dust collection and how to record the diary of symptoms were explained to the participants. They were assigned at random by coin tossing by the allergic clinic nurses to the experimental and control groups.

One of the researchers visited each subject at homes to assess the environment and collect dust samples on the morning of the appointed day. The experimental group learned the bedding control method from a demonstration by the researcher, and kept the bedding control for 4 weeks.

A second visit was done 4 weeks later to collect post-test data, dust samples and symptom diaries.

Demographic characteristics regarding the patients, including gender and age, and clinical information such as family history and medical treatment information were obtained from the subject's medical records.

2.6. Ethical consideration

The study was approved by the Medical Research Ethics Committees of the four university hospitals. The patients in this study received information from the

investigator about the purpose and procedure of the study. Verbal consent was obtained. Subjects were informed that participation was optional and they could withdraw at any time, and that their answers would remain confidential.

2.7. Data analysis

Statistical data analysis was performed using SAS software (ver.8.1). Descriptive methods, χ^2 and Fisher's exact tests were performed to compare the demographic and environmental conditions of the experimental and control groups.

Means, standard deviation of the concentration of HDMA, PEF and the scores of allergic rhinitis symptoms were computed. As the assumption of normality was not met, non-parametric analysis was used instead of parametric analysis. The Wilcoxon rank

sums test and Wilcoxon signed rank test were used to examine the differences within and between group means for the concentration of HDMA, PEF and scores of allergic rhinitis symptoms.

3. Results

3.1. Description of participants

The subjects were 40 (56.3%) males and 31 (43.7%) females. No significant difference was shown between the two groups in general characteristics (Table 2). There was no significant difference between the two groups for the variables related to environmental factors associated with the concentration of HDMA, such as room temperature and humidity (Table 2).

Table 2
Demographic and environmental characteristics of participants

Characteristics	N (%)			χ^2	p
	Exp. (n = 36)	Cont. (n = 35)	Total (n = 71)		
Gender					
Male	23 (63.9)	17 (48.6)	40 (56.3)	1.69	0.193
Female	13 (36.1)	18 (51.4)	31 (43.7)		
Age (yr)					
<20	13 (36.1)	9 (25.7)	22 (31.0)	1.92	0.590
20–29	5 (13.9)	9 (25.7)	14 (19.7)		
30–39	9 (25.0)	9 (25.7)	18 (25.4)		
40≤	9 (25.0)	8 (22.9)	17 (23.9)		
Duration of disease					
<1	6 (16.7)	6 (17.1)	12 (16.9)	0.59	0.898
≤1 to <5	18 (50.0)	15 (42.9)	33 (46.5)		
≤5 to <10	7 (19.4)	7 (20.0)	14 (19.7)		
10≤	5 (13.9)	7 (20.0)	12 (16.9)		
Immunotherapy					
Yes	21 (58.3)	21 (60.0)	42 (59.2)	0.02	0.886
No	15 (41.7)	14 (40.0)	29 (40.8)		
Diagnosis					
Asthma	22 (61.1)	20 (57.1)	42 (59.2)	0.12	0.734
Rhinitis	14 (38.9)	15 (42.9)	29 (40.8)		
Relative humidity in bedroom (%)					
<50	13 (36.1)	13 (37.1)	26 (36.6)	0.01	0.928
50≤	23 (63.9)	22 (62.9)	45 (63.4)		
Temperature in bedroom (°C)					
<25	19 (52.8)	17 (48.6)	36 (50.7)	0.13	0.723
25≤	17 (47.2)	18 (51.4)	35 (49.3)		
Days after bedding washing (days)					
≤14	14 (38.9)	9 (25.7)	23 (32.4)	1.41	0.236
15<	22 (61.1)	26 (74.3)	48 (67.8)		

Exp.: experimental group; Cont.: control group.

Table 3
Baseline of research variables before intervention by group

Variable	Mean	SD	Z	p
<i>HDM allergens (ng/g of dust)</i>				
Group I				
Exp. (n = 36)	18619.2	17373.7	0.58	0.565
Cont. (n = 35)	17943.5	20452.8		
Group II				
Exp. (n = 36)	3023.5	8321.1	0.25	0.800
Cont. (n = 35)	2258.8	6925.7		
Morning PEF (L/min)				
Exp. (n = 22)	403.90	89.70	1.53	0.101
Cont. (n = 20)	415.50	83.69		
<i>Allergic rhinitis (score)</i>				
Sneezing				
Exp. (n = 14)	1.43	1.28	0.42	0.680
Cont. (n = 15)	1.27	1.28		
Nose blowing				
Exp. (n = 14)	1.71	0.91	0.94	0.380
Cont. (n = 15)	1.33	0.98		
Nasal obstruction				
Exp. (n = 14)	1.79	1.19	0.14	0.890
Cont. (n = 15)	1.73	1.09		

Exp.: experimental group; Cont.: control group.

