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Self-reported prevalence of asthma symptoms in children in Australia, England, Germany and New Zealand: an international comparison using the ISAAC protocol

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ABSTRACT: There is a need for a standardized approach to international and regional comparisons of the prevalence and severity of asthma, and for the monitoring of asthma morbidity over time.

In 1991, standardized written and video questionnaires were developed and administered in surveys of schoolchildren, aged 12–15 yrs, in five regions in four countries: Adelaide, Australia (n=1,428); Sydney, Australia (n=1519); West Sussex, England (n=2,097); Bochum, Germany (n=1928); and Wellington, New Zealand (n=1863).

The self-reported prevalence of wheezing during the previous 12 months was similar in West Sussex (29% using the written questionnaire and 30% using the video questionnaire), Wellington (28 and 36%), Adelaide (29 and 37%), and Sydney (30 and 40%), but was lower in Bochum (20 and 27%). The one year prevalence of severe wheezing limiting speech was greater in Wellington (11%), Adelaide (10%) and Sydney (13%), than in West Sussex (7%) and Bochum (6%). The self-reported one year prevalences of frequent attacks, frequent nocturnal wheezing, and doctor diagnosed asthma, were also higher in the Australasian centres than in the European centres.

We conclude, that an international comparison of asthma symptom prevalence in childhood, using simple standardized instruments, is feasible. Possible explanations for the differences in reported asthma severity between the Australasian and European centres include differences in exposure to risk factors and differences in the management of asthma.

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Recent increases in asthma mortality, morbidity and prevalence in some countries indicate the need for a standardized approach to international and regional comparisons of asthma prevalence and severity. However, international comparisons have been hampered by differences in methods and diagnostic criteria, and there have so far been relatively few attempts to compare asthma prevalence using the same methods in different countries [1–3]. However, an international survey of asthma prevalence in adults [4] is now well-advanced, and an International Study of Asthma and Allergies in Childhood (ISAAC) is also under way [5].

A problem with such international comparisons is that there may be cultural or language differences between the countries being compared. Although the presence of bronchial hyperresponsiveness (BHR) has been used in working definitions of current asthma [6], symptoms remain the cornerstone of large-scale epidemiological surveys of asthma in children [7]. Standard written questionnaires have previously been the principal instrument for measuring asthma prevalence in community surveys, and in homogeneous populations these have been standardized, validated, and shown to be reproducible. However, in studies of populations speaking different languages, and from different cultural backgrounds, standard written questionnaires may have greater problems of validity. This problem has been experienced in studies of the Tokelauan community in New Zealand [8], in the translation into German of the International Union Against Tuberculosis and Lung Disease (IUATLD) questionnaire [9] (since there is no colloquial term for "wheezing" in the German language), and in a recent study in a French-speaking population [10].

In response to these translation problems, a video questionnaire involving the audiovisual presentation of clinical signs and symptoms of asthma has been developed [11, 12], in an attempt to minimize these difficulties of comparability of information in large surveys amongst diverse populations. In particular, the video questionnaire was developed to avoid problems of translation

and comprehension of terms such as "wheeze" or "whistling in the chest", and their use in culturally heterogeneous populations [13]. In addition, other research groups have been involved in the development of a simple standardized written questionnaire for measuring asthma prevalence in childhood *e.g.* [1, 2, 14, 15]. These questionnaires have now been adapted for use in phase I of the ISAAC study [5], which is designed to obtain an overview of the international distribution of the prevalence and severity of asthma and allergies in childhood, and to generate hypotheses for testing in phase II, which will include assessments of BHR and atopy.

We report the results of a preliminary study using the ISAAC video questionnaire and the ISAAC written questionnaire in surveys in teenage children, in five centres in four countries. The study was conducted to compare the responses between the video and written questionnaires, and to assess the feasibility of their use cross-culturally, as well as to obtain some preliminary information on international differences in the prevalence of asthma symptoms in children. In the latter context, one reason for selecting these countries for comparison is that during the past decade, asthma mortality and hospital admission rates have been relatively high in Australia and New Zealand, and lower in England and Germany [2, 16].

Methods

Written questionnaire

The ISAAC written questionnaire is based on questions drawn from the IUATLD Questionnaire [9], and surveys conducted in London [14], Melbourne [15], and Auckland [1]. The questionnaire concentrates on wheezing during the previous 12 months, and includes questions on the frequency of attacks, sleep disturbance, and wheezing severe enough to limit speech.

