Comparison of reported prevalences of recent asthma in longitudinal and cross-sectional studies


ABSTRACT: A potential source of bias in prevalence rates reported for symptoms and diagnoses of asthma in longitudinal studies could arise if repeated questioning of subjects or previous experience of lung function and airway responsiveness tests increased awareness of respiratory symptoms. We wished to determine the extent of any such bias by comparing reported prevalence rates from a longitudinal and cross-sectional study within similar populations.

The prevalences of wheezing in the last year, waking with chest tightness, waking with shortness of breath, waking with coughing, having an attack of asthma in the last year, and current use of medications for asthma were determined using identical questions in two populations. Self-completed questionnaire responses of 946 subjects, 21 yrs of age, participating in the seventh respiratory assessment in the longitudinal Dunedin Multidisciplinary Health and Development Research Study were compared with responses provided by 991 subjects, aged 20–22 yrs, completing a postal questionnaire on one occasion only for the New Zealand section of the European Community Respiratory Health Study.

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We conclude that repeated questioning regarding respiratory symptoms and repeated lung function and bronchial challenge testing in a longitudinal study of asthma did not bias prevalence rates compared with those obtained in a similar population of the same age studied on only one occasion.


Numerous estimates of the prevalence of asthma have been made in recent years, based mainly on cross-sectional population studies [1–4]. In some countries, particularly Australia and New Zealand, longitudinal studies of the natural history of asthma have been in progress over the last two or three decades [5, 6]. These studies have reported very high prevalence rates for asthma and wheezing in childhood and young adulthood.

In the Dunedin, New Zealand, study of the natural history of asthma in a birth cohort, we observed a progressive increase in the prevalence of reported diagnosed asthma, and of wheezing whether or not diagnosed as asthma, in each succeeding survey from 9–18 yrs of age. While the prevalence of these conditions decreased at 21 yrs of age, the rates remained high compared with many other countries.

One possible explanation for these high prevalence rates could be bias arising from the nature of a longitudinal study. Subjects may be made more aware of respiratory symptoms by repeatedly answering questionnaires every 2 or 3 yrs, although a “training effect” from repeatedly answering the same questionnaire was not found in a prospective study of London transport workers by Fletcher et al. [7]. Samet [8] concluded, from that study, that twice yearly questioning about chest illnesses for 8 yrs was not associated with an increase in positive responses. However, the difference between our studies and those of Fletcher et al. [7] was that our subjects may have experienced symptoms of chest tightness or wheezing when performing methacholine challenge tests during previous surveys, which may facilitate recall of similar minor symptoms they have experienced.

We therefore wished to compare results from this longitudinal study with results from single survey studies in other randomly selected, age-matched subjects in this population. However, use of historical data would be likely to introduce other biases and render any such comparison uninterpretable. The first opportunity to make a direct comparison with data from another New Zealand study arose with the completion of the New Zealand component of the European Community Respiratory Health Survey (ECRHS) [9] in the year before...
the subjects in the longitudinal study were reviewed at 21 yrs of age. Although the studies were performed in close proximity to each other, the initiative to compare data from these studies arose after both surveys were completed and, therefore, data are not influenced by a known intent to compare results.

In this paper, we report a comparison of data obtained in independent longitudinal and cross-sectional studies of prevalence of asthma and wheeze in young adults from the New Zealand population.

Methods

The longitudinal study (Dunedin)

The subjects participating in the longitudinal Dunedin Multidisciplinary Health and Development Research Unit study have been fully described previously [6, 10, 11]. In brief, 1,661 live births occurred at the one maternity hospital in Dunedin, New Zealand, between April 1, 1972 and March 31, 1973. Of these, 1,139 children still residing in the province of Otago at 3 yrs of age were invited to participate in a longitudinal study, and 1,037 (91%) agreed to do so. This cohort was under-representative of ethnic minority groups compared with the New Zealand population as a whole [10]. Children (with an accompanying parent for children up to the age of 11 yrs) were requested to attend the study centre in Dunedin every 2 yrs from 3–15 yrs of age, and again at 18 and 21 yrs of age, for assessment of physical and mental health and development. By 21 yrs of age, 17 subjects had died, leaving a sample of 1,020 subjects potentially available for review. At 21 yrs of age, 64% of subjects still resided in Dunedin, 6% lived elsewhere in the Otago province, 20% lived in other parts of New Zealand, 7% were overseas, and only 3% refused follow-up or could not be traced.

