

The impact of home cleaning on quality of life for homes with asthmatic children

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ABSTRACT

Treatment with common household bleach containing hypochlorite destroys dust mites and denatures protein allergens. The purpose of this study was to determine if home use of hypochlorite products results in lowered exposure to bacteria, fungi, and protein allergens and improved quality of life (QOL) for asthmatic persons in the home. Asthmatic and nonasthmatic households containing at least three persons (between 2 and 17 years of age) were recruited. Households were supplied one of three sets of cleaning products (regular products, some containing hypochlorite; regular products plus three additional products with dilute hypochlorite; control, no products). Participants were supplied with cleaning instructions and asthma education. The control group was instructed to clean as usual. Participants completed general health and QOL questionnaires. Asthmatic participants completed an additional asthma QOL questionnaire. Families participated in the study for 8 weeks and completed the full set of questions every 2 weeks. Homes were visited at the beginning of the study and twice thereafter at monthly intervals. Samples evaluated were surface bacteria, viable and nonviable airborne spores, and dust antigen content. Reductions in surface bacteria, airborne fungal spores, and dust antigen levels were achieved. Significant improvement in general health parameters was seen for the asthmatic product groups over the control group. Significant improvement in general QOL and asthma-specific QOL was seen in the asthmatic group. Emphasis on cleaning and cleaning education combined with hypochlorite-based cleaning supplies resulted in significantly improved QOL for families with asthmatic children.

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Hypochlorous acid is one of the resultant species generated when chlorine gas is dissolved in water.¹ The most commonly used form, sodium hypochlorite, is produced by sodium hydroxide reacting with chlorine gas to produce sodium hypochlorite or common household bleach. Hypochlorous acid also is formed in cellular vacuoles by the action of myeloperoxidase.^{2,3} Hypochlorite is a strong protein denaturing agent. At moderate concentration, it reacts with amino acids that carry amino-bearing side chains to form chloramine adducts.⁴ These modified amino acids spontaneously rearrange to form more stable compounds often resulting in the breaking of peptide bonds and alteration of protein structure. At lower concentrations, hypochlorite can react with sulfhydryl groups to produce partial or complete oxidation of sulfhydryl, once again altering the structure of the

protein.⁵ Previous work with recombinant cat allergen protein rFel d1 has shown that at a molar ratio of 560/1 hypochlorite/protein, rFel d1 is no longer recognized by the monoclonal antibody directed against it. In this same examination the ability of rFel d1 to elicit histamine release from basophils of cat-allergic humans was significantly reduced at a molar ratio of 70/1 hypochlorite/protein.⁶ Indeed, proteins can be fragmented into peptides at hypochlorite concentrations as low as 10 mM.⁷ Experimental work has also been performed on hypochlorite in its common role as a disinfectant. In a test to see how effective bleach products are in cleaning buildings with fungal contamination it was found that the hypochlorite preparations both killed *Aspergillus fumigatus* and rendered the antigens produced by this fungus largely unrecognizable both by enzyme immunoassay and skin-prick testing.⁸

Removal of dust from the environment of asthmatic individuals has long been recommended by allergists. House dust is known to contain numerous protein substances identified as asthma triggers. These include allergenic materials from cats, dogs, rodents, dust mites, cockroaches, and fungi. Recent publications in major asthma-related scientific journals indicate that remediation efforts directed at home cleaning signifi-

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cantly improve the health of home occupants.⁹ Sodium hypochlorite is the disinfectant of choice in most laboratory and hospital settings. It has been shown to be effective against a broad range of organisms including virus, bacteria, and fungi.¹⁰ Also, chlorine bleach in many different dilutions and preparations has long been used as a common household cleaner. Recently, it has been reported that Danish school children who lived in homes regularly cleaned with bleach had a lower incidence of asthma and eczema than their classmates.¹¹ In this work we test the ability of regular cleaning using a combination of products, many containing dilute hypochlorite, to produce an improvement in the quality of life (QOL) of asthmatic children and their parents.

