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Pediatrics 2004;113:1216-1222

DOI: 10.1542/peds.113.5.1216

This information is current as of October 25, 2005

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://www.pediatrics.org/cgi/content/full/113/5/1216>

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American Academy of Pediatrics

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The Bedding Environment, Sleep Position, and Frequent Wheeze in Childhood

Anne-Louise Ponsonby, PhD, FAFPHM*‡; Terence Dwyer, PhD, FAFPHM‡; Leigh Trevillian, MPH*;
Andrew Kemp, PhD, FRACP§; Jennifer Cochrane, BA‡; David Couper, PhD||; and
Allan Carmichael, MD, FRACP¶

ABSTRACT. *Objective.* Synthetic quilt use has been associated with increased childhood wheeze in previous studies. Our aim was to examine whether the adverse effect of synthetic quilt use on frequent wheeze differed by usual sleep position.

Design, Setting, and Participants. A population-based cross-sectional study of 6378 (92% of those eligible) 7-year-olds in Tasmania, Australia, was conducted in 1995. Exercise-challenge lung function was obtained on a subset of 414 children from randomly selected schools.

Exposure Measures. Child bedding including pillow and overbedding composition and usual sleep position by parental questionnaire.

Outcome Measures. Frequent wheeze (>12 wheeze episodes over the past year), using the International Study of Asthma and Allergies in Childhood parental questionnaire, and baseline and postexercise forced expiratory volume in 1 second lung-function measures.

Results. Frequent wheeze ($n = 117$) was positively associated with synthetic quilts, synthetic pillows, electric blankets, and sleeping in a bottom bunk bed but did not vary by sleep position. In a nested case-control analysis, the association between synthetic quilt use and frequent wheeze differed by sleep position. Among children who slept supine, synthetic (versus feather) quilt use was associated with frequent wheeze (adjusted odds ratio: 2.37 [1.08, 5.23]). However, among nonsupine sleepers, overlying synthetic quilt use was not associated with frequent wheeze (adjusted odds ratio: 1.06 [0.60, 1.88]). This difference in quilt effect by sleep position was highly significant. Similarly, synthetic quilt use was associated with lower postexercise forced expiratory volume in 1 second measures among supine but not nonsupine sleeping children.

Conclusion. An increasing focus on the bedding environment immediately adjacent to the nose and mouth is required for respiratory disorders provoked by bedding, such as child asthma characterized by frequent wheeze. *Pediatrics* 2004;113:1216–1222; bedding, sleep position, interaction, asthma, wheeze.

ABBREVIATIONS. HDM, house dust mite; Der P, *Dermatophagoides pteronyssinus*; CI, confidence interval; FEV₁, forced expiratory volume in 1 second; OR, odds ratio.

Bedding can trigger child wheeze, particularly wheeze caused by house dust mite (HDM)-related airway obstruction. Bedding HDM (such as *Dermatophagoides pteronyssinus* [Der p]) levels predict respiratory symptoms and lung function.^{1,2} Mattresses and underbedding are significant HDM allergen reservoirs.^{3,4} It is less recognized that upperbedding such as quilts also can be a source of HDM exposure during sleep. A 10-fold reduction of airborne HDM allergen near the face during sleep was obtained by replacing used overlying quilts with new quilts.⁵ Recently, synthetic quilts have been shown to have a markedly higher Der p content than feather quilts⁶; the ratio (synthetic/feather) of the geometric mean for Der p ($\mu\text{g}/\text{m}^2$) was 15.45 (95% confidence interval [CI]: 4.28–55.8).⁶ Higher HDM allergen levels have been found also in synthetic as compared with feather pillows.^{7,8} The higher allergen loading near a child's airway has been proposed as one possible explanation^{7,8} for the numerous cross-sectional^{9–11} and prospective associations^{12,13} between synthetic bedding and childhood wheeze. However, the association may reflect selection bias associated with the preferential choice of synthetic bedding for children at risk of later allergic asthma.¹¹ Although randomized, controlled trials are constrained by the ethics of applying potentially deleterious synthetic bedding to children with severe wheeze, additional confirmatory evidence is needed from observational studies.

