

REVIEW ARTICLE

House dust mite avoidance measures for perennial allergic rhinitis: an updated Cochrane systematic review

U. Nurmatov¹, C. P. van Schayck^{1,2}, B. Hurwitz³ & A. Sheikh^{1,2}

¹Allergy & Respiratory Research Group, Centre for Population Health Sciences, University of Edinburgh, Edinburgh, UK; ²Department of General Practice, CAPHRI, Maastricht University, Maastricht, The Netherlands; ³Division of Health and Social Care Research, Department of English Language and Literature, King's College London, London, UK

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Correspondence

Prof. Aziz Sheikh, Allergy & Respiratory Research Group, Centre for Population Health Sciences, University of Edinburgh, Edinburgh EH8 9AG, UK.
Tel.: +44 (0)131-651-4151
Fax: +44 (0)131-650-9119
E-mail: aziz.sheikh@ed.ac.uk

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Abstract

Background: To assess the benefits and harms of measures designed to reduce house dust mite (HDM) exposure in the management of house dust mite-sensitive allergic rhinitis.

Methods: Systematic review of randomized controlled trials was made, in which HDM control measures have been evaluated in comparison with placebo or other HDM avoidance measures, in patients with clinically proven allergic rhinitis.

Results: Nine trials involving 501 participants satisfied the inclusion criteria. These trials have investigated the effectiveness of bedroom environmental control programmes involving the use of HDM impermeable bedding covers ($n = 4$), acaricides ($n = 2$), high-efficiency particulate air filters ($n = 2$) and, using a factorial design, acaricide and HDM impermeable bedding covers in isolation and combination ($n = 1$). Seven of the nine trials reported that, when compared with control, the interventions studied resulted in significant reductions in HDM load. Of the interventions studied to date, acaricides appear to be the most promising, although the findings from these studies need to be interpreted with care because of their methodological limitations. House dust mite impermeable bedding as an isolated intervention is unlikely to offer benefit.

Conclusions: Trials have tended to be small and of poor methodological quality, making it difficult to offer any definitive recommendations. Interventions that achieve substantial reductions in HDM load may offer some benefit in reducing rhinitis symptoms. Isolated use of HDM impermeable bedding is unlikely to prove effective.

It is estimated that up to 30% of the general population of developed countries suffer from one or more allergic diseases (1–6). Almost 3% of all general practitioner consultations in, for example, the United Kingdom are for allergic rhinitis (2, 7, 8). As with many other allergic diseases, there is concern that the prevalence of allergic rhinitis has increased in recent decades for reasons that are poorly understood (8, 9).

The main clinical symptoms of rhinitis are nasal irritation, sneezing, watery nasal discharge (rhinorrhoea) and the sensation of a blocked nose (10). Rhinitis is responsible for considerable morbidity and significant costs to health services (11, 12).

Traditionally, allergic rhinitis has been managed by advising regular use of topical nasal steroids or the use of systemic or topical antihistamines. Other agents used include topical

mast cell stabilizers. In more severe cases, systemic steroids or immunotherapy may be used. Surgical treatment may be needed for the very small proportion of patients who fail to respond to medical treatment/immunotherapy and who predominantly experience obstructive symptoms. Although allergen avoidance has always occupied a central role in the specialist management of allergic rhinitis, this advice has subsequently also been extended to the general management of allergic rhinitis (10, 13–15).

Allergic rhinitis can be classified as being intermittent/seasonal (e.g. hay fever), in which case the major allergen trigger is pollen, or persistent/perennial (lasting throughout the year). In many countries, the commonest allergic trigger for persistent allergic rhinitis is the house dust mite (HDM). There are a number of techniques designed to decrease the

exposure to HDM: these can be classified as physical (heating, ventilation, freezing, washing, barrier methods, air filtration, vacuuming and ionizers) or chemical treatments (acaricides), or a combination of these approaches.

Attempts at HDM reduction in the management of house dust mite-sensitive individuals with perennial allergic rhinitis are logical. However, these approaches have received only patchy uptake as there are concerns regarding the practicality, feasibility, effectiveness and cost-effectiveness of such interventions (15). The present review, which is an update of a Cochrane review first published in *The Cochrane Library* in 2001 and previously updated in 2003 and 2007 (16–18), aims to ascertain the value of HDM control measures in the management of perennial allergic rhinitis by searching the literature systematically and analysing all evidence arising from randomized controlled trials to ascertain the usefulness of HDM control measures in the management of perennial allergic rhinitis.