MATERIALS AND METHODS

Materials

Products for cleaning were provided by Clorox Corp. (Pleasanton CA). They included Ultra Clorox Bleach, Clorox Clean Up, Clorox Disinfecting Wipes, Ready Mop, Clorox Toilet Bowl Cleaner, Clorox Disinfecting Spray, and Clorox Toilet Bowl Automatic Cleaning Tablets. These products are available commercially. Clorox Corp. supplied three additional products containing diluted 0.09% sodium hypochlorite. One was supplied in a hand-operated spray bottle, one was supplied as a propellant-driven sprayer, and one was supplied in an electrically powered spray unit.

Study Design

This was a descriptive, applied, single center, randomized study. The control group received no cleaning products or instructions during the study. The control group was aware that this was a cleaning study and the study could not be blinded. There were two populations of subjects recruited for the study (asthmatic and nonasthmatic) with three product groups in each population. One product group used regular products supplied by the study, the second group used diluted hypochlorite products intended to reduce protein allergen concentration in addition to regular products, and the third group had no products supplied during the study. So that all groups were treated the same over time, the control group was provided a supply of regular products at the conclusion of the study. All human subjects work was approved by the Pediatric Internal Review Board of Children's Mercy Hospital.

We recruited homes from the asthmatic population seen in Children's Mercy Hospital Asthma/Allergy/Immunology Clinic, from homes enrolled in previous research projects, and from families without asthmatic persons referred by families already enrolled in the study. The asthmatic population was enrolled in the

fall and spring when their allergies might be worse and the nonasthmatic population was recruited during the winter cold and flu season. We surveyed all houses for cleaning products and usage during our first visit to the home. All health questions and QOL forms were completed during a telephone call to the home within a plus or minus 2-day interval. Calls began at or shortly after enrollment and questions covered the prior 2-week interval. Two weeks after enrollment (4 weeks after initial data) the house was sampled and the family was randomized into one of the groups. Product group families were provided with usage charts, cleaning protocols describing how to use the products, and diaries for their respective sets of products. Control families also were asked to keep cleaning diaries. All families received asthma trigger education and product use families received additional cleaning suggestions and admonitions. Around the time of the first visit the family completed a second health and wellness questionnaire and the two QOL surveys by telephone interview. The family was contacted every 2 weeks for the next 8 weeks and asked to complete the same questionnaire and surveys. At every visit to the home product usage was estimated. At the end of 4 weeks the house was sampled again. At the end of 8 weeks the house was sampled a third time and the family completed the study.

Inclusion and Exclusion Criteria

Homes included in the study housed at least three persons with at least one person between 2 and 17 years of age. Homes in the asthmatic population included at least one child with persistent asthma as defined by National Heart, Lung, and Blood Institute guidelines or one child with other chronic respiratory symptoms including rhinitis or bronchitis. The family must have lived in the same home, either rental or self-owned, for at least 2 months. We excluded any home where an occupant stated they were allergic or sensitive to bleach-based products and any home that was grossly contaminated with fungi, was mechanically unsound, or was generally unsafe.

Sampling

Between four and six collections were taken at every home on every sampling occasion for visual airborne nonviable fungal spores. Whenever possible the sample locations included living/TV/family room, subject bedroom, kitchen, basement, and outside. Also, one collection was taken in the main living space (living/TV/family room) for determination of viable colony-forming fungal units. Two house-dust collections were taken for allergen determination by enzyme linked immunoassay. One house composite collection was taken from the home vacuum or from 9 ft² of carpet,

throw rug, or floor. One collection was taken in the subject bedroom from 9 ft² of carpet, throw rug, floor stuffed animals, and bedding.

Air collections for nonviable fungal spores were counted microscopically and reported as estimates of spores per cubic meter of air. Air collections for viable airborne fungi were counted on the developing plate and reported as estimates of fungal colony-forming units (CFU) per cubic meter of air. House-dust collections were analyzed by enzyme immunoassay for total antigen content of nine common allergenic taxa including cats, dogs, dust mites, roaches, mice, *Alternaria*, *Aspergillus*, *Cladosporium*, and *Penicillium*.¹²⁻¹⁴ Surface samples for bacteria were analyzed by growth on bacterial media and reported as quantitative estimates of total bacterial CFU per square centimeter. Ten CFUs were Gram-stained, examined microscopically, and divided into Gram-positive or -negative and into cocci or bacilli.