One novel approach to assess the role of bedding in asthma could be to look at the interaction between bedding and different sleep positions with regard to child wheeze. Specifically, if it could be demonstrated that synthetic quilt use, for example, conferred a different risk if a child slept in a different sleep position, then the case for synthetic quilt use being causally related to asthma would be strengthened. If the adverse effect was mediated through some mechanism that involved the bedding being in close proximity to the airway, one would postulate that the association between overlying synthetic quilt use and adverse respiratory outcomes would be observed specifically among children sleeping supine,

From the *National Centre for Epidemiology and Population Health, Australian National University, Canberra ACT, Australia; ‡Menzies Centre for Population Health and ¶Department of Paediatrics and Child Health, University of Tasmania, Tasmania, Australia; ||Department of Biostatistics, University of North Carolina, Chapel Hill, North Carolina; and §Department of Immunology, Royal Children's Hospital, University of Melbourne, Melbourne, Australia.

Received for publication Jan 9, 2003; accepted Jul 14, 2003.

Address correspondence to Anne-Louise Ponsonby, PhD, FAFPHM, National Centre for Epidemiology and Population Health, Mills Rd, Australian National University, Canberra ACT 0200, Australia. E-mail: anne-louise.ponsonby@anu.edu.au

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during which the face would be closer to overlying bedding.

In the Tasmanian Asthma Survey, synthetic bedding was strongly associated with frequent wheeze.¹³ The aim of this report is to examine whether the association between synthetic quilt use and frequent wheeze is significantly stronger among children who slept supine compared with children who slept non-supine.

METHODS

The 1995 Tasmanian Asthma Survey

We conducted a cross-sectional survey on all children who turned 7 years old in Tasmania, Australia, identified through primary schools and home-learning and distance-education organizations. By December 31, 1995, questionnaires had been completed for 92% (6378 of 6911) of eligible children.¹³ The questionnaire included questions from the International Study of Asthma and Allergies in Childhood.¹⁴ Previous validation work has shown that the report of wheeze over the past 12 months has a sensitivity of 0.81 and a specificity of 0.85 for the physician diagnosis of asthma in childhood.¹⁵

Sleep position was classified as supine if the parents reported that the child usually slept on the back in response to the question: "What position does your child usually sleep in?" Children usually sleeping on their sides or stomachs were termed nonsupine sleepers. Synthetic pillows were those reported as foam/sponge/tontine/polyester/Dacron. Quilts, doonas, or duvets of Dacron, polyester, or other synthetic composition were classed as synthetic quilts. Overlying bedding was categorized into 3 categories: any synthetic quilt, feather quilt, and other bedding (ie, neither feather nor synthetic quilt). Sheepskin was any wool fleece underbedding with either hide or material backing.

In addition, we conducted full exercise-challenge lung-function testing on 414 children at 23 randomly selected schools in Southern Tasmania; the method is described in detail elsewhere.¹⁶ It included baseline and postexercise spirometric measures of forced expiratory volume in 1 second (FEV₁), the latter after 6 minutes of free running.¹⁶ These studies were approved by the University of Tasmania Ethics Committee (Human Experimentation), and parents provided informed, written consent.

