Asthma and chronic airflow limitation in the highlands of Papua New Guinea: low prevalence of asthma in the Asaro Valley

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ABSTRACT: The prevalence of asthma in the South Fore region of Papua New Guinea was found to be 7.3%, which is thought exceptionally high for highland areas in this country. To investigate the prevalence of asthma and of chronic airflow limitation in a different highland region with similar living conditions, adults and children from 7 villages in the Asaro Valley were interviewed. Questions were asked about smoking history and about past and present symptoms of cough, of shortness of breath, of chest tightness and of asthma. Of 743 adults interviewed, 206 underwent a clinical study with measurements of lung function, bronchial responsiveness and skin prick tests. Dust was collected from the floors and blankets of 36 houses for counts of house dust mites. We did not find any children with symptoms of asthma. Only 2 adults (0.3%) had symptoms consistent with asthma, and a further 6.2% had symptoms and/or lung function consistent with chronic airflow limitation. Most bronchial hyperresponsiveness was associated with asthma or with chronic airflow limitation. The prevalence of atopy was similar in the Asaro and South Fore populations, but the South Fore had higher house dust mite counts in blanket dust. The low prevalence of asthma in the Asaro Valley is unexplained in terms of factors normally associated with asthma. Because asthma in this area does not appear in childhood and only develops in a small proportion of adults, it may be of different aetiology to asthma in Caucasian populations.

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In 1983, we reported that the prevalence of asthma was 7.3% in adults living in the South Fore linguistic group of the Eastern Highlands Province of Papua New Guinea [1]. Because anecdotal evidence suggests that asthma is extremely uncommon in populations living in other rural areas of the Papua New Guinea highlands [2-4], this prevalence is considered exceptionally high. There is also strong evidence that the occurrence of asthma in the South Fore population is a recent event [1, 5]. However, there have not been any recent studies of the prevalence of asthma in Papua New Guinea in areas other than the South Fore. In addition, the prevalence of chronic airflow limitation (CAL) in highland areas has not been measured although the nature of CAL in Papua New Guinea populations has been described [6, 7].

In 1984, we undertook a study of a population living in the Asaro Valley in the Eastern Highlands Province of Papua New Guinea where the social and environmental conditions were similar to those of the South Fore region. The aims of the study were to determine the prevalence of asthma and of CAL, and to investigate the relation between bronchial hyperresponsiveness (BHR) and respiratory illness in the Asaro region. The prevalence of atopy and the numbers of house dust mites in the Asaro Valley and in the South Fore regions are compared because of their role as putative factors associated with asthma.

Methods

Population

The Asaro Valley is well defined geographically and, despite the presence of two language groups, social customs are homogeneous. This area was chosen because the environmental, social and housing conditions were similar to those of the South Fore region [1]. In both areas, most houses lie between 1700 and 1850 metres above sea level. The people of both areas are subsistence farmers who grow coffee as the main cash crop.
Their diets appeared similar and there were no obvious differences in environmental allergens such as pollens and animals.

The Asaro Valley was also chosen for study because it is geographically closer to Goroka. The people of this area therefore had easier access to medical facilities and they had more contact with introduced European goods, such as blankets. Two of the authors (D. Smith and M. Alpers) have been involved with an ongoing epidemiological survey of acute respiratory infections in the Asaro Valley and were well acquainted with the health problems of the community. Evidence from this survey and from records at the Goroka hospital suggested that few people in this area had asthma.

Villages were selected randomly to give a study population of approximately 1500 adults and children from a total population of approximately 55,000 people. There were seven villages selected, each with three or four hamlets. A house to house demographic survey was made in each village and the age, sex and date of birth of all people living in each house was recorded. Migrants not born in the Asaro Valley were excluded from this study, with the exception of a small number of women who had married into the area from villages bordering the valley.

From the interview sample of 743 adults, 206 adults were selected randomly for a clinical study of lung function tests, bronchial responsiveness and skin prick tests.

Interviews

Adults and children present at each hamlet were questioned about past or present chest symptoms and smoking history. Each subject was asked whether he/she had ever experienced symptoms of cough, shortness of breath or chest tightness or had ever been diagnosed as having asthma or pneumonia. In addition, subjects who gave positive replies were questioned about the circumstances and times when symptoms occurred. Questions about wheeze were not included because there is no translation for this word and the meaning is not understood.