QOL Instruments and Health Questions

Two QOL instruments were used. All subjects were asked to compete the SF-12 general quality of life form^{15,16} at the beginning of the study and at every 2-week interval afterward. In addition, all families with an asthmatic child were asked to complete the Pediatric Asthma Caregiver's Quality of Life Questionnaire.^{17,18} Also, each subject was asked to answer a series of general health questions. These questions inquired into specific health-related events that might have occurred in the past 2-week interval such as colds, cough, wheezing, doctor/emergency room visits, and days missed from normal activities.

Statistical or Data Handling

Results of telephone questionnaires were entered directly into an access database (Microsoft Corp., Redmond, OR) Results of cleaning diaries and other questionnaires completed by subjects were entered into Excel spreadsheets as were results from all analytical procedures. For analysis, information was imported directly into and analyzed using the statistical functions of SPSS 13 (SPSS, Inc., Chicago, IL).

RESULTS

Total Participants

A total of 193 families were enrolled in the study. There were 97 families enrolled in the asthmatic population and 96 families enrolled in the nonasthmatic population. Six persons were removed from the nonasthmatic population leaving 90 families to complete the study and six persons also were removed from the asthmatic population of the study leaving 91 families to complete the study. Reasons for removal from the study included loss of interest by the family and failure to have a qualifying child in the home. Consequently, there is complete data for 181 families.

Demographics

The locations of homes in the study included urban core (40%), suburban (55%), and rural (5%). By inclusion criteria all families in the study contained at least three members residing in the home and for the asthmatic population at least one of the children must have been asthmatic by National Institutes of Health guidelines. The mean number of persons per household was 3.97. The houses had carpeting on ~50% of the flooring area with 11% of homes containing no wall-to-wall carpet. The homes contained a mean of 0.3 cats and 0.97 dogs with 18% having at least 1 cat and 58% having at least 1 dog. The homes were all air-conditioned and centrally heated by gas forced air. Measurements taken of the three main air indices, temperature, relative humidity, and carbon dioxide levels, reflected that all homes in the study were heated and air-conditioned and indoor temperatures were maintained around 22°C and 50% relative humidity. Outdoor temperatures during the study ranged from near 38°C to below freezing. All of the homes in the study were in good condition and none had a chronic problem with water intrusion or leaking plumbing or fungal contamination issues.

Bacteria Results

All samples taken in homes for bacterial enumeration where a product was used were compared with all samples taken in homes where no product was sup-

Table 1 Comparison of means ($\pm$ SD) for bacteria culture data of product use and control homes

Bacteria	Control (n = 594)	Product (n = 471)	p Value
Total colonies	56.53 (80.55)	41.15 (80.51)	0.02
Gram-negative bacilli	17.86 (45.45)	12.33 (37.63)	0.19
Gram-positive bacilli	14.91 (40.96)	12.54 (35.74)	0.30
Gram-positive cocci	15.35 (31.72)	11.83 (35.45)	0.08
Gram-negative cocci	5.21 (21.59)	3.01 (13.46)	0.05

Table 2 Comparison of viable spore counts mean ($\pm$ SD) of product use and control homes

Taxa	Control (n = 300)	Product (n = 229)	p Value
Total fungi	364 (346)	330 (330)	0.25
<i>Alternaria</i>	36 (67)	48 (207)	—
<i>Aspergillus</i>	8 (27)	13 (52)	—
<i>Cladosporium</i>	172 (241)	168 (261)	0.86
<i>Penicillium</i>	73 (157)	50 (90)	0.05

Table 3 Comparison of mean household nonviable spore counts ($\pm$ SD) of product use and control homes

Taxa	Control (n = 287)	Product (n = 226)	p Value
<i>Aspergillus/Penicillium</i>	531 (3755)	397 (3991)	0.03
<i>Alternaria</i>	12 (18)	11 (18)	0.34
<i>Cladosporium</i>	452 (722)	368 (893)	<0.01
<i>Stachybotrys</i>	2 (13)	0 (1)	<0.01
Total Spores	1416 (4834)	1070 (4247)	<0.01

Values of p calculated assuming log-normal distribution.