Methods

We conducted systematic searches for randomized controlled trials. There were no language, publication year or publication status restrictions. The latest update searches were conducted in December 2009.

We searched the Cochrane Ear, Nose and Throat Disorders Group Trials Register, the Cochrane Central Register of Controlled Trials Register (CENTRAL) (*The Cochrane Library* Issue 4, 2009), MEDLINE (2005–2009), EMBASE (2005–2009), CINAHL, mRCT (metaRegister of Clinical Trials, including www.clinicaltrials.gov), NRR (National Research Register), LILACS, KoreaMed, IndMed, PakMedi-Net, China Knowledge Network, CAB Abstracts, Web of Science, BIOSIS Previews, mRCT (Current Controlled Trials), ICTRP (International Clinical Trials Registry Platform) and Google.

We combined subject strategies with adaptations of the highly sensitive search strategy designed by the Cochrane Collaboration for identifying randomized controlled trials and controlled clinical trials (as described in the *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.0.2, Box 6.4.b) (19).

For the previous update, in May 2005, we searched the Cochrane Ear, Nose and Throat Disorders Group Trials Register, the CENTRAL (*The Cochrane Library*, Issue 2, 2005), MEDLINE (1950–May 2005) and EMBASE (1974–May 2005), CINAHL, AMED, LILACS, KoreaMed, IndMed, MedCarib, NRR, mRCT (metaRegister of Controlled Trials) and ISRCTN, ZETOC Conference Proceedings, Cambridge Scientific Abstracts, Science Citation Index (via ISI Web of Science) and ISI Proceedings.

For this most recent update, we scanned the reference lists of identified publications for additional trials and contacted trial authors where necessary. In addition, we searched PubMed, TRIP database, NHS Evidence–ENT & Audiology and Google to retrieve existing systematic reviews relevant to this systematic review, so that we could scan their reference lists for additional trials.

The bibliography of each paper identified in the 2005 update was also checked for further references. The primary authors of each study were contacted in an attempt to ascertain additional trials, whether published or unpublished.

Randomized controlled trials with or without blinding were included in the review. As some HDM control measures are impossible to blind, we accepted trials in which blinding was not undertaken. All patients (children and adults of all ages and both sexes) with a diagnosis of allergic rhinitis made by a qualified physician were included. We stipulated that a diagnosis of HDM allergy must have been confirmed by an objective test, such as skin prick testing, allergen-specific IgE concentrations or provocation testing. These included studies in which HDM control measures were compared with placebo or in which different types of control measures were compared. We considered studies evaluating physical and chemical treatments, or a combination of these approaches.

We were interested in both subjective and objective outcome measures. Primary outcome measures were quality of life, general well-being; days off/sick leave from school/work; nasal symptom scores; and any adverse outcome as reported in trials. Secondary outcomes included nasal peak inspiratory flow; nasal provocation tests; rhinomanometry; medication usage; compliance with treatment; and percentage of drop-outs.

Two independent authors checked titles and abstracts identified from the searches. We obtained the full texts of all studies of possible relevance for assessment. We decided which trials satisfied the inclusion criteria and graded their methodological quality. Any disagreement was resolved by discussion between the authors. One author performed data extraction (UN) using a standardized form; this process was checked by the second author (AS).

We assessed the quality of each trial following the Cochrane approach using the methods detailed in Chapter 6 of the *Cochrane Handbook for Systematic Reviews of Interventions* (19). We focused on the following domains to assess the quality of included studies: adequate sequence generation; allocation concealment; blinding (of subjects, investigators, outcome assessors or data analysts); incomplete outcome data adequately addressed; free of selective reporting; and free of other bias. Each parameter was given a judgement as follows: 'yes' a low risk of bias; 'no' a high risk of bias; and 'unclear' an uncertain risk of bias. We also documented the methodological quality of studies with regard to the following criteria: baseline differences between experimental groups, diagnostic criteria used and length of follow-up.