Subjects who reported having spontaneous onset of symptoms were defined as having "symptoms consistent with asthma" and subjects who reported breathlessness only to exertion or who had persistent cough were defined as having "symptoms consistent with CAL".

Clinical studies

Lung function

A Vitalograph dry spirometer, driven by a portable generator, was used to measure forced expiratory volume in one second (FEV1) and forced vital capacity (FVC). The measurements were repeated until two forced expiratory curves reproducible to within 5% were recorded. If the subject was unable to co-operate, peak expiratory flow rate (PEFR) was measured using a Wright peak flow meter. Five attempts at PEFR were made. The maximum value obtained was recorded, provided that two values reproducible to within 5% were obtained.

Normal values used to calculate predicted values and percent of predicted values were those of Anderson et al [8] for FEV1, and those of Woo.Cock et al [9] for PEFR. Lung function was considered to be abnormal when the FEV1 of PEFR was less than 70% of the predicted value.

Bronchial responsiveness

Bronchial responsiveness was measured by histamine inhalations test using the method of Yan et al. [10]. After measurement of resting lung function, subjects were given first saline, then increasing doses of histamine from De Vilbiss hand-held glass nebulisers. Lung function was measured again one minute after each dose. The test was stopped when the FEV1 had fallen by 20% or more, or after 7.8 µmol of histamine had been administered. The dose of histamine that caused a 20% fall (PD20FEV1) was read from a dose-response curve of percent change from post-saline FEV1 plotted against the logarithm of the histamine dose. Subjects with a PD20FEV1 value below 7.8 µmol histamine were considered to have BHR.

In subjects unable to perform satisfactory spiromgrams, a Wright Peak Flow Meter was used in place of a Vitalograph and bronchial responsiveness was measured using PEFR in place of FEV1.

Bronchodilator test

After measurement of baseline lung function, 200 mg of orciprenaline was administered from a metered aerosol and the measurement of lung function repeated after 10 minutes. A second dose of orciprenaline was then administered and the lung function recorded again after a further 10 minutes.

Skin tests and house dust mite counts

Skin prick tests to 13 common allergens were performed using the method of Peps [11]. The presence of one or more skin wheals with a mean diameter of 2 mm or greater was used to define atopy. The allergens tested were house dust; Dermatophagoides farinae; D. pteronyssinus; cat; dog; horse; feather mix; timothy grass; rye grass; ragweed; plantain; Alternaria tenuis; Aspergillus fumigatus; Ascaris lumbricoides. Feather mix and D. pteronyssinus were manufactured by Dome (Slough, U.K); A. lumbricoides was manufactured by the Department of medicine, Sydney University and the remainder were supplied by Hollister-Suter (Elk Hart, U.S.A.).
Table 1. - Details of subjects with asthma, chronic airflow limitation or abnormal lung function

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Height</th>
<th>Smoker**</th>
<th>FEV₁</th>
<th>PEFR</th>
<th>PD₂₁EV₁</th>
<th>BDT*</th>
<th>%predicted</th>
<th>% increase</th>
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**N-no, Y-yes; *Bronchodilator test; PEFR: Peak expiratory flow rate, FEV₁: forced expiratory volume in 1 sec; BHR: bronchial hyperreactivity.

Dust samples were obtained from 36 houses selected at random from the 7 villages. Samples were collected from the blankets by shaking them in a large plastic bag and from the floors by taking a sample of surface dirt. The method used for counting house dust mite numbers has been described [12].

Statistical methods

Statistical differences between categorical variables were tested by chi-square analysis of contingency tables. Ranges given for prevalence rates are those of the 95% confidence interval (CI).

Results

When the residents of the selected villages were interviewed, no child was found with symptoms of shortness of breath or chest tightness. Therefore, children were excluded from further study.

In the interview group there were 743 adults of whom 206 underwent a clinical study. The age and sex distribution of subjects in these interview and clinical samples is shown in fig. 1. In the interview sample, only two subjects (0.3%, CI 0.0, 0.7%) had symptoms of spontaneous onset of breathlessness or of chest tightness which were consistent with asthma. Both of these subjects were in the clinical sample and both had abnormal lung function and BHR (table 1).