Table 4 Comparison of mean household antigen levels for homes with cleaning supplies and control homes without cleaning supplies

Taxa	Control (n = 301)	Product (n = 244)	p Value
<i>Alternaria</i>	0.50 (0.80)	0.49 (0.58)	0.89
<i>Aspergillus</i>	0.66 (1.22)	0.61 (0.43)	0.46
Cat	1.13 (1.24)	1.10 (1.10)	0.78
<i>Cladosporium</i>	0.82 (0.38)	0.64 (0.37)	0.25
Dog	0.93 (1.07)	0.73 (1.37)	0.15
Dust mite	1.73 (2.14)	1.69 (1.97)	0.78
<i>Penicillium</i>	0.54 (0.81)	0.48 (0.30)	0.25
Roach	5.09 (3.77)	5.17 (3.90)	0.81
Rodent	0.07 (0.16)	0.10 (0.36)	0.26
Sum of antigens	11.48 (6.64)	11.15 (5.97)	0.54

plied (Table 1). Notice there is an improvement in all categories and significance at the 95% level is achieved in all but two of the subgroups.

Viable Fungi

Results of sampling for viable airborne fungal spore enumeration taken from the main living area of the homes are displayed in Table 2. A comparison is made for counts from houses in the active cleaning group with counts from houses in the control group.

Nonviable Fungal Spore Results

Collections taken for determination of total airborne spores by visual observation are listed in Table 3. Mean indoor airborne counts for all rooms sampled in the home are listed in the table. There were reductions in all spore types seen in the houses for the active cleaning product-supplied group. The typical reduction

was 25%. Although the deviation for these counts is quite high, several of the spore types and the total spore counts are significantly reduced when a log-normal distribution of values is assumed.

Dust Antigen Levels

An analysis of the dust antigen data from all homes comparing control homes where no product was used and active cleaning homes sampled after at least 1 month of product use (Table 4) indicated reduction in the concentration of measured antigenic material occurred for seven of the nine species evaluated and also for the sum of all allergenic material in the room. These reductions did not reach statistical significance (95% confidence) for any of the species tested. The values for a subset of the overall dust antigen data, the bedroom of the asthmatic subjects, are presented in Table 5. This represents a comparison of the dust values from sam-

Table 5 Comparison of asthmatic subject bedroom antigen levels for homes with cleaning supplies comparing values at visit 1 with values at visit 3

Species	Visit 1 (n = 31)	Visit 3 (n = 30)	p Value
<i>Alternaria</i>	1.14 (3.67)	0.83 (1.13)	0.66
<i>Aspergillus</i>	0.54 (0.50)	0.35 (0.33)	0.08
Cat	1.16 (1.00)	1.11 (1.07)	0.88
<i>Cladosporium</i>	0.74 (0.39)	0.96 (0.70)	0.14
Dog	1.09 (1.95)	0.71 (1.26)	0.37
Dust mite	2.57 (3.72)	1.68 (2.45)	0.27
<i>Penicillium</i>	0.57 (0.81)	0.46 (0.30)	0.20
Roach	6.58 (4.27)	6.17 (4.62)	0.81
Rodent	0.06 (0.12)	0.08 (0.17)	0.26
Sum of antigens	14.45 (10.05)	12.36 (7.79)	0.36

Table 6 Comparison of answers to questions on a 7-point Likert scale concerning asthma symptom severity in asthmatic subjects in control and active cleaning groups

Question	Product (n = 283)	Control (n = 376)	p Value
Wheeze in P.M.	1.70 (2.27)	2.47 (3.42)	0.001
Cough in P.M.	3.44 (4.39)	2.47 (3.42)	0.004
Breathing trouble in P.M.	2.18 (3.31)	4.61 (5.54)	0.001
Controller meds in P.M.	3.73 (6.06)	4.17 (6.57)	0.38
Wheeze in A.M.	1.67 (2.59)	2.10 (2.90)	0.05
Cough in A.M.	3.47 (4.53)	4.14 (5.13)	0.08
Breathing trouble in A.M.	2.02 (2.95)	2.86 (3.85)	0.02
Controller meds in A.M.	4.03 (6.06)	5.12 (7.21)	0.04
Stuffy nose	5.78 (6.49)	6.99 (7.27)	0.03
Sneezing	5.49 (6.49)	5.66 (6.37)	0.72
Itchy, watery eyes	3.76 (5.21)	5.07 (6.13)	0.04

The data presented are for asthmatic subjects only. The collected data for the nonasthmatic groups were not significantly different for any of the questions.

ples collected specifically in the asthmatic subject's bedroom where a dilute hypochlorite product designed specifically to reduce dust allergen levels was being used.