Because of the relatively few trials uncovered, trialists' failure to present their results fully and the clinical heterogeneity of the patient groups studied, meta-analysis was not considered appropriate. We therefore summarized results in a narrative overview. We had planned to perform quantitative analyses of outcomes on an intention-to-treat basis, where relevant, considering data in terms of changes from baseline.

Results

Of the titles and abstracts reviewed, we considered 12 randomized controlled trials to be possibly relevant. Four of the

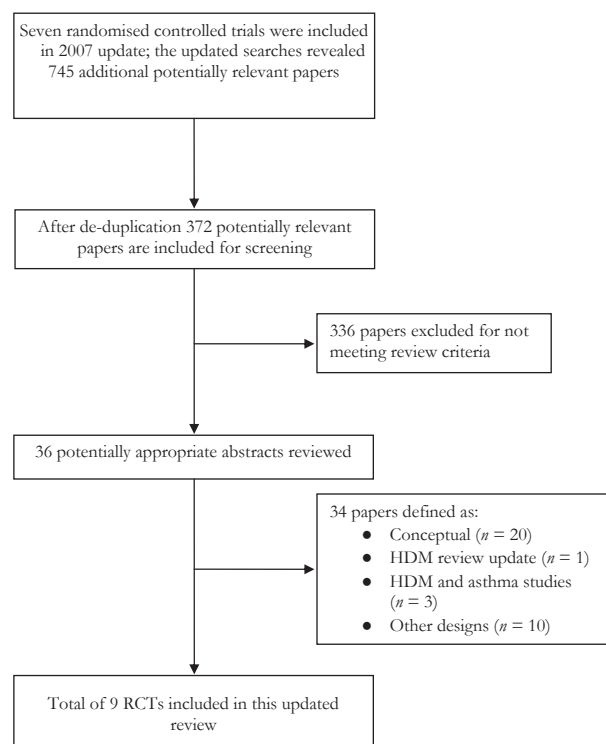


Figure 1 Updated PRISMA flow diagram.

papers, however, reported data from the same two trials (20–23). A further trial was available only in abstract format (we made a request for the full-text report to the lead author, but no response was received) (24). Nine unique randomized controlled trials studying a total of 501 participants, which have been reported in full, therefore satisfied the inclusion criteria (see Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] flow diagram, Fig. 1) (20, 22, 25–31). One of these trials required translating into English (28). Searching the bibliographies of these papers did not reveal any further trials.

Only two studies investigating the effectiveness of mite impermeable bedding covers were of good quality (22, 28); the remaining seven studies were small and of poor quality (20, 25–27, 29–31). Two trials investigated the efficacy of acaricides (20, 26); another two trials investigated the role of high-efficiency particulate air (HEPA) filters (25, 31). One trial, using a factorial design, investigated the efficacy of both acaricide and HDM impermeable bedding covers in isolation and combination (29); the remaining four trials investigated the efficacy of bedroom environmental control programmes involving the use of HDM impermeable bedding covers (22, 27, 28, 30). The key characteristics of these trials are summarized in Table 1.

The key findings from these trials are summarized in Table 2. Six of the seven studies reporting after the intervention showed decrease in HDM load (20, 22, 26, 28, 30, 31), the seventh showed no significant differences between groups (25). The other two studies did not provide any postintervention

HDM measurements (27, 29). Overall, these studies suggest that achieving substantial reductions in HDM load may be associated with improvements in symptom control, although the findings from these studies need to be interpreted with care because of their methodological limitations (see Table 1). House dust mite impermeable bedding as an isolated intervention did not, however, appear to offer clinical benefits (22, 28, 30). No serious adverse effects were reported from any of the interventions.

Discussion

Trials to date have on the whole been small and of poor methodological quality, making it difficult to offer any definitive recommendations on the role, if any, of HDM avoidance measures in the management of house dust mite-sensitive perennial allergic rhinitis. The results of these studies suggest that the use of acaricides and extensive bedroom-based environmental control programmes may be of some benefit in reducing rhinitis symptoms. There is now reasonably strong evidence that isolated use of HDM impermeable bedding is unlikely to prove effective.