Outcome Measurement

Disease misclassification within the broad spectrum of asthma has been a large problem in asthma epidemiology. For this bedding study, we were interested in identifying children who would

be more likely to have HDM-triggered airway disease rather than those with asthma caused by other mechanisms. We chose to compare children with frequent wheeze (>12 episodes in the past year compared with children with no wheeze) for the following reasons: 1) children with asthma who are also sensitized to HDM are more likely to have severe or frequent asthma¹⁷; 2) feather pillow and quilt use has been inversely associated with severe wheeze¹⁸; and 3) in our setting, we have reported previously that HDM-sensitized children are much more likely ($P < .0001$) to have frequent wheeze than nonsensitized children in our setting (prevalence ratio 19.6 [95% CI: 6.9, 55.6]).¹⁹ In addition, we examined postexercise FEV₁, a lung measure previously observed to be lower in children with recent wheeze or asthma.¹⁶

Statistical Methods

First, univariate odds ratios (ORs) were calculated by using logistic regression.²⁰ The reference group chosen for upperbedding was feather quilts, because this bedding type has 1) lower HDM levels^{7,8} and 2) has been associated previously with reduced wheeze, compared with synthetic quilts.¹⁰ We examined the interaction between quilt type and sleep position by comparing synthetic and feather quilts. Most children (88.1%) slept under these 2 overbedding types (Table 1). For sleep position, children who slept supine were compared with nonsupine children, and children with no usual sleep position were excluded. The Breslow-Day test was used to examine differences in the association between synthetic versus feather quilt use and severe wheeze by sleep-position strata.²¹ We then conducted a nested case-control study among the children who were reported to have a usual sleep position. Each child with frequent wheeze matched to control children with no wheeze over the past year. Each index child was matched to the nearest controls by date of birth who had the same status as the index child with regard to 4 characteristics: gender, foam mattress or not, electric blanket or not, and sheepskin or not. Thus, in the matched analysis, each matched set was standardized with regard to underbedding except for pillow type. Feather pillows and allergen-occlusive mattress covers were too uncommon to allow adequate matching and thus were considered as additional confounders in the matched analyses. In total, 117 children with frequent wheeze were matched to 1162 controls, with up to 10 controls per case. More than 80% of controls were born within a month of the index case. Conditional logistic regression models then were used to examine the relation between quilt use, sleep position, and reported respiratory outcomes, with control for confounders.²⁰ The difference in the quilt-wheeze associations by sleep position was examined by the log likelihood ratio test for the reduction in deviance associated with the addition of an interaction term into the logistic model.²² Thus, the interaction is based on a multiplicative model. Any interactions observed would be

TABLE 1. Distribution of Sleeping Environment Characteristics and Respiratory Wheeze in the 1995 Cross-Sectional Study

Characteristic	Total, <i>n</i>	<i>n</i>	% With Variable
Usual sleep position	6355		
Supine (on back) sleep position		2431	38.3
Nonsupine (on side or tummy)		3048	48.0
No usual sleep position or other		876	13.8
Overbedding	6345		
Any synthetic quilt use		2649	41.7
Feather quilt use		2941	46.4
Other overbedding		755	11.9
Pillow	6340		
Any synthetic pillow		5709	90.0
Feather pillow		231	3.6
Other pillow		400	6.3
Sheepskin underbedding	6307	1331	21.1
Electric blanket	6307	1347	21.4
Allergen-occlusive mattress cover	6307	54	0.9
Foam mattress	6363	2038	32.0
Bed type	6354		
Bottom bunk bed		686	10.8
Wheeze frequency over the past year	6107		
None (0 episodes)		4707	77.1
Moderate (1–12 episodes)		1264	20.7
Frequent (>12 episodes)		136	2.2

present also in an additive model, but negative or absent findings cannot be taken to mean that additive interactions are not present.²³ The lung-function sample was relatively small, and thus synthetic quilt use was examined as a dichotomous exposure to maximize the sample size for analysis. Multiple linear regression models were used to examine FEV₁ as a continuous outcome, with adjustment for relevant confounders.²⁴

RESULTS

General Features

The mean age of the participants was 6.9 years (SD: 0.3), and 50.5% were male. Synthetic pillow or quilt use was common (Table 1). Feather quilt use was also common, but feather pillow use was not. Most parents were able to report a usual child sleep position, with 86% of children with frequent wheeze (117 of 136) or no wheeze (4048 of 4707) reported to have a usual position. More than one third of the children slept supine (Table 1). Among nonsupine children, the side position ($n = 2564$) was much more common than the prone sleep position ($n = 484$). Although many children had recent wheeze (23%), only 2% ($n = 136$) of the children were reported to have had frequent wheeze with >12 episodes in the last year (Table 1).