Video questionnaire

A pilot video questionnaire (AVQ1.0) was tested in 1989 [11], and a second version (AVQ2.0) was developed in 1990 [12] and subsequently adapted for the ISAAC study. The questionnaire involves five sequences of asthma symptoms in young persons. After each sequence, participants are asked to specify whether their breathing had ever been like that of the person in the video; if so, they are asked further nested questions as to whether this had occurred in the last year, and one or more times a month. In a validation exercise, the video questionnaire was found to be as sensitive and specific for predicting BHR, and was substantially more repeatable than the IUATLD questionnaire [12].

Data collection and analysis

The study was conducted in Bochum (Germany), West Sussex (England), Wellington (New Zealand), Adelaide (Australia), and Sydney (Australia). The Bochum survey involved all seventh and eighth year students in 13 schools, chosen at random from the 38 schools in the area. The West Sussex survey involved state secondary schools from the county of West Sussex, a relatively rural health district, 30 miles south of London; 12 of the 16 schools agreed to take part. The Wellington survey involved all third form students at 13 secondary schools chosen at random from the state secondary schools in the Wellington area, excluding two state secondary schools which had been involved in a previous study involving the video questionnaire; all of the 13 secondary schools agreed to take part. The Adelaide survey involved secondary schools chosen at random from those in Northern and Western Adelaide; 10 of the 11 schools selected agreed to participate. The Sydney survey involved all six secondary schools in the area of Campbelltown in South Western Sydney. In each centre, about 50% of the participating students were male, with the exception of Sydney where 40% were male.

In each centre, about 50% of the children completed the written questionnaire first, with the exception of Sydney, where 61% of students completed the video questionnaire first. Some students (1–5%) apparently had problems with the nested questions in the video questionnaire and, for example, answered "yes" to "one or more times a month" but "no" to "in the last year"; in the data analysis, any student who answered "yes" to a subcategory (*e.g.* "one or more times a month") was recoded as "yes" for the more general categories (*e.g.* "in the last year" and "ever in your life"). Respondents who were outside of the 12–15 yr age range, and those who did not answer one of the stem questions ("wheezing ever" in the written questionnaire, or "symptoms ever" for any of the five video sequences) were excluded from the analysis.

All data were analysed using PC SAS [17]; logistic regression was used in multivariate analyses, simultaneously controlling for centre, age, gender, and order of administration of questionnaires (logistic regression is the appropriate method of analysis for data of this type, since the prevalence odds ratio is the main effect measure of interest [18]).

Results

Response rates of approximately 90% were obtained in all five centres (table 1). Approximately 50% of the respondents were female; Bochum (53%), West Sussex (53%), Wellington (48%) and Adelaide (46%), whereas 59% of respondents were female in Sydney.

Prevalence

Using the written questionnaire (table 2), the self-reported one year prevalence of wheezing was similar in Wellington (28%), Adelaide (29%), Sydney (30%), and West Sussex (29%), but relatively low in Bochum (20%).

Different estimates of one year prevalence of wheezing were obtained from the video questionnaire, depending

Table 1. – Study populations and response rates

	Germany	England	New Zealand	Australia	
				Adelaide	Sydney
Area surveyed	Bochum	West Sussex	Wellington	Adelaide	Cambelltown NSW
Month of data collection (in 1991)	June–July	May–June	June	November	August
Schools n	13	12	13	10	6
Responders n (%)	2050 (93)	2170 (92)	1901 (87)	1592 (86)	1646 (88)
Exclusions n					
Invalid or missing age	83	9	6	79	29
Missing data for stem questions	39	64	32	85	98
Included in analysis n	1928	2097	1863	1428	1519

Table 2. – Self-reported prevalence of asthma symptoms: findings from the written questionnaire

Question	Bochum		West Sussex		Wellington		Adelaide		Sydney	
	%	n	%	n	%	n	%	n	%	n
Wheeze ever	33	630	48	1009	44	820	40	576	45	681
Wheeze in past year	20	384	29	610	28	527	29	413	30	463
Attacks of wheezing in past year*										
None	80	1540	73	1526	75	1392	74	1054	-	
1–3	16	316	20	425	17	319	15	209	-	
4–12	3	57	5	98	5	92	7	93	-	
>12	1	15	2	48	3	60	5	72	-	
Sleep disturbed by wheezing in past year										
Never	94	1809	91	1908	88	1647	86	1222	86	1302
<1 per week	4	75	7	145	8	145	10	137	10	158
1+ per week	2	44	2	44	4	71	5	69	4	59
Severe attack of wheezing limiting speech in past year										
	6	111	7	138	11	196	10	142	13	191