With the exception of the Terreehorst et al.'s trial (22), all studies conducted to date have been small and omit the presentation of power calculations. Furthermore, these nine studies provide insufficient information to allow retrospective power calculations to be made. This makes it difficult to be sure that sample sizes studied have been adequate to exclude the possibility of false-negative results (Type II errors) confidently. All trials identified included both children and adults, but it is unclear how representative the population groups studied are of HDM allergic perennial rhinitis sufferers in the general population. In particular, none appear to have recruited from a community care setting, which suggests that the groups of patients being studied had greater disease severity than those routinely seen in a primary care setting.

The findings of several studies suggested that the interventions employed can result in some reduction in rhinitis symptoms, although it is not possible to estimate the magnitude or clinical significance of this likely reduction reliably because of various limitations in their study design, rendering them at moderate or high risk of bias (21, 26, 30, 31). Also noteworthy is that in the study by Moon and Choi (30), routine provision of advice on measures to reduce exposure to HDM failed either to decrease HDM load or (more importantly) to reduce clinical symptoms of rhinitis, which raises important questions about the generalizability of this environmental intervention in routine clinical care.

Neither of the two fully reported studies newly included in this update provided convincing evidence of clinical benefit associated with the interventions studied (27, 29). Only one small study, which is at present only available in abstract format, suggested that HDM impermeable bed covers may be associated with improvement in rhinitis symptoms (24).

Of the interventions studied to date, acaricides still appear to be the most promising and further pragmatic randomized controlled trials to determine the effectiveness of this monointervention are warranted in patients not receiving concomi-

Table 1 Characteristics of included studies

Study	Methods	Participants	Interventions	Outcomes	Quality
Reisman et al. (31)	Double-blind cross-over randomized controlled trial	40 subjects with perennial allergic rhinitis and/or asthma and confirmed allergy to house dust mite	Group 1: HEPA loaded with an active Enviracaire filter for 4 weeks followed by placebo for 4 weeks. Group 2: Same as Group 1 but order of active and placebo filters reversed	Particulate counts in bedroom air Symptom and medication scores Patient's subjective responses to treatment	C
Antonicelli et al. (25)	Randomized cross-over study	Nine participants aged 10–28 years with either allergic rhinitis or asthma	Using an air-cleaning device equipped with HEPA	House dust mite (Der p1, Der f1 and Der m1) allergen level Rhinitis and asthma symptom score	C
Kniest et al. (20)	Double-blind matched pair controlled trial	20 subjects aged 12–36 with HDM rhinitis. Divided into matched pairs on clinical and environmental parameters and then arbitrarily allocated to one of the two interventions	12 months of intensive home cleaning either with or without the addition of acaricide (solidified benzylbenzoate)	Daily symptoms and medication scores Physician assessment Total and mite-specific IgE Blood and nose eosinophils Guanine exposure	C
Geller-Bernstein et al. (26)	Double-blind randomized controlled trial	32 children aged 4–12 years with either allergic rhinitis or asthma or both and confirmed mono-allergy to house dust mite	Bedroom sprayed with either Acardust acaricide or placebo on days 0 and 90	Daily rhinitis and asthma symptom scores, medication use, twice-weekly PEF and monthly clinical assessment Dust HDM antigen concentration at days 0, 90 and 180	C
Moon and Choi (29)	Open randomized controlled trial	30 subjects aged 6–31 with confirmed HDM rhinitis and no other concomitant allergy to common aero-allergens	All subjects continued normal rhinitis treatment. In addition, they received either verbal advice on allergen avoidance or provision of the following bedroom-based intervention for 4 weeks: vinyl mattress cover, daily wet cleaning of floor, fortnightly boil washing of top bedding cover and removal of soft furnishings	Change in HDM load and daily rhinitis symptom scores from baseline and between groups	C
Terreehorst et al. (22)	Double-blind randomized controlled trial	279 participants aged 8–50 years with history of allergic rhinitis and/or asthma	Using bed covers that were impermeable to mite allergens	Score on the rhinitis-specific VAS, daily symptom score, the score on nasal allergen-provocation testing and concentrations of Der p1 and Der f1	A
Ghazala et al. (28)	Randomized cross-over study	30 subjects with mean age 29.8 years complaining of allergic rhinitis or asthma	Using encasings that were impermeable to mite allergens	Allergen (Der p1, Der f1 and mite group 2) content, subjective clinical complaint	A
Brehler and Kniest (27)	Randomized placebo-controlled, double-blind, parallel-group design	32 patients of mean age 37.2 years with proven sensitivity to HDM and symptoms of rhinoconjunctivitis	House dust mite impermeable bedding	Symptom scores and use of anti-allergic medication	C