Sleeping Environment and Other Characteristics Associated With Frequent Wheeze or Sleep Position

Frequent wheeze was positively associated with the use of a synthetic quilt, synthetic pillow, or electric blanket and sleeping in a bottom bunk (Table 2). A supine sleep position was associated with electric blanket or foam mattress use but not with frequent wheeze, rhinitis, or eczema (Table 2). Asthma medication type and use over the past year did not relate to sleep position. In Australia in 1997, bedding advice to children with asthma included the use of an

allergen-occlusive mattress cover and sheepskin avoidance.²⁵ Consistent with this, children with frequent wheeze were more likely (OR: 18.39; $P < .0001$) to sleep on allergen-occlusive covers but less likely (OR: 0.54; $P = .02$) to sleep on a sheepskin.

The Relation Between Overbedding Composition and Frequent Wheeze by Usual Sleep Position

First, we examined the association between quilt use and severe wheeze after stratification by sleep position (Table 2). Among supine sleepers, synthetic (versus feather) quilt use was associated with frequent wheeze (OR: 3.75 [95% CI: 1.78, 8.63]). However, this apparent adverse effect was not evident among nonsupine children (OR: 1.12 [95% CI: 0.65, 1.93]). The difference in synthetic quilt effect by sleep position was significant (test for interaction: $P = .007$). There was no difference in the association between allergen-occlusive cover use or sheepskin use and recent wheeze by sleep position.

Second, we examined the data, taking possible confounding factors into account. We examined the nested case-control sample in which each child with frequent wheeze was matched to controls without wheeze with regard to age, gender, foam mattress use, electric blanket use, and sheepskin use. Again, synthetic compared with feather quilt use was associated ($P = .02$) with severe wheeze among supine sleepers (OR: 2.54 [95% CI: 1.18, 5.48]), but this association was absent for children sleeping on their sides or prone (OR: 1.09 [95% CI: 0.62, 1.92]; test for interaction: $P = .005$). Additional adjustment for synthetic pillow use provided matched ORs of 2.37 (95% CI: 1.08, 5.23) and 1.06 (95% CI: 0.60, 1.88), respectively (test for interaction: $P = .005$). Among nonsupine children, the effect of synthetic versus feather

TABLE 2. The Association Between Sleeping Environment, Child Characteristics, and Frequent Wheeze or Supine Sleep Position in the Tasmanian Asthma Survey

Characteristic (Reference Group)	OR (95% CI) for Frequent Wheeze	OR (95% CI) for Supine Sleep Position
Sleeping environment		
Usual supine position (usual side or prone)	0.90 (0.61, 1.33)	...
Synthetic quilt (feather quilt)	1.74 (1.20, 2.51)	1.03 (0.92, 1.16)
Other overbedding (feather quilt)	1.37 (0.78, 2.39)	0.92 (0.77, 1.10)
Synthetic pillow (feather pillow)	3.24 (1.03, 10.24)	0.98 (0.78, 1.23)
Other pillow (feather pillow)	2.59 (0.57, 11.73)	1.26 (0.88, 1.81)
Sheepskin underbedding (no sheepskin)	0.54 (0.33, 0.90)	1.06 (0.93, 1.20)
Electric blanket (no electric blanket)	1.56 (1.07, 2.29)	1.17 (1.02, 1.33)
Foam mattress (no foam mattress)	1.35 (0.95, 1.92)	1.21 (1.08, 1.36)
Bottom bunk bed (other type of bed)	1.76 (1.08, 2.88)	0.96 (0.81, 1.15)
Overbedding by sleep position		
Among supine sleepers, synthetic (feather) quilt	3.75 (1.78, 8.63)*	—
Among nonsupine sleepers, synthetic (feather) quilt	1.12 (0.65, 1.93)*	—
Among supine sleepers, other overbedding (feather) quilt	2.76 (0.89, 7.90)†	—
Among nonsupine sleepers, other overbedding (feather) quilt	0.99 (0.39, 2.21)†	—
Child characteristics		
Male sex	1.31 (0.93, 1.85)	1.07 (0.96, 1.20)
Premature (<37 wk gestation) birth	2.19 (1.31, 3.64)	0.86 (0.70, 1.06)
Breastfed in infancy	0.61 (0.41, 0.92)	0.93 (0.81, 1.06)
No siblings	1.31 (0.66, 2.62)	0.95 (0.75, 1.21)
Family history of asthma	5.43 (3.50, 8.41)	1.03 (0.92, 1.15)
Eczema	3.69 (2.60, 5.23)	1.12 (0.98, 1.28)
Hay fever	9.05 (6.37, 12.86)	1.11 (0.97, 1.27)