Health Question Results

The responses to questions where all respondents (asthmatic and nonasthmatic subjects) would be expected to indicate change were unremarkable. The questions asked were straightforward and represented the subject's health concerns for the preceding 2 weeks. The number of occurrences for events in question such as "did you have an asthma attack" was too small to provide significance. Responses for the product group were generally better than for the controls. One area where the active treatment group did significantly better than the control group was on the question, "can you breathe through your nose OK today?" The compilation of the answers to the asthma-related general health questions are presented in Table 6. These are

questions to which only the asthmatic group would show a change. The nonasthmatic group also responded to the questions in Table 6 (data not shown). Their responses were significantly different from the responses of the asthmatic subjects but showed no change during the study.

General QOL Results

Two QOL forms were used in the study. The 1441 responses of persons who completed the general QOL form are represented in Fig. 1 and the responses of the asthmatic children who completed the asthma-specific QOL form, in addition, are displayed in Fig. 2. Note that the responses of the nonasthmatic children to the general QOL form are typically higher than the asthmatic children and show no significant change over the study. The greatest change ($p < 0.05$) is seen in the group of asthmatic children who received product group A, which included a diluted hypochlorite-based product designed to denature allergens.

General Quality of Life

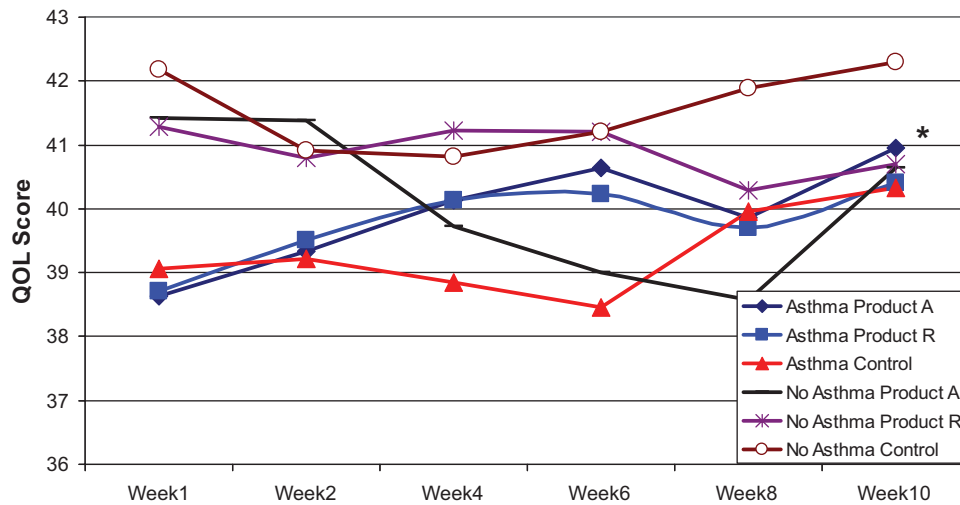


Figure 1. Results of the general QOL survey for all 1441 respondents. Responses of nonasthmatic subjects are above asthmatic subjects and significant change is seen for asthmatic subjects receiving cleaning instructions and products. *, change from baseline $p < 0.05$.

Asthma QOL Results

The responses of the asthmatic children represented in Fig. 2 indicate that there is a rapid rise in the QOL score for the children in the product group that included a specific product designed to reduce allergen levels. This was followed by a similar but less dramatic rise in QOL levels for the group receiving the same products minus the specific allergen reduction formulation. The control (no products) group also gradually increased in perceived QOL and was significantly different from the baseline responses at the end of the 10 weeks of the study.

DISCUSSION

Participants

The dropout rate for the study was <10% with 90 families from the nonasthmatic population and 91 fami-

lies from the asthmatic population completing the study. The main reason families were removed from the study was that they lost interest and did not schedule proper follow-up visits to the home. There is complete data for 181 families. The subjects were about one-half urban core and about one-half suburban with a few rural families also participating. The nonasthmatic population closely resembled the asthmatic population because the asthmatic population participants were asked to recruit additional participants from among their neighbors. The housing in the study was typical for Kansas City. All homes were air-conditioned and centrally heated. We excluded homes that were mechanically unsound or required remediation for fungal contamination. We did note more hardwood flooring and less carpet (~50% of flooring area) than we anticipated. Pet ownership also was slightly lower than anticipated in that 18% of homes had cats and 58% of homes had dogs.