Table 1 (Continued)

Study	Methods	Participants	Interventions	Outcomes	Quality
Incorvaia et al. (29)	Randomized placebo-controlled 2 × 2 factorial trial	29 patients (age range not given) with proven sensitivity to HDM and allergic rhinitis	Participants were divided in four groups: (1) Both active mattress encasement and acaricide; (2) active encasement and placebo acaricide; (3) placebo encasement and active acaricide; (4) placebo bedding and placebo acaricide	Disease-specific quality of life using the RQLQ	C

HEPA, High-efficiency particulate air; HDM, house dust mite; RQLQ, Rhinoconjunctivitis Quality of Life Questionnaire.

Table 2 Summary of key findings

Study	Key findings
Reisman et al. (31)	Of the 40 patients recruited, there were eight drop-outs (three from one site and five from the other). Reasons for drop-out were inadequate record keeping ($n = 3$), poor compliance ($n = 3$), severe concurrent respiratory infection ($n = 1$) and inappropriate selection ($n = 1$). Outcomes: (1) Particulate counts: average reduction (from baseline) in particulate counts $\geq 0.3 \mu\text{m}$ in bedroom air after active filtration was 73.4%, whereas average count increased by 3.6% with placebo filtration (2) Aggregated rhinitis and asthma symptom/medication scores: over the last 2 weeks of treatment, symptom/medication scores were lower after active filtration than after placebo filtration (day 8.79 vs 10.38, night 8.28 vs 9.90) with Wilcoxon matched pair rank sum test suggesting active filtration resulted in significant reduction of symptom/medication scores for 24-hour nasal congestion and discharge, eye irritation and upper airway scores (3) Patients' subjective response: 11 subjects reported improvement with active filtration, seven with placebo and 14 reported no change in symptoms
Antonicelli et al. (25)	All patients completed the study with only one complaint (by one patient) concerning excessive night time noise produced by the Enviracaire®. A comparison between the floor allergen levels showed no significant differences associated with HEPA use. The intervention failed to have any significant impact on rhinitis symptom scores
Kniest et al. (20)	All subjects completed the study and reported no toxic effects. Twelve months after treatment, 3-month symptom scores (0–3 months vs 9–12 months) were lower in the acaricide cleaner group as compared with the control group (matched pairs $P = 0.025$). Absolute values were not reported but categorized as improved, no change or worse, based upon the ratio of medians in each of the last three quarters of the study to the median value of patient symptom scores in the first quarter of the study. Physicians' assessments showed more patients in the acaricide group improved (start to end) than in the control group (start to end, $P = 0.05$) but comparison in matched pairs showed no difference. Four of the ten patients in the acaricide group reported using medication on a daily basis compared with six of the ten patients in the placebo group. Total IgE dropped in the acaricide group as compared to the control group (matched pairs $P = 0.0049$) but there was no difference in specific IgE to D Pteronyssinus levels. In each of the four patients of the acaricide group with raised baseline eosinophil levels, the count fell below 200 after 12 months of treatment, compared with a similar fall in one of three patients with raised baseline levels in the placebo group. Guaninine exposure dropped in the acaricide group (matched pairs $P = 0.0049$) on comparing start to finish, but dust exposure did not change. Guaninine levels decreased constantly in the acaricide group reaching 70% of the starting value by the end of the study ($P = 0.001$), whereas in the control group exposure fell by 3%
Geller-Bernstein et al. (26)	Of 35 children recruited, three dropped out owing to poor compliance. Of the 32 children remaining in the study, 17 were in the Acardust® group and 15 in the placebo group. Treatment and controls were comparable as regards sex ratio, duration of disease, proportion with asthma and rhinitis and age [average age of active group 9.7 years (SD 2.6) compared with 8.1 years (SD 2.6) in placebo group, $P = 0.09$] Determination of Der fl antigen in dust samples showed a fall over 6 months in the mean allergen levels (mg/g dust) in the Acardust®-treated group from 10.05 (SD 13.74) to 4.15 (SD 6.51) compared with 6.01 (SD 8.01) to 3.01 (SD 4.33) in the placebo-treated group ($P = 0.02$). Tabulated symptom scores are not disaggregated for asthma and rhinitis but mean symptom scores decreased more in the Acardust® group than in the placebo group over the 6-month period on the following aggregated symptom dimensions: daily activity disruption (Acardust® 117–13 compared with placebo 94–27) Patient's overall evaluation of symptoms (Acardust® 3483 to 547 compared with placebo 2988 to 660) Doctor's evaluation of symptoms (Acardust® 3456 to 420 compared with placebo 2965 to 600) Symptoms of nasal secretion, the symptom complex sneezing/lacrimation/itching and rhinitis medication use all reduced more quickly on a log time scale in the Acardust®-treated group than in the placebo group