*: This question was not included in the Sydney survey.

on whether wheezing was defined as a positive response to the first video sequence (wheezing while at rest), or as a positive response to any of the three video sequences of wheezing (table 3). Using the latter definition, the self-reported one year prevalence of wheezing was, once again, similar in Wellington (36%), Adelaide (37%) and Sydney (40%), but there was less evidence of differences between West Sussex (30%) and Bochum (27%).

In general, the combination of three video sequences of wheezing yielded one year prevalence estimates that were about one-third higher than those obtained with the general written question on wheezing. The exception was West Sussex, where similar prevalence estimates were obtained with the written questionnaire (29%) and the video questionnaire (30%).

Severity

On the other hand, the findings for symptoms of severe asthma were more consistent between the written and video questionnaires (tables 2 and 3). In both instances, the reported one year prevalence of severe attacks was greater in Wellington (11% with the written questionnaire, 15% with the video questionnaire), Adelaide (10 and 17%) and Sydney (13 and 17%), than in West Sussex (7 and 9%) and Bochum (6 and 4%).

The video questionnaire also included questions on doctor-diagnosed "asthma" (not shown in tables). This was particularly frequent in Sydney (26%) and Adelaide (22%), intermediate in Wellington (18%) and West Sussex (15%), and low in Bochum (4%).

Subgroup analyses

One-year prevalence of wheezing was also estimated in various subgroups, in order to examine the consistency of the international patterns, and to assess possible sources of bias. Table 4 shows the one year prevalence findings stratified by age, gender, and order of administration of questionnaires. Wheezing in the previous 12

months was slightly more common in females than in males in all five centres, but the difference was larger in West Sussex and Wellington when using the video questionnaire. Perhaps the most interesting feature of the table is that the prevalence estimates from the written questionnaire in Bochum were larger when the video questionnaire had been administered first, whereas there was little evidence in other centres of systematic differences in the findings depending on the order of administration of the questionnaires.

Concordance of the written and video questionnaires

Table 5 shows the concordance between the written and video questionnaires. In each of the five centres,

Table 3. – Self reported prevalence of asthma symptoms: findings from the video questionnaire

Question	Bochum		West Sussex		Wellington		Adelaide		Sydney	
	%	n	%	n	%	n	%	n	%	n
1. Wheezing (while at rest)										
Ever	11	208	18	380	28	526	30	431	28	423
In last year	9	166	11	236	20	370	23	322	21	319
Once or more/month	3	64	4	73	8	152	11	155	11	167
2. Wheezing after exercise										
Ever	26	502	33	694	38	698	37	523	41	625
In last year	22	423	26	536	29	538	30	422	35	531
Once or more/month	10	193	9	181	13	249	16	225	18	275
3. Waking with wheezing										
Ever	9	182	13	263	19	355	21	294	21	324
In last year	7	134	7	154	12	223	15	209	17	260
Once or more/month	3	50	3	52	5	85	7	96	8	121
Any wheezing (any of questions 1–3)										
Ever	32	625	40	833	47	876	45	639	48	722
In last year	27	526	30	637	36	671	37	522	40	614
Once or more/month	12	240	10	218	17	318	19	273	22	334
4. Waking with cough										
Ever	31	603	36	751	34	636	27	384	38	571
In last year	24	466	24	509	23	431	20	283	29	437
Once or more/month	7	134	4	87	7	135	8	109	9	143
5. Severe attack										
Ever	6	123	13	280	22	409	23	330	23	353
In last year	4	85	9	179	15	283	17	244	17	262
Once or more/month	1	26	3	53	7	121	7	106	8	128

Table 4. – Self-reported one year prevalence of wheezing by age, gender, and order of questionnaires

