Mites and house dust mite allergy in bronchial asthma in Northern Zambia

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Summary
Of 100 asthmatic patients prick tested for allergy to Dermatophagoides pteronyssinus, 88% were positive compared with only 14% of controls. A significantly greater proportion of dust samples from the houses of the asthmatics contained Dermatophagoides mites. The house-dust mite D. pteronyssinus, constituted 90% of the mites identified, other pyroglyphid mites, Cheyletus and Glycophagus making up most of the remainder. This study confirms that allergy to D. pteronyssinus is an important factor in the aetiology of asthma in Ndola. It is suggested that prevention of asthmatic attacks could be directed towards mite control and hyposensitization.

Introduction
There is a high incidence of bronchial asthma in many parts of Africa (Mitchell, 1970; Sofowora, 1970; Gitoho and Rees, 1971; Anim and Edoo, 1972). Ndola, Zambia, lies at an altitude of 1280 m, latitude 13° S, and has a Sudan-type climate. We have already shown in a preliminary study in Ndola that asthma admissions are greatly increased during the wet season when conditions for house-dust mite growth are favourable, that a significantly greater proportion of asthmatics compared with controls had positive skin reactions to extracts of D. farinae, and that mites of the Dermatophagoides genus were found in the majority of dust specimens from the houses of asthmatics (Buchanan and Jones, 1972). The results of this study encouraged us to attempt to confirm our findings in a larger series of patients and perform quantitative analysis of mite populations in the house-dust of asthmatic patients and controls.

The acarine mite D. pteronyssinus has frequently been shown to be the most abundant in house-dust, and the most important allergen in mite asthma (Maunsell, Wraith and Cunnington, 1968; Pepys, Chan and Hargreave, 1968; McAllen, Assem and Maunsell, 1970). The recent commercial availability of an extract of this allergen enabled us to perform skin tests on asthmatics and controls both with this allergen and that of D. farinae.

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Materials and methods
One hundred unselected adult African Zambian asthmatics (sixty-six male, thirty-four female) were prick tested with extracts of D. farinae and D. pteronyssinus (Bencard, England) and compared with 100 controls matched for sex and age. Their ages ranged from 19 to 60. The tests were performed between mid-January and mid-March 1973, the peak period for asthma attendance. A weal of 3 mm or less was graded 2+, a weal of 4 or 5 mm as 3+, and larger weals as 4+. Erythema was not used in the interpretation of skin tests because of the difficulty in recording it reliably in deeply pigmented skins.

Each patient and control was asked to provide a sample of dust from his sleeping area. An accurately weighed sample in the region of 100 mg of dust was dispersed in 10-0 ml of 90% lactic acid in a Petri dish and incubated at 55°C for 24 hr after which the contents were centrifuged at approximately 400 g for 3-4 min. The supernatant was transferred to a Petri dish and examined for mites under a low-power stereoscopic binocular microscope. The total number of mites in the specimen was counted, and samples of mites from all positive specimens were mounted for species identification using keys constructed for identification of Dermatophagoides mites (Fain, 1966, 1967).

Results
Eighty-eight asthmatics gave positive reactions to the prick test with D. pteronyssinus compared with only fourteen controls, a highly significant difference. The degree of reaction is given in Table 1. The results of testing with D. farinae allergen were almost identical, only five of the 200 subjects reacting to one allergen alone.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>0</th>
<th>2+</th>
<th>3+</th>
<th>4+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthmatics</td>
<td>12</td>
<td>28</td>
<td>33</td>
<td>27</td>
<td>100</td>
</tr>
<tr>
<td>Controls</td>
<td>86</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>35</td>
<td>36</td>
<td>31</td>
<td>200</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 110.5; \ \text{d.f.} = 3; \ P < 0.0005. \]
Suitable dust specimens were received from seventy-five asthmatics and fifty controls. Mites were found in sixty-one of the specimens received from asthmatics and *Dermatophagoides* mites were found in all but two of these, the total mite counts ranging from 10 to 10,400/g of dust. Mites were found in thirty-two specimens received from controls and *Dermatophagoides* mites were found in thirty of these, significantly fewer than in dust collected from the asthmatics, the total mite counts ranging from 6 to 700/g of dust (Table 2).

### Table 2. Presence of *Dermatophagoides* mites in the dust samples collected from asthmatic patients and controls

<table>
<thead>
<tr>
<th></th>
<th>No. of dust samples positive for <em>Dermatophagoides</em> mites</th>
<th>No. of dust samples negative for <em>Dermatophagoides</em> mites</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthmatics</td>
<td>59</td>
<td>16</td>
<td>75</td>
</tr>
<tr>
<td>Controls</td>
<td>30</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>89</td>
<td>36</td>
<td>125</td>
</tr>
</tbody>
</table>

\( \chi^2 = 4.23; \text{ d.f.} = 1; 0.05 > P > 0.02. \)

Dust samples were collected from January to April and Table 3 shows the mean monthly mite count per gram of dust from the controls. A rise and fall in the mean relative humidity parallels both the mean monthly mite counts and the monthly asthma admissions to the medical wards of the hospital.