A further 39 subjects in the interview sample (5.2%, CI 3.6, 6.8%) reported a history of chronic productive cough or symptoms of breathlessness on exertion, and were considered to have CAL. Chronic airflow limitation tended to occur more in older subjects and occurred equally in males and females (table 1).

Figure 2 shows the number of subjects in the clinical sample who had symptoms of asthma or of CAL, and who had abnormal lung function and/or BHR. Of the 8 subjects with symptoms of CAL, 7 subjects had normal lung function and 4 subjects had BHR. There were 2 subjects (0.97% of the clinical sample) who had abnormal lung function consistent with CAL, but who were asymptomatic.

In the clinical sample, 10 subjects had BHR (4.9%, CI 2.0, 7.9%). Of these 10 subjects, 6 subjects had symptoms consistent with asthma or with CAL. The remaining 4 subjects with BHR were asymptomatic (1.9%, CI 0.1, 3.8%).

![Figure 1](image_url)
Residents interviewed in 7 villages did not report any child with symptoms of breathlessness or of chest tightness. Furthermore, children rarely present at hospitals in any of the highland areas of Papua New Guinea for treatment for these symptoms. The prevalence of childhood asthma is probably extremely low in this population, and may be close to zero as it was in the South Fore region [13].

The low prevalence of asthma in adults (0.3%) was similar to that of 0.2–0.3% reported by Anderson in 1974 [4]. Our clinical study found two asymptomatic subjects who had abnormal lung function, one of whom had a negative bronchodilator test and one of whom had BHR. It is probable that these two subjects had mild CAL. The failure of the clinical study to find further subjects with undiagnosed asthma confirms that, in this population, it is unlikely that there are many subjects with unrecognized asthma.

In the interview sample, 5.2% of subjects reported symptoms consistent with CAL. We considered a further one percent of the clinical group to have CAL, indicating that the prevalence of CAL is slightly higher than indicated by symptoms in the interview sample and is likely to be approximately 6.2%. A small proportion of the subjects with CAL were nonsmokers suggesting that, in this population, CAL is probably of multifactorial aetiology. As found in a Western population [14], CAL was more prevalent in older age groups and occurred in both males and females.

The prevalence of BHR in this community was much lower than the prevalence of between 12% and 24% reported in adults in Western communities [15–17]. We found that 1.9% (CI 0.1, 3.8%) of the clinical study group had asymptomatic BHR compared with 3.5% (CI 2.3, 4.7%) of a population of adults in Western Australia [15]; these rates were significantly different. Apart from the two subjects with asthma, 50% of the subjects with BHR had symptoms consistent with CAL. Except for one subject, BHR was less severe in the subjects with CAL than in the subjects who had asthma. It has been shown that the level of baseline lung function and that the causes of BHR associated with CAL and with asthma are probably different [18, 19].

The prevalence of atopy in the Asaro Valley was 24% (CI 18, 30%), which is low compared with the prevalence of 40% found in a random population sample of the Baiyer River [20] and with figures of 34% to 50% reported in Western populations [21]. Although differences in study design preclude valid comparisons, the prevalence of atopy in the control group in the South Fore study was 32% (CI 20, 44%). In Caucasian populations, asthma and atopy are closely associated [22, 23] and it is interesting that, in the Asaro Valley sample, only a small proportion of atopic subjects had symptoms of asthma.

We could detect few differences in the living conditions of people of the Asaro Valley and of the South Fore district. The environment was not different in that there are no plants which grow exclusively in one area and not in the other. No difference in smoking habits was found. Although detailed dietary histories were not

Table 1 shows the lung function, bronchial responsiveness and/or bronchodilator results of the 15 subjects with abnormal lung function (FEV1 or PEFR less than 70% of the predicted value) or with BHR. Six of the 11 subjects with abnormal lung function had a histamine challenge and all had BHR. The remaining 5 subjects had a bronchodilator test and this was negative in all 5 subjects. The two subjects with asthma had more severe levels of BHR than all but one of the 8 nonasthmatic subjects who had BHR.