Table 2 Summary of key findings

Study	Key findings
Moon and Choi (29)	Both groups were comparable at baseline with respect to key demographic variables and had similar disease severity. Of the 30 subjects recruited, only one subject from the control group was lost to follow up. There were no adverse effects reported. Mean dust mite loads were significantly reduced in the active group compared with the control group over the 4-week study period (-32.5 vs $+15.8$; 95% CI of difference not presented; $P = 0.03$) Mean daily rhinitis symptom scores fell in the experimental group from 5 at baseline to 2.1 (SD not presented) after 4 weeks of active treatment (mean difference -2.9; $P = 0.001$), compared with a change from a mean of 4.2 at baseline to 3.9 (SD not presented) at the end of the trial (mean difference -0.3; $P > 0.05$). Comparison of change in nasal symptom scores between active and control groups showed the bedroom environmental measures undertaken conferred significant benefit (-2.9 vs -0.3; 95% CI of difference not presented; $P = 0.026$)
Terreehorst et al. (22)	Of 279 patients recruited, there were 47 drop-outs (25 from one intervention group and 22 from control group). Reasons for drop-out included pregnancy ($n = 4$), patients having moved ($n = 11$), protocol violation ($n = 7$), study took too much time ($n = 2$), losing contact ($n = 1$), study was too bothersome ($n = 3$), covers were too hot ($n = 3$), unable to stop nasal medication ($n = 1$), unrelated illnesses ($n = 3$), missed medication too often ($n = 1$), lack of co-operation ($n = 1$), no reason given ($n = 3$), unknown ($n = 3$) and no data on the primary outcome ($n = 4$) The geometric mean concentration of Derp1 and Derf1 in the mattress sample was significantly lower in the impermeable cover group when compared with the control group ($P < 0.001$). The ratio of the level 12 months after the covers were put on to the level before the covers were put on was 0.31 (0.21–0.46) in the intervention group, as compared with 0.82 (0.58–1.15) in the control group There was, however, no significant difference between groups in the score on specific visual analogue scale, the nasal allergen-provocation testing or the daily symptom score. The mean change of symptoms on the rhinitis-specific visual analogue scale (VAS) was -10.86 [-16.64 to -50.09] in the control group and -9.83 [-15.28 to -4.39] in the intervention group ($P = 0.8$). Mean change in the nasal allergen-provocation test was also comparable between the two arms: -0.33 [-1.42 to 0.76] in the control group and -0.23 [-1.28 to 0.81] in the intervention group ($P = 0.90$), as was mean change of daily symptom scores: -0.33 [-0.63 to -0.02] in the control group and -0.18 [-0.45 to 0.10] in the intervention group ($P = 0.48$)
Ghazala et al. (28)	Of 30 patients recruited, 26 completed the study. A statistically significant reduction in allergen content from $1.4 \mu\text{g}/\text{m}^2/2 \text{ min}$ to $0.065 \mu\text{g}/\text{m}^2/2 \text{ min}$ was found after using the active cover ($P = 0.006$), but not after using the placebo cover ($1.49 \mu\text{g}/\text{m}^2/2 \text{ min}$) (exact P-value not specified). The general comfort using the active cover was good with the exception of some rustling There was a statistically significant decrease in the subjective rhinitis and ocular symptom scores in all 26 patients receiving either placebo ($P = 0.025$) or active ($P = 0.02$) treatments. In eight patients with an elevated eosinophil cationic protein level ($>16 \mu\text{g}/\text{l}$), an amelioration of rhinitis could be seen in the active phase compared with the placebo phase where six of eight patients had a lower level of eosinophil cationic protein in the active group, while six patients had a higher level of eosinophil cationic protein at the placebo group ($P < 0.025$). However, this finding needs to be interpreted with care as it arose from a <i>post hoc</i> analysis. Medication intake declined in both active and placebo groups, but no difference between the reductions achieved was found
Brehler and Kniest (27)	Of the 32 participants enrolled in this trial, 21 participants completed the study. Reasons for drop-out included volunteers who moved ($n = 4$), incorrect/inadequate use of covers ($n = 4$), problems with recording symptoms ($n = 1$), mould allergy ($n = 1$) and one patient who withdrew informed consent. One further participant developed a significant mould allergy after 9 months of entering the study necessitating continuous asthma therapy before the study ended The authors only undertook within arm trial comparisons, both for symptom scores and for the use of anti-allergic drugs, these revealing a statistically significant reduction in symptom scores when compared with baseline in the intervention arm, but not in the placebo arm; there was no reduction in the use of anti-allergic drugs in either the intervention or placebo arms These analyses are, however, potentially very biased and we therefore reanalysed the reported data (per-protocol analysis) comparing the outcomes of interest between the trial arms. This revealed a nonsignificant reduction in symptom scores (mean difference -2.34, 95% CI of difference -5.68 to 1.18) and anti-allergic drug use (-0.41, 95% CI -2.50–1.68)
Incorvaia et al. (29)	29 subjects with mite-induced rhinitis and asthma were divided in four groups using the factorial design: (1) both active mattress encasement and acaricide; (2) active encasement and placebo acaricide; (3) placebo encasement and active acaricide; and (4) both placebo treatments. Four patients were lost to follow up; reasons for drop-out included two patients who moved to another house, one who refused to continue and one for unspecified reasons. Thus, 25 patients were evaluated for changes in quality of life, 12 allocated to active treatment and 13 to placebo treatment The main trial results were difficult to interpret, but it seemed as if the analysis was mainly within group rather than between groups. Thus, although the two active treatments resulted in a significant improvement compared with baseline, the difference relative to the placebo interventions is unclear