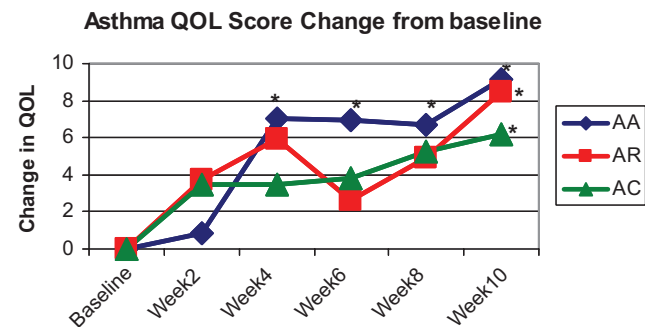


Figure 2. Results of the asthma-specific QOL survey for asthmatic respondents. Responses of the active groups increase rapidly on cleaning instruction and introduction of products at week 2. Significant change is seen rapidly for the group (AA) with specific allergen reduction product and more slowly for the group (AR) with regular products. In addition, improvement is seen for the control group (AC). *, change from baseline $p < 0.05$.

Bacteria and Fungal Results

Because many of the products had strong disinfectant properties we expected to see bacterial levels especially on hard, cleanable surfaces decline through the study if the products were being used properly. This was indeed the case as indicated by the uniform and most often significant reductions in bacteria observed. Reductions in both viable and nonviable spores also were seen in the product use groups with a significant reduction in viable *Penicillium* CFUs and a nearly 30% reduction in these same spore types on nonviable airborne estimates. *Alternaria* and *Aspergillus* viable spores rose slightly but not significantly during the study (Table 1). *Alternaria* was increased probably because of introduction of *Alternaria* spores from the outdoor environment and *Aspergillus* counts were very low overall so the increase probably

represents sampling variability. Also, because airborne fungal spores can increase several logs during one brief amplification event, the underlying variation in counts can be considerable.

Dust Antigen Determinations

The antigens tested included the fungi *Alternaria*, *Cladosporium*, *Aspergillus*, and *Penicillium*. Also, antigenic material from *Dermatophagoides farini*, *Canis familiaris*, *Felis domesticus*, *Periplaneta americana*, and *Mus musculus* was quantified. The overall reduction in specific antigenic material in product use groups over control groups from these nine taxa was not that significant, averaging ~5%. However, the reduction in this same material for the asthmatic group over the course of the study was greater, averaging 15% less on visit 3 compared with visit 1 (Table 5). Many of the allergen reductions seen in the bedroom dust of the asthmatic children nearly reached significance (e.g., *Aspergillus*, *Penicillium*, and the sum of all antigens) and probably would be significant with a larger sample size. It is known that allergen levels for many taxa are not constant in the environment but vary with seasonal effects on the indoor climate. Because all homes were air-conditioned and centrally heated the impact was diminished in this study; however, there still could have been a seasonal impact on the dust antigen data. The dust allergen data did not show as many significant reductions as we had anticipated.

There were clearly significant reductions in many specific antigenic species and we got overall reductions in many of the major comparisons. For example, dust-mite antigen in the subject room and house dust frequently showed significant improvement but cat antigen usually was not reduced. This is probably a result of the nature and source of the allergen. Many persons sprayed their bedding and mattresses routinely and it has been reported previously that bleach and hot water kills mites in bedding during washing. On the other hand, cat allergen is very persistent in the environment and our treatment did nothing to remove the source of the allergen. One cat spending the night on the bed would overcome a whole month of product use. Previous studies on the role of hypochlorite bleach on allergen levels in the home have indicated that washing clothing and bedding with detergent plus bleach removed most allergen and a significant ($p < 0.05$) portion of live mites.¹⁹ It has been recognized previously that hypochlorite has the ability to fragment allergens at low concentrations.²⁰ *In vitro* studies involving the ability of hypochlorite to denature allergens and render them unrecognizable to human antibodies have been very successful.⁶ Using recombinant (r)Fel d 1, these researchers showed that a loss of antibody recognition on immunoblots correlated with a loss of biological activity measured by basophilic histamine release. They concluded that sodium hypochlorite modified rFel d 1, re-

sulting in loss of immunogenicity and attenuation of biological activity. It has long been recognized that disinfectants that contain diluted sodium hypochlorite can kill mold and are practical to use. It was shown recently⁸ that sodium hypochlorite disinfectants killed *A. fumigatus* in solution and on mold-contaminated building materials. They also inhibited *A. fumigatus* recognition by ELISA and skin testing showed loss of reactivity to sodium hypochlorite-treated mold solutions in most of the subjects.