Subjects answered questionnaires on respiratory health at every survey from 7–21 yrs of age (parent-completed at 7–11 yrs of age, subject-completed at 13–21 yrs of age). At ages 18 and 21 yrs, a number of questions were taken directly from the ECRHS for purposes of international comparison, using the 1990 version (table 1) supplied by Burney. These questions were self-completed before any interviewer-administered questions were asked. Subjects completed the study between April 1991 and December 1992. The prevalences of: wheezing in the last year; waking with tightness in the chest in the last year; waking with shortness of breath in the last year; waking with an attack of coughing in the last year; having an attack of asthma in the last year; and currently taking any medications for asthma, were determined in each population. The gender and ethnic group of respondents were recorded as stated by the subjects.

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Comparisons

For purposes of comparison with data from the Dunedin study of 21 year olds, subjects aged 20–22 yrs were selected from the NZRHS study, providing a similar number of subjects to those seen in Dunedin at age 21 yrs, age-matched to within 1 year. The prevalences of: wheezing in the last year; waking with tightness in the chest in the last year; waking with shortness of breath in the last year; waking with an attack of coughing in the last year; having an attack of asthma in the last year; and currently taking any medications for asthma, were determined in each population. The gender and ethnic group of respondents were recorded as stated by the subjects.

The exact questions employed in each study are shown in table 1. Because the Dunedin study had used an earlier version of the ECRHS questionnaire [12] at 18 yrs of age and repeated these questions at exactly 21 yrs of age, there were minor differences in the wording of two questions, and a slight difference in format. The words "at night" were included in Question 3 in the Dunedin questionnaire. Questions 5 and 6 were preceded in the Dunedin questionnaire by the question "Have you ever had asthma?", and only those responding positively to the question about "asthma ever" went on to answer Questions 5 and 6 regarding asthma in the last year and medications currently used. It is most unlikely that this excluded any subject with current asthma or current medications. The word "medication" was used in Question 6 in Dunedin, whereas "medicine" was used in the NZRHS study.

### Table 1. – Exact wording of questions used in the longitudinal (Dunedin) and cross-sectional (NZRHS) studies

<table>
<thead>
<tr>
<th>Longitudinal study (Dunedin)</th>
<th>Cross-sectional study (NZRHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you had wheezing or whistling in your chest at any time in the last 12 months?</td>
<td>Have you had wheezing or whistling in your chest at any time in the last 12 months?</td>
</tr>
<tr>
<td>2. Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?</td>
<td>Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?</td>
</tr>
<tr>
<td>3. Have you been woken at night by an attack of shortness of breath at any time in the last 12 months?</td>
<td>Have you been woken by an attack of shortness of breath at any time in the last 12 months?</td>
</tr>
<tr>
<td>4. Have you been woken by an attack of coughing at any time in the last 12 months?</td>
<td>Have you been woken by an attack of coughing at any time in the last 12 months?</td>
</tr>
<tr>
<td>5. Have you had an attack of asthma in the last 12 months?</td>
<td>Have you had an attack of asthma in the last 12 months?</td>
</tr>
<tr>
<td>6. Are you currently taking any medications (including inhalers, aerosols, or tablets) for asthma?</td>
<td>Are you currently taking any medicine (including inhalers, aerosols, or tablets) for asthma?</td>
</tr>
</tbody>
</table>

NZRHS: New Zealand Respiratory Health Study
Analyses

The Dunedin data were entered into the computer at the University of Otago, Dunedin and analysed using Statistical Package for the Social Sciences (SPSS). The NZRHS data were entered into the computer in Wellington, and analysed using Statistical Analysis System (SAS). Prevalence rates were determined by frequency of positive responses, and the 95% confidence interval (95% CI) was calculated. Significance of any differences detected between prevalences or proportions were determined by Chi-squared test.

Results

In Dunedin, 946 subjects attended the Study Centre for review at 21 yrs of age, of whom 51% were male, and 97% European. Of those responding to the NZRHS survey, 991 were aged 20–22 yrs, of whom 48% were male (difference to Dunedin not significant) and 84% European (p<0.001 compared with Dunedin). The response rates were 93% and 74% for the Dunedin and NZRHS studies, respectively.

There were no differences between the populations in the mean prevalence rates for wheezing in the last 12 months, waking with chest tightness, waking with breathlessness, waking with coughing, attacks of asthma in the last year, and use of asthma medicines (table 2). The proportion of those with positive responses to "nocturnal symptoms" and/or "attacks of asthma" and/or "asthma medications in the last year" (i.e. any positive response to questions 3, 5 or 6), again did not differ between these populations. There was no systematic trend towards higher or lower prevalence rates for any of the symptoms or medication use. The 95% CIs overlapped in all instances, with some means being slightly higher in the Dunedin group and other means being slightly higher in the NZRHS group (fig. 1).