* Difference in effect by sleep position; $P = .007$.

† Difference in effect by sleep position; $P = .10$.

quilt use did not vary between side- and prone-sleeping children ($P = .86$). The significant difference in quilt effect by sleep position persisted after adjustment for premature (<37 weeks' gestation) birth, breastfeeding history, sibling number, allergen-occlusive mattress cover use, overlying sheet use, home gas use, child exposure to tobacco smoke, or exposure to the other factors listed in Table 2. The interaction effect also persisted after adjustment for child hay fever, eczema, and family history of asthma (test for interaction: $P = .01$). Third, we examined 6 different sleep-position-overbedding combinations with regard to frequent wheeze (Table 3). The baseline group for each pairwise comparison was sleeping supine under a feather quilt. All other sleep combinations were associated with a higher risk of frequent wheeze, and the difference in risk for synthetic quilt use was significant regardless of sleep position used under a synthetic quilt. Fourth, we attempted to examine the effect of pillow composition on frequent wheeze by sleep position. However, this was not possible because of low numbers: only 3 children who slept supine on a nonsynthetic pillow were reported to have frequent wheeze.

Lung Function

The median FEV₁ in this sample was 1.44 L (interquartile range: 1.30–1.59 L). The results in Table 4 have been adjusted for child age, gender, height, distance run, ambient humidity during exercise, family history of asthma, child exposure to active smoking, and whether asthma medications were taken within 6 hours of testing. Increasing wheeze frequency over the past year was clearly associated with lower postexercise FEV₁ measures. Children with any wheeze episodes over the past year had a lower FEV₁ postexercise than children with no wheeze. Among children who slept nonsupine, synthetic quilt use was not associated with a significant FEV₁ reduction postexercise, compared with children not using this item. However, among children who did sleep supine, synthetic quilt use was associated ($P = .05$) with a lower postexercise FEV₁ compared with supine sleepers under feather or other bedding (Table 4). Thus, an adverse effect for synthetic quilt use, particularly among supine sleepers, was observed for this measure of lung function, similar to the findings reported above for frequent wheeze.

DISCUSSION

An interaction between quilt use and sleep position on respiratory function was observed. There was an adverse effect associated with synthetic quilt use on frequent wheeze and postexercise lung function among children who slept supine but not among children who did not sleep supine. It is of relevance to study the interaction between bedding and different sleep positions, an approach we have used previously in sudden infant death research.²⁶ For the issue of overlying synthetic quilts and child wheeze, if the adverse effect was mediated through some mechanism that involved the bedding being in close proximity to the airway (such as, but not restricted to, HDM allergen transfer), one would postulate that the association between overlying synthetic quilt use and adverse respiratory outcomes would be observed specifically among children sleeping supine, during which the face would be closer to overlying bedding, as was observed in the present study. In contrast, the adverse effect of an overlying synthetic quilt would be less evident for side- or prone-sleeping children, because other bedding items such as the mattress would be closer to the airway and thus relatively more important than any overlying items such as quilts. A diagrammatic representation of this is shown in Fig 1.