Health Surveys Data

Three health survey tools were used in the study. A total of 254 children (multiple children could be surveyed in one family) completed health history forms. For the general health questions the product groups usually (but not always) reported fewer symptoms and improved health parameters during the study. For example, in the asthma group taken alone (Table 6) (comparing all product groups while product was being used to all control groups) the health improvements included fewer doctor visits, fewer cough symptoms, fewer flulike symptoms, fewer intestinal illnesses, better breathing, fewer asthmatic symptoms, less morning and nighttime wheezing, less morning and nighttime cough, better morning and nighttime breathing, fewer morning and nighttime medicines, fewer watery eyes, fewer stuffy noses, and better ability to concentrate mentally. A test for equality of means for these groups indicated that 17 of 24 questions concerning typical asthma symptoms were improved in the product use groups when products were supplied. Of the 17 categories where improvement occurred, 9 were statistically significant.

For the general QOL survey (Fig. 1) it is clear that the three asthmatic groups had lower scores than the three nonasthma groups. Also, among the asthma groups the control group (AC) that received no products had the lowest scores overall. Statistical analysis of the difference of the means in the groups as they progressed through the study showed a statistically significant improvement in the asthmatic population group receiving a product specifically formulated to denature allergens on hard and soft surfaces.

Asthma QOL Results

The specific asthma QOL results (Fig. 2) were very encouraging. Results for the two product-supplied groups showed improvement through the study with a statistically significant change from baseline achieved more quickly in the group that was supplied with the specific allergen reduction product. It is important to note that the control families also achieved an improved QOL even though the advent was much slower than for the two product groups. This placebo effect is

observed often in these types of studies and in this case (because these families were keeping diaries) it indicates that attention to cleaning can be helpful for all persons.

In a cross-sectional study¹¹ to evaluate to what extent regular house cleaning with bleach can influence the risks of respiratory and allergic diseases through the ability of sodium hypochlorite to inactivate common indoor allergens, a group of 234 Danish schoolchildren were examined. Children living in a house who regularly cleaned with bleach were found to be less likely to have asthma (OR, 0.10; CI, 0.02–0.51), eczema (OR, 0.22; CI, 0.06–0.79), or sensitivity to indoor aeroallergens (OR, 0.53; CI, 0.27–1.02), especially house-dust mites (OR, 0.43; CI, 0.19–0.99), independent of gender, ethnicity, previous respiratory infections, total serum IgE level, and family history of allergic diseases. They concluded that house cleaning with chlorine bleach appears to protect children from the risks of asthma and of sensitization to indoor allergens.

Although many studies have been conducted to connect the presence of indoor allergens with the presence of asthma and these allergens are universally recognized as allergen triggers, the kinetics of the buildup and destruction of allergens in the home has received little attention. This and other recent studies involving the reduction of indoor allergenic material and the concomitant reduction of allergic and asthmatic disease are beginning to shine a little light on the subject. Nonetheless, we still are a long way from realizing the ability to provide effective and reliable control of indoor allergen exposure.

CONCLUSIONS

This study considered the impact on cleaning practices on home allergen levels and occupant QOL. The major comparisons in this study showed a reduction in bacteria, fungi, and allergenic material that occurred during the 8 weeks of cleaning product use. There usually was a reduction in health-related parameters for product-supplied homes over control homes as well as a reduction of these parameters for individual product groups as the study progressed. Many, but certainly not all, of these reductions were statistically significant. The most interesting findings of the study were the improvement in reported QOL scores for many groups in the study with best improvement seen for the groups where hypochlorite-based products were supplied. We conclude that appropriate attention to cleaning and the use of effective cleaning products can produce an improved QOL for families with asthmatic children.

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