Because of the significant difference in ethnic mix in the two study groups, comparisons were made restricting subjects to those recording their ancestry as European or other (i.e. excluding Maori and Polynesian subjects). There were no significant differences between prevalence rates for any of the symptoms or medication use in this restricted analysis (data not shown).

Within each study, symptom prevalences differed between males and females. However, within each gender, no differences in symptom prevalence were detected between the two study populations (data not shown).

The data obtained in the Dunedin study were also compared with cross-sectional study data restricted to Christchurch, the nearest large city to Dunedin, and no significant differences were found in the results obtained in these geographically adjacent urban areas comparing longitudinal with cross-sectional data. There were, likewise, no significant differences in prevalence rates for any symptoms in this age group between Christchurch and the other three regions surveyed in the NZRHS study.

Discussion

Possible biases in epidemiological studies of asthma have many sources, including: sampling frame; response rates; awareness of asthma; diagnostic habits; the nature of the questions asked; and the criteria for making a diagnosis of asthma [14, 15]. In addition, observer bias, seasonal bias, questionnaire modifications and mode of administration may influence results [8]. Added to these concerns is the possibility that repeated questioning and lung function testing could "sensitize" respondents to report respiratory symptoms. The possibility that this factor could be responsible for the steady increase in prevalence cannot be excluded.

Table 2. – Comparisons of prevalence rates for symptoms and medication used in all subjects in the longitudinal and cross-sectional studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Longitudinal (Dunedin)</th>
<th>Cross-sectional (NZRHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence %</td>
<td>95% CI</td>
</tr>
<tr>
<td>1. Wheezing in the last 12 months</td>
<td>32</td>
<td>29–35</td>
</tr>
<tr>
<td>2. Woken by chest tightness</td>
<td>20</td>
<td>17–22</td>
</tr>
<tr>
<td>3. Woken with breathlessness</td>
<td>8</td>
<td>6–10</td>
</tr>
<tr>
<td>5. Attacks of asthma</td>
<td>10</td>
<td>8–12</td>
</tr>
<tr>
<td>6. Asthma medicines</td>
<td>10</td>
<td>9–12</td>
</tr>
<tr>
<td>7. Asthma (any positive response to Questions 3, 5 or 6)</td>
<td>15</td>
<td>12–17</td>
</tr>
</tbody>
</table>

95% CI: 95% confidence interval; NZRHS: New Zealand Respiratory Health Study.
rates of respiratory symptoms with increasing age of the subjects in the Dunedin study, led us to examine the validity of the longitudinal study prevalence data by a direct comparison with another study.

Very little reduction in number of subjects had occurred in the longitudinal study, with 946 of 1,020 living subjects available at 21 yrs of age (93%). Of the 74 non-responders in the longitudinal study, 32 had been seen at 18 yrs of age, of whom 11 had reported respiratory symptoms (34%), a very similar figure to the current prevalence rate at 21 yrs of age, suggesting minimal nonresponse bias. The response rate of the cross-sectional study was lower, which might have been expected to produce falsely higher prevalence rates if, as is usual, nonresponders have fewer symptoms. No information is available for nonresponders to the NZRHS questionnaire. The cross-sectional study was conducted by postal questionnaire, whilst the longitudinal study was conducted at a study centre, but both questionnaires were self-completed without guidance from research personnel.

Poor recall of respiratory symptoms, especially those that occur infrequently or cause little disability, might be a significant source of error in determining true prevalence rates [16]. By confining questionnaires to symptoms within the last 12 months, problems of recall are reduced but not eliminated. Peat et al. [17] examined the reliability of a childhood respiratory history questionnaire by having the parent self-complete the questionnaire, and then having a nurse readminister the questionnaire 3 months later. While prevalence rates overall did not change, there was considerable change from symptom-positive to symptom-negative status and vice versa [17]. One might expect events associated with something tangible (e.g. prescription or use of medication) to be more readily recalled than minor symptoms not requiring any intervention. In our comparison of cross-sectional and longitudinal studies, there was no disparity between the similarity of responses regarding medication use and symptoms.

The similarity between prevalence rates in each of the four centres making up the NZRHS study and the Dunedin prevalence rates suggests substantial uniformity of prevalence across the country, giving greater confidence in our finding that the longitudinal study data were not biased by our methodology.

In conclusion, we took the opportunity to compare prevalence rates for asthma, wheeze and other respiratory symptoms and medication use obtained in the seventh survey of a longitudinal study with those obtained in a single cross-sectional study in similar populations of young adults. The self-reported prevalence rates for these conditions in young adults using these two methods were not significantly different for any diagnosis or symptom, suggesting that the longitudinal study methodology itself did not introduce bias to the study. These findings are consistent with the few previous studies examining the possibility of bias from longitudinal studies of respiratory conditions [7, 8].

References