HEPA, high-efficiency particulate air.

tant medical therapy, in order to allow the effectiveness of the control measures to be determined reliably. More generally, there is also a need for trials of more multifaceted interventions that aim to achieve substantial reductions in HDM load. Such trials need to be adequately powered (and may therefore need to be multicentred), generalizable, use validated outcome measures and have long enough follow-up (more than 6 months) to allow clinically meaningful results to be obtained. In the context of the management of a chronic disease such as rhinitis, a broad range of outcome measures should be studied including the quality of life measures, school/work absences and other medication usage. Detailed health economic analysis should also be built into future trials. Such trials should wherever possible be adequately blinded; this may, however, not always be possible depending on the actual intervention being investigated, and if this is the case, then there is a need to take active steps to minimize the risk of information bias by, for example, using validated instruments and independent checking of the measurement of outcomes.

Strengths and limitations of the study

The strengths of this updated review are the comprehensiveness of the searches, which included 23 international electronic databases without any language restrictions, contacting trial authors where necessary for primary data, and greater methodological rigour.

The limitations of this review included small numbers of experimental studies with poor quality, small study sample sizes, heterogeneity of study design, inconsistent exposure assessment and differing outcome measures. Consequently, we were unable to conduct meta-analysis because of the clinical heterogeneity of the patient groups studied.

Comparison with existing literature

We are not aware of any other systematic reviews that summarize the findings of HDM avoidance measures for perennial allergic rhinitis.

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Author's contributions

Aziz Sheikh conceived the idea for this review and together with Brian Hurwitz formulated the review protocol. Ulugbek Nurmatov and Aziz Sheikh led the update with Brian Hurwitz and Onno van Schayck contributing to the interpretation of findings from included studies. Ulugbek Nurmatov and Aziz Sheikh led the drafting of this manuscript, with co-authors commenting on drafts of the manuscript.

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Ethical approval

Ethical approval was not required.

Conflict of interest

Aziz Sheikh has previously received a small travel grant from Allerayde, manufacturers and distributors of allergy control bedding. The other authors have no conflicts of interest.

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