### Table 3. Mean monthly relative humidity at Ndola; mean monthly mite counts per gram of dust from controls; monthly asthma admissions to Ndola Central Hospital for January to April 1973

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean monthly relative humidity percentage</td>
<td>77</td>
<td>82</td>
<td>76</td>
<td>73</td>
</tr>
<tr>
<td>Mean mite count per gram of dust</td>
<td>56</td>
<td>100</td>
<td>83</td>
<td>42</td>
</tr>
<tr>
<td>Asthma admissions</td>
<td>10</td>
<td>17</td>
<td>16</td>
<td>7</td>
</tr>
</tbody>
</table>

To eliminate the possibility that the date of collection of the dust accounted for the difference between the asthmatic and control dusts, the thirty-two cases in which the dust specimens were received from asthmatic patients and their controls within 2 weeks of each other were examined. Twenty-six dusts from asthmatic patients contained *Dermatophagoides* mites compared with only seventeen from the controls, a significant difference (Table 4). The mean mite counts were 176/g of dust in asthmatics and 72/g of dust in controls.

### Table 4. Presence of *Dermatophagoides* mites in the dust samples collected from thirty-two asthmatic patients and their controls within 2 weeks of each other

<table>
<thead>
<tr>
<th></th>
<th>No. of dust samples positive for <em>Dermatophagoides</em> mites</th>
<th>No. of dust samples negative for <em>Dermatophagoides</em> mites</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthmatics</td>
<td>26</td>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>Controls</td>
<td>17</td>
<td>15</td>
<td>32</td>
</tr>
</tbody>
</table>

\( \chi^2 = 4.54; \text{ d.f.} = 1; 0.05 > P > 0.02. \)

Out of a total of 3125 mites counted, 607 were mounted and 479 of these were suitable for species identification. *D. pteronyssinus* comprised 433 of these (90.4%). Other pyroglyphid mites, *Cheyletus* and *Glycophagus* made up most of the remainder (Table 5).

### Table 5. Mite species present in ninety-three out of 125 samples of house dust received from asthmatics and controls

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of mites identified</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>D. pteronyssinus</em></td>
<td>433 (90.4%)</td>
</tr>
<tr>
<td>Other pyroglyphid mites</td>
<td>21 (4.4%)</td>
</tr>
<tr>
<td><em>Cheyletus</em> spp.</td>
<td>15 (3.1%)</td>
</tr>
<tr>
<td><em>Glycophagus</em> spp.</td>
<td>7 (1.5%)</td>
</tr>
<tr>
<td>Others</td>
<td>3 (0.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>479 (100%)</td>
</tr>
</tbody>
</table>

**Discussion**

The highly significant difference between the reaction of asthmatics and controls to prick testing with *D. pteronyssinus* allergen confirms our previous findings with *D. farinae*. We also confirmed in Zambian Africans the high degree of cross-sensitivity to the two allergens shown to exist by other workers (Brown and Filer, 1968; Pepys et al., 1968; Smith et al., 1969). Of our asthmatic patients, 88% gave a positive reaction to *D. pteronyssinus* and an identical percentage to *D. farinae*. This compares with a figure of approximately 50% positivity to *D. farinae* by workers in Ghana (Commey and Haddock, 1973). Conditions for mite growth in Ndola are good only during the 6 months of the rainy season when the relative humidity reaches levels over 70%. A majority of our asthmatics gave a history of asthma occurring only during the rainy season, only 16% giving a history of perennial asthma. As our tests were performed only during the rains, the resulting bias in favour of seasonal asthmatics may account for some of the difference between our findings and those of the workers in Ghana.

A significantly greater number of dusts from asthmatic patients contained *Dermatophagoides* mites
than those from controls, even when the date of collection of the dust was eliminated as a variant. However, it is possible that this difference resulted from more diligent collection of dust by the more motivated asthmatics, who also produced a greater return of dust samples than controls.

The proportion of *D. pteronyssinus* mites in our dust samples (90% of all mites) is higher than that found in a British study (Maunsell *et al.*, 1968) where the comparable figure was 67%. The climate of northern Europe is not as favourable for the growth of *D. pteronyssinus* as that of Ndola in the wet season, and this may account for the difference. In addition, there may also have been a significant sampling error as we made no attempt to mount and identify all the mites counted.

There seems little doubt that sensitivity to the house-dust mite, *D. pteronyssinus*, is an important factor in the aetiology of asthma in Ndola, and this is likely to be the case in other areas of Africa where asthma is common. That the incidence of asthma in Ndola is seasonal, and that there is a significant difference in the presence of mites in the dusts of asthmatic patients and controls, confirms that both environmental and constitutional factors are implicated in causation of asthma. There are thus two possibilities for prevention of asthmatic attacks: environmental measures could be tried to reduce the population of mites during the rainy season; constitutional measures can be directed towards hypo-sensitization. Since such a high proportion of asthmatics in Northern Zambia appear to be allergic to *D. pteronyssinus*, and asthma is a common disease, this would seem to be a suitable place for controlled trials of hypo-sensitization and mite control.

Acknowledgments

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References


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