The strengths of this study are a high participation rate, the availability of lung-function and symptom-report data, and the use of frequent wheeze as a study outcome. Frequent wheeze is a better marker of HDM allergen-related wheeze than the global term "asthma," because HDM atopy is strongly related to frequent wheeze.¹⁹ The use of a nested case-control analysis with matching on underbedding reduced the likelihood that underbedding variability contributed to the observed interaction. The cross-sectional design study does not limit the study materially, because the postulated interaction is based on short-term disease processes. Synthetic bedding has been postulated to induce adverse effects through HDM allergen loading,⁷ the release of volatile organic compounds,¹⁸ or altered endotoxin exposure.¹³ Bronchial provocation with aeroallergen can produce either an immediate or late response with wheeze and FEV₁ reduction.^{27,28} Volatile organic compounds can induce a decline in FEV₁ in asthmatic subjects within 1.5 hours of exposure.²⁹ Inhaled endotoxin can produce a dose-related bronchoconstriction within 6 hours.³⁰ Thus, bedding-

TABLE 3. The Risk of Frequent Wheeze for Various Combined Sleep Arrangements Compared With Sleeping Supine Under a Feather Quilt

Combined Sleeping Arrangement		Cases, % (<i>n</i> = 117)	Matched Controls, % (<i>n</i> = 1144)	Matched OR* (95% CI)	<i>P</i> Value
Sleep Position	Overbedding				
Supine	Feather quilt	8.5	20.6	1.00 (reference)	—
Supine	Other overbedding	6.0	4.9	2.88 (0.83, 10.03)	.10
Supine	Synthetic quilt	26.5	17.7	2.67 (1.23, 5.80)	.01
Nonsupine	Feather quilt	27.4	26.0	1.87 (0.86, 4.08)	.12
Nonsupine	Other overbedding	6.8	6.5	6.84 (0.82, 56.75)	.08
Nonsupine	Synthetic quilt	24.8	24.4	2.38 (1.09, 5.18)	.03

* Cases matched to controls with regard to age, gender, foam mattress use, electric blanket use, and sheepskin use.

TABLE 4. Change in FEV₁ Postexercise by Wheeze Frequency and Sleep Arrangement

Factor	No. of Children With Lung-Function Tests and Data Available	FEV ₁ Change in mL Postexercise (95% CI)	P Value
Number of wheeze episodes in the past year			
None (reference)	320	0% (reference)	—
1–3	48	–5.5 (–8.80 to –2.2)	.001
4–12	16	–5.5 (–11.1 to 0.05)	.05
>12	2	–16.6 (–30.9 to –2.21)	.02
Supine sleep position	349	–0.1 (–2.6 to 2.4)	.94
Synthetic quilt use	406	–1.3 (–3.6 to 1.00)	.27
For children with nonsupine sleep position, synthetic quilt use	196	–1.0 (–4.7 to 2.8)	.61
For children with supine sleep position, synthetic quilt use	151	–3.6 (–7.0 to 0.03)	.05

Lung-function measures were adjusted for child height, age, gender, distance run, ambient humidity during exercise, family history of asthma, child exposure to active smoking, and whether asthma medications were taken within 6 hours of testing. Children with no usual sleep position were excluded. Children using β -agonists on the day of testing were excluded ($n = 6$).