Wheezing in last year	Bochum		West Sussex		Wellington		Adelaide		Sydney	
	%	n	%	n	%	n	%	n	%	n
Written questionnaire										
Total	20	384	29	610	28	527	29	413	30	463
Age 12–13 yrs	19	145	26	137	29	429	28	182	30	310
14–15 yrs	21	239	30	473	24	98	29	231	31	153
Gender male	18	168	26	252	26	255	26	195	28	174
female	21	216	32	353	30	272	33	213	32	288
Order video first	23	227	29	316	26	242	30	227	31	293
written first	17	157	29	294	30	285	27	186	29	170
Video questionnaire*										
Total	27	526	30	637	36	671	37	522	40	614
Age 12–13 yrs	28	212	28	145	36	532	36	230	41	419
14–15 yrs	27	314	31	492	35	139	37	292	39	195
Gender male	26	234	25	244	30	292	34	258	38	234
female	29	292	35	389	42	379	40	260	42	379
Order video first	30	298	30	317	33	307	38	289	40	369
written first	24	228	31	320	39	364	34	233	42	245

*: For the video questionnaire, wheezing is defined as a positive response to any of the first three video sequences.

Table 5. – Self-reported one year prevalence of wheezing: concordance between the written and video questionnaires

Questionnaire		Bochum		West Sussex		Wellington		Adelaide		Sydney	
Written	Video	%	n	%	n	%	n	%	n	%	n
Yes	Yes	12	226	19	389	22	402	25	364	23	342
Yes	No	8	158	11	221	7	125	3	49	8	121
No	Yes	16	300	12	248	14	269	11	158	18	272
No	No	65	1244	59	1239	57	1067	60	857	52	784
Concordance		76	1470	78	1628	79	1469	85	1221	74	1126

*: For the video questionnaire, wheezing is defined as a positive response to any of the first three video sequences.

Table 6. – Self-reported one year prevalence of asthma symptoms: findings of logistic regression analysis

	Written questionnaire				Video questionnaire*			
	Wheezing		Severe attack		Wheezing		Severe attack	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Bochum+	1.00	-	1.00	-	1.00	-	1.00	-
West Sussex	1.65	1.43–1.91	1.15	0.89–1.49	1.16	1.01–1.33	2.02	1.55–2.64
Wellington	1.59	1.36–1.86	1.87	1.46–2.40	1.52	1.32–1.75	3.96	3.05–5.12
Adelaide	1.66	1.41–1.95	1.80	1.39–2.34	1.57	1.35–1.82	4.57	3.53–5.92
Sydney	1.70	1.45–2.00	2.24	1.74–2.89	1.76	1.52–2.05	4.49	3.45–5.84
Age#	0.98	0.90–1.06	0.93	0.83–1.06	0.99	0.92–1.07	1.01	0.91–1.12
Female+	1.00	-	1.00	-	1.00	-	1.00	-
Male	0.79	0.72–0.86	0.88	0.76–1.03	0.72	0.66–0.79	0.74	0.65–0.85
Written first+	1.00	-	1.00	-	1.00	-	1.00	-
Video first	1.08	0.98–1.19	1.05	0.90–1.21	1.00	0.91–1.09	0.94	0.83–1.08

*: For the video questionnaire, wheezing is defined as a positive response to any of the first three video sequences; +: reference category; #: increase in age by one year in the 12–15 yrs range. OR: odds ratio; 95% CI: 95% confidence interval.

there was a substantial proportion (14–26%) who responded positively to one questionnaire but not the other; most of these responded positively to the video questionnaire rather than the written questionnaire, but this may be because the video questionnaire data is based on positive responses to any of the three wheezing sequences, whereas the written questionnaire involved a single general question. The pattern of discordance was similar in four of the centres, but was different in West Sussex, where a relatively high proportion responded positively to the written questionnaire only.

Multivariate analyses

Table 6 shows the findings of logistic regression analyses of the effects of region, age, gender, and order of questionnaires on the self-reported one year prevalence of wheezing and severe attacks. In general, these findings are similar to those in tables 2–4, but they do permit the assessment of each factor while adjusting for the other factors. When Bochum was taken as the reference centre, all other centres showed significantly increased prevalence odds ratios (with the exception of West Sussex for the category of "severe attacks"). In general, the West Sussex findings were intermediate between the findings for Bochum and the Australasian centres (with the exception of wheezing in the last year in the written questionnaire).

There was little effect of age on the self-reported prevalence. Males had a significantly lower self-reported prevalence than females; overall there was little evidence of marked differences between the written and video questionnaires in this respect.