3.2. Pre-test scores

The groups were balanced in terms of research variables such as HDMA, PEF and allergic rhinitis symptoms at pre-test (Table 3).

3.3. Concentration of HDMA

There was a significant difference in the change of the concentration of HDM group I allergen between the experimental and control groups ($p = 0.010$). The concentration of HDM group I allergen showed a 9098.4 ng/g decrease after bedding control in the experimental group, while showing a 6.6 ng/g increase in the control group.

There was a significant difference in the change of the concentration of HDM group II allergens between the experimental and control groups ($p = 0.009$). The concentration of HDM group II allergens after bedding control showed a 2825.3 ng/g decrease in the experimental group, while showing a 379.6 ng/g increase in the control group (Table 4).

3.4. The morning PEF

No significant change was shown in the morning PEF between the experimental and control groups. The

morning PEF of the experimental group increased slightly, by 12.64 L/min, while that of the control group decreased slightly, by 2.88 L/min, after bedding control (Table 5).

3.5. Symptoms of allergic rhinitis

There was a significant difference in the change of the score of sneezing between the experimental and control groups after bedding control ($p = 0.051$). The decrement in the score of sneezing was 1.07 in the experimental group, and 0.14 in the control group.

There was a significant difference in the change of the score of nose blowing between the experimental and control groups after bedding control ($p = 0.016$). The score of nose blowing decreased significantly, a 1.14 decrease in the experimental group. The score of nose blowing increased by 0.07 in the control group.

No significant difference was shown in the change of the score of nasal obstruction between the experimental and control groups after bedding control (Table 5).

4. Discussion

There are conflicting data on the effectiveness of HDMA control in patients with bronchial asthma; in a

Table 4

Concentration of HDMA before and after intervention by group (ng/g of dust)

Variable	Before		After		Z^w	p	Difference (after–before)		Z^b	p
	Mean	SD	Mean	SD			Mean	SD		
Group I										
Exp. ($n = 36$)	18619.2	17373.7	9520.8	10247.8	3.80	0.000	−9098.4	16208.2	2.58	0.010
Cont. ($n = 35$)	17943.5	20452.8	17950.1	19756.9	0.43	0.670	6.6	19973.0		
Group II										
Exp. ($n = 36$)	3023.5	8321.1	198.2	311.9	3.07	0.002	−2825.3	8259.8	2.59	0.009
Cont. ($n = 35$)	2258.8	6925.7	2638.4	7180.9	0.64	0.520	379.6	2107.4		

Exp.: experimental group; Cont.: control group.

 Z^w : Wilcoxon signed rank test; Z^b : Wilcoxon rank sums test.

Table 5

Morning PEF of bronchial asthma and symptoms of allergic rhinitis before and after intervention by group

Variable	Before		After		Z^w	p	Difference (after–before)		Z^b	p
	Mean	SD	Mean	SD			Mean	SD		
Morning PEF (L/min)										
Exp. ($n = 22$)	403.90	89.70	416.60	101.77	1.33	0.183	12.64	40.45	1.31	0.190
Cont. ($n = 20$)	415.50	83.69	412.63	91.58	0.41	0.679	−2.88	53.52		
Allergic rhinitis (score)										
Sneezing										
Exp. ($n = 14$)	1.43	1.28	0.36	0.63	2.55	0.011	−1.07	1.14	2.13	0.051
Cont. ($n = 15$)	1.27	1.28	1.13	1.06	0.54	0.589	−0.14	0.92		
Nose blowing										
Exp. ($n = 14$)	1.71	0.91	0.57	0.65	2.70	0.007	−1.14	1.09	2.42	0.016
Cont. ($n = 15$)	1.33	0.98	1.40	1.06	0.43	0.665	0.07	1.09		
Nasal obstruction										
Exp. ($n = 14$)	1.79	1.19	0.93	0.73	2.40	0.016	−0.86	1.03	1.35	0.177
Cont. ($n = 15$)	1.73	1.09	1.53	0.92	0.78	0.438	−0.20	1.20		

Exp.: experimental group; Cont.: control group.