Of the 206 subjects who were in the clinical sample, 186 subjects had skin tests performed, of whom 45 subjects (24%, CI 17.9, 30.1%) were atopic. When the dust samples were analysed, almost no house dust mites were found in the samples from floors. There were 36 blankets tested of which 25 blankets (69%) contained house dust mites. In these blankets, the mean mite count was 389 per gram (range 20–2308 mites).

Discussion

This study has confirmed the anecdotal assertion that the people of the Asaro Valley have a very low prevalence of asthma. The prevalence of 0.3% found in this population is significantly lower than the prevalence of 7.3% found in the South Fore population (p<0.001). Moreover, in the Asaro Valley we did not find any children who had symptoms consistent with asthma. The prevalence of CAL in the interview sample was 5.2%. Lung function tests in the clinical sample revealed a further 1% of subjects with asymptomatic CAL, so that the prevalence of CAL in this population is likely to be approximately 6.2%. The prevalence of BHR was 4.9%. Of the subjects with BHR, 60% had clinically apparent asthma or CAL.

The study groups were selected using random sampling methods and, therefore, there is reason to believe that both the interview sample of 743 adults and the clinical study sample of 206 adults were representative of the general population living in this area.
taken, the dietary habits appeared similar. However, there were more house dust mites in the blanketed areas of South Fore subjects (mean 1371 mites, range 78 to 8300) than in the blanketed areas of Asaro Valley subjects and this finding requires further investigation. Although the prevalence of skin reactions to house dust mite was not different between the two areas, it is possible that the presence of house dust mite allergen adds to the overall allergen load in the South Fore and perhaps acts to induce symptoms.

Further studies are required to determine both the extent to which variations in the prevalence of asthma exist in the highland areas of Papua New Guinea, and the extent to which such variations are associated with variations in house dust mite counts, atopy and bronchial responsiveness. Other factors which were not measured in our studies, including HLA status, parasitic infection and diet also deserve investigation. Because asthma does not appear to develop during childhood, only develops in a very small proportion of adults in the Asaro Valley and is not closely associated with atopy, it may be of different aetiology to asthma found in Caucasian populations.

Acknowledgements: The authors wish to acknowledge the help of Mr. George Koki in this study.

References


La prévalence de l'asthme dans la région South Fore de la Nouvelle Guinée Papoue s'élève à 7.3%, ce que est considéré comme exceptionnellement élevé pour les zones d'altitude dans cette région. Nous avons interviewé des adultes et des enfants provenant de 7 villages de la vallée d'Asaro, afin d'investiger la prévalence de l'asthme et des limitations chroniques du débit aérien dans différentes régions des hauts pays ayant des conditions de vie similaires. Les questions portaient sur les antécédents de tabagisme, les symptômes anciens ou présents de toux, d'oppression, de dyspnée et d'asthme. Sur 743 adultes interviewés, 206 ont subi un examen clinique et des mesures fonctionnelles pulmonaires, l'étude de l'hyperréactivité bronchique et des tests cutanés.
allergiques. La poussière provenant du sol et des couvertures de 36 maisons a été prélevée pour décompte des mites de la poussière de maison. Nous n'avons trouvé aucun enfant présentant des symptômes d'asthme. Deux adultes seulement (0.3%) ont des symptômes compatibles avec l'asthme et 6.2% de plus ont des symptômes et/ou des anomalies fonctionnelles compatibles avec une limitations chronique des débits aériens. La plupart des cas d'hyperréactivité bronchique sont associés à l'asthme et aux limitations chroniques du débit aérien. La prévalence de l'atopic s'avère similaire dans les populations d'Asaro et du South Fore, mais les décomptes de mites de la poussière de maison s'avèrent plus élevés dans la poussière de couverture dans le South Fore. La faible prévalance de l'asthme dans le vallée d'Asaro reste inexplicable par les facteurs normalement associés à l'asthme. Étant donné que dans cette région l'asthme n'apparaît pas dans l'enfance, et ne se développe que dans une faible proportion d'adultes, son étiologie pourrait être différents par rapport aux populations cau- casiennes.

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