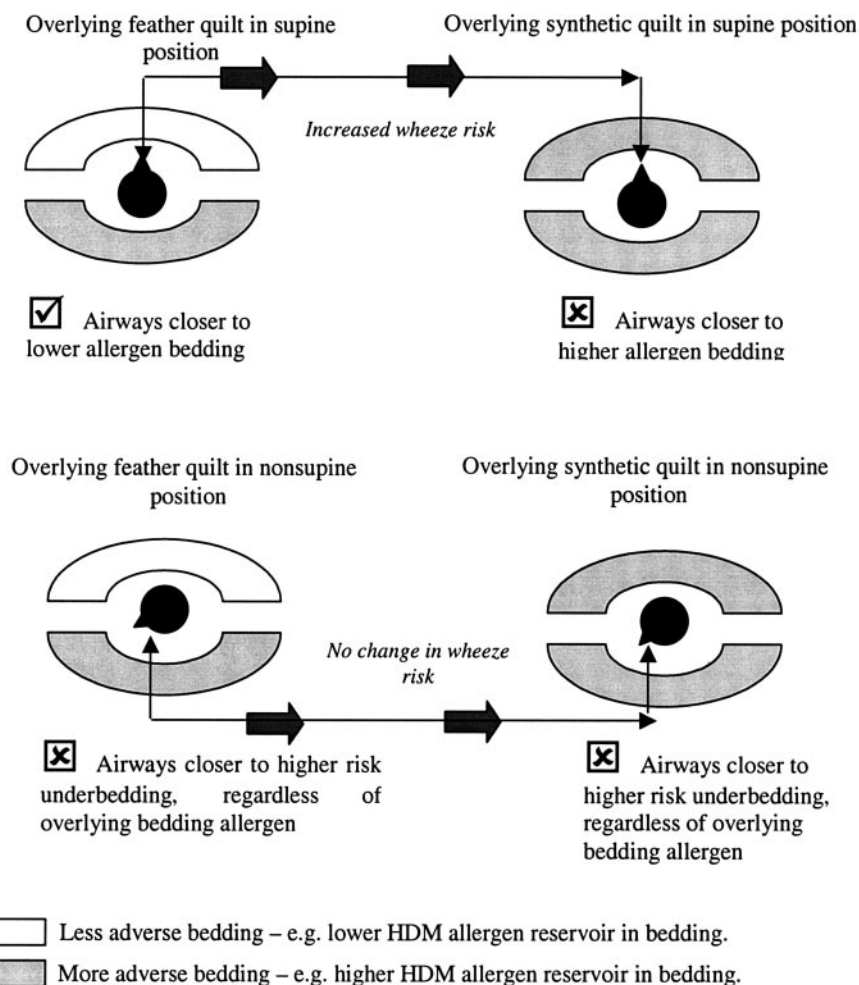


Fig. 1. Schematic representation of a hypothesized mechanism involving close proximity of bedding to the child's airway. The hypothesis is that the adverse effect of an overlying synthetic quilt is mediated by a mechanism involving close proximity to the airway. For example, the inhaled HDM allergen dose into a child's airways could be less if the airway is in close proximity to lower HDM allergen bedding such as feather quilts,⁶ compared with higher HDM allergen bedding such as synthetic quilts,⁶ underbedding,³ or mattresses.⁴

induced bronchoconstriction could occur over a short time period. A potential weakness of the study is that frequent wheeze, bedding, and sleep position were based on parental report only. The report of wheeze frequency showed good agreement with measures of postexercise lung function. Additionally, the findings for synthetic quilts and lung function were similar to those for frequent wheeze. The lung-function decrement associated with synthetic quilt use among supine sleepers was small, but it was two thirds the magnitude of the decrement associated with recent wheeze and thus may be of

clinical relevance. Previously, the parent report of infant bedding has been shown to agree well with interviewer observations at home interview. The validity of a parental report of usual sleep position in children of this age group has not been established. Child sleep position is likely to change during the night,³¹ which could lead to misclassification of usual sleep position. This misclassification would be likely to be nondifferential and thus reduce the study's ability to detect sleep-position effects.