 Z^w : Wilcoxon signed rank test; Z^b : Wilcoxon rank sums test.

PEF: peak expiratory flow.

Cochran meta-analysis, chemical and physical methods aimed at reducing exposure to HDMA lacked effect in people with asthma (Göttsche et al., 2006). Another systematic review study concluded that environmental control of allergens, although difficult, should be an integral part of the overall management of sensitized patients (Custovic et al., 1998).

Among the various HDMA avoidance measures, we focused on feasibility and adopted bedding control. Washing bedding is a routine household affair, so the subjects could carry it out easily without much economic burden or procedural difficulty. Boiling with detergent water is familiar to Koreans, and potentially effective for removing heat-resistant HDM group II allergens. Most participants reported that they had no problem

with washing, but disinfecting bedding by sunlight was highly laborious. This problem could be solved by wrapping the bedding with vinyl covers or allergen-impermeable covers, methods shown to be clinically ineffective as sole allergen avoidance measures (Woodcock et al., 2003).

We observed that the concentration of HDMA in the experimental group decreased significantly following the bedding control. The concentration of HDM group I allergens showed a decrease of 51.1% after treatment. Although this result was lower than that of 83.6% reported by Choi (1996), the reduction in the concentration of HDMA after bedding control was similar to those of other studies. In those studies, the level of allergens decreased: (1) after the children's bedrooms

were treated with an acaricide, and the mattresses, pillows and duvets were encased in exclusion covers for 6 weeks (Carswell et al., 1996); (2) wrapping the mattress combined with laundering bedding in hot water every week (Owen et al., 1990); (3) improving the hygienic conditions surrounding allergic patients following a physician's advice (Konishi and Uehara, 1994); (4) encasing the mattress after chemical treatment plus hot water washing of bedding every 2 weeks (Weeks et al., 1995); (5) encasing in exclusion covers, washing the top bedding covers with 55°C hot water, removal of soft furniture and wet cleaning the bedroom floor for 4 weeks (Choi, 1996); (6) dry steam-cleaning plus vacuuming (Patrick et al., 2001); and (7) using impermeable mattress covers and an acaricidal washing detergent for bedding (Mihirshahi et al., 2003). The smaller decrease in our study compared with the previous studies was probably due to the difference in treatment methods; our method is simpler and quicker. Longer and more in-depth studies should be undertaken in the future.

The concentration of HDM group II allergens decreased significantly in the experimental group, as we expected. This result was supported from boiling bedding covers, based on the fact that protein denaturation of HDM group II allergens within bedding covers occurs only at temperatures higher than 208.4°F.

We observed that the concentration of HDMA of both group I and group II allergens had a tendency to increase in the control group. These results implied that routine verbal instruction was not enough to instigate HDMA avoidance measures for patients or their families. Perhaps they need more details about the HDMA avoidance measures, or stronger motivation to practice them. They need additional care, such as an assessment of their comprehension of the given instruction, and follow-up to determine the need for supplemental and reinforcing care (Moon and Choi, 1999).

We could not observe any significant difference in the morning PEF between groups. This result could be explained in that the initial PEF rate (86.5%) was too high for any increment to be effective and this is supported by the meta-analysis of HDM control measures for asthma that concluded PEF measurements did not suggest any worthwhile effect (Göttsche et al., 2006). This result implied that the bedding control provided in this study was not enough to lower the level of the HDM group I allergens to the threshold level regarded as a risk for asthma attack. Perhaps subjects need more details about bedding control measures or some stronger motivation to practice them or additional environmental control methods, such as lowering room humidity and temperature, or wrapping the mattress with a vinyl cover.

The scores of sneezing and nose blowing of rhinitis patients in the experimental group improved significantly compared with those of the control group and

pre-test levels. Although we could not detect any difference in the symptom score of nasal obstruction between the two groups, we did observe significant improvement compared with those before bedding control. This outcome of reduced nasal symptoms is similar to those found in other studies that showed that 1 month of environmental control measures relieved nasal symptoms significantly (Moon and Choi, 1999).

5. Conclusions and study limitations

Overall, this study had the following limitations: (1) because the participants were recruited from four urban university hospitals they were not fully representative of Korean people with respiratory allergies; and (2) bedding control was applied for only a short period of time. However, the bedding control method used in this study demonstrated a significant decrement in the concentration of HDMA, thereby partially reducing allergic rhinitis symptoms. This result suggests that bedding control may be a useful nursing intervention and beneficial for respiratory allergy patients.

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