However, the important issue is that the interaction between synthetic bedding and sleep position

cannot be explained by such misclassification. Sleep position was classified as a binary factor (supine/nonsupine), and both differential and nondifferential misclassification of a binary environmental factor will, if it has any effect, bias a multiplicative interaction effect toward the null value when the following conditions are met.³² First, the 2 binary factors should be independent. The lack of association between synthetic quilt use and supine sleeping in Table 2 satisfies the criteria that the 2 binary factors should be independent.³² A second condition is that the measures must classify the true exposures better than random.³² Past validation work shows a high level of agreement between parental report and nurse observation of infant bedding.¹³ Thus, parental report is likely to classify bedding correctly, certainly better than random. To our knowledge, the parental report of child usual sleep position at age 7 has not been validated. However, findings in this study related to sleep position and electric blanket use indicate that parental classification of usual sleep position is not random. Children sleeping on electric blankets were classified by parents as significantly more likely to sleep supine, consistent with past thermal work on sleeping infants.³³ That is, the sleep-position data do provide a pattern of results consistent with past work on thermal balance,³³ which would predict that children with electric blankets would avoid the prone position, which provides a reduced capacity to lose body heat. Thus, parental report, although it may not classify all sleep positions correctly, is likely to reflect the actual predominant sleeping position.

There is growing evidence that synthetic bedding materials are associated with increased childhood wheeze.^{9–11} It is now a high priority to establish whether the association is causal in nature. Previous studies have shown that the association between synthetic upperbedding and severe wheeze has a high strength of association,^{13,18} a dose-response relationship,¹³ biological plausibility,⁷ and ecological coherence.^{9–11} Two recent birth cohorts have reported that a prospective relationship is evident.^{12,13} However, experimental evidence is not available and may be difficult to obtain because of the ethics of applying a potentially deleterious exposure (synthetic bedding) to children with asthma. One of the counterarguments against a causal role for synthetic bedding with childhood wheeze was that the association may merely reflect selection bias even before wheeze development (ie, synthetic bedding was preferentially selected for children at risk of subsequent wheeze). However, the finding that the adverse effect of synthetic quilts was restricted to supine-sleeping children only is evidence against this, because it is unlikely that this selection bias differs by sleep position. This is supported by the findings of no interaction between sleep position and the 2 bedding items (sheepskin and allergen-occlusive mattress cover) that do seem to reflect selection according to the asthma recommendations existing at the time of the study. In 1997, Australian asthma recommendations were to avoid sheepskins and use impermeable mattress covers.²⁵ The interaction re-

ported here provides additional support for a causal interpretation,³⁴ because the adverse effect of synthetic quilts was most evident in children who would be more likely to be sleeping face-up near the quilt. In contrast, as predicted, the adverse effect of an overlying synthetic quilt was less evident for side- or supine-sleeping children, because other bedding items such as the pillow or mattress would be closer to the face and thus relatively more important than overlying quilts. The exact mechanisms that underlie this interaction are not understood yet. An increasing focus on the bedding environment immediately adjacent to the nose and mouth of children during sleep is required.

ACKNOWLEDGMENTS

The Public Health Research and Development Committee of the National Health and Medical Research Council (Australia) funded the 1995 Tasmanian study. The analysis of this project was funded partly by a grant from Blundstone's Pty Ltd and a Coles Supermarket grant to the Canberra Region Medical Foundation. Part of the analysis of this project was funded by a grant from the National Priority Areas Initiative (Asthma), Department of Health and Aged Care (Australia).

We thank the parents, families, infants, and children who participated in these studies; the research staff for data collection and collation; and the hospitals participating in the infant cohort study. We thank the participating schools, the Department of Education, the Department of Cultural and Community Development, and the Catholic Education Office. We thank the Asthma Foundation of Tasmania for the equipment loan.

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Callahan P. *Wall Street Journal*. August 18, 2003

Noted by JFL, MD

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Anne-Louise Ponsonby, Terence Dwyer, Leigh Trevillian, Andrew Kemp, Jennifer Cochrane, David Couper and Allan Carmichael

Pediatrics 2004;113;1216-1222

DOI: 10.1542/peds.113.5.1216

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