Finally, the order of administration of the questionnaires had little effect on the responses, although there was a weak (nonsignificant) tendency for the written questionnaire prevalence findings to be slightly higher if the video questionnaire had been shown first.

Discussion

There are obvious limitations to studies of this type, in that information obtained by questionnaire may be subject to recall bias, and the study did not include any "objective" test, such as BHR testing, exercise challenge, or blind review by a panel of respiratory physicians [13]. However, previous work [12] has found that the ISAAC written and video questionnaires have reasonable sensitivity and specificity for BHR in an English-speaking population, and the video questionnaire was specifically developed for use in international comparisons involving different languages and cultural groups.

The surveys were conducted in winter in Sydney and Wellington, and in spring or summer in the other three centres; it is, therefore, possible that seasonal differences may account for some of the differences observed between

the Northern and Southern hemisphere centres. However, the Adelaide survey was conducted in spring, and the findings were similar to those in the other Australasian centres. Furthermore, the New Zealand prevalence findings were similar to those in a previous study, which was conducted in spring (September 1990) using the same video questionnaire and a similar written questionnaire [11]. Thus, it appears unlikely that the high reported prevalence of severe asthma in the Australasian centres was due to the timing of the data collection.

This study differed from previous international comparisons [1–3] in that questionnaires were completed by the children themselves, rather than by parents, and the reported prevalences of wheezing were relatively high in the current study. For example, the reported one year prevalence of wheezing was about 30% in Sussex, Wellington and Sydney using the written questionnaire in the current study, whereas estimates in the range of 10–20% have been obtained in previous surveys involving parental completion of questionnaires [1–3]. This is not unexpected, since occasional minor episodes of wheezing (*e.g.* after exercise) are more likely to be identified by direct interviews than by surrogate interviews; in fact, the self-reported prevalence of wheezing in Wellington was very similar to that in a similar survey in adults during the same time period [19]. The first aim of the current study was to test the feasibility of the ISAAC written and video questionnaires and to compare their responses cross-nationally. It was found that the written and video questionnaires were easily administered in the school setting. The international prevalence patterns did not appear to be markedly affected by the gender or age of the respondents, or the order of administration of the questionnaires.

The absolute level of one year symptom prevalence was different depending on whether wheezing was measured with the written questionnaire, the first question on the video questionnaire, or by grouping all three wheezing questions on the video questionnaire.

For four of the centres (Bochum, Wellington, Adelaide and Sydney), the international patterns were similar whichever measure of symptom prevalence was used; the combination of three video sequences of wheezing yielded one year prevalence estimates which were about one-third higher than those obtained with a general question on wheezing in the written questionnaire. The exception was West Sussex, where similar prevalence estimates were obtained with the written and video questionnaires. These findings raise the possibility that even English-speaking children in this age-group may be unclear about the interpretation of terms such as "wheezing", or may respond differently to the visual context of the video; this emphasizes the importance of employing a variety of standardized approaches in international comparisons, rather than relying on a single method. In fact, there was considerable discordance between the two questionnaires, but the international prevalence patterns were similar (with the exception of West Sussex), and both questionnaires have been found to have reasonable sensitivity and specificity for BHR [12].

A second aim of this study was to gather some initial information on international differences in asthma prevalence in childhood. Although the data are preliminary, the existing findings are nevertheless of interest, since this is the largest international study in children which has been conducted to date.

There were four main findings in the current study.

Firstly, the one year prevalence of wheezing was similar in West Sussex, Wellington, Adelaide, and Sydney when using the written questionnaire, and was also reasonably similar in the four centres when using the video questionnaire (with the possible exception of West Sussex). The finding of similar prevalences in Wellington and Sydney is consistent with the previous work of ASHER *et al.* [1]. The finding of similar prevalences in West Sussex and Wellington is consistent with the previous work of BARRY *et al.* [3] (the latter study did find some differences in wheezing prevalence between Wales and New Zealand, but these were relatively small). This study, therefore, adds to previous evidence that asthma prevalence is not markedly higher in New Zealand and Australia than in other English-speaking countries [1–3].

Secondly, the one-year prevalence of asthma symptoms was lower in Bochum than in the Australasian centres, whichever questionnaire was used. It also appeared to be lower in Bochum than in West Sussex, but there were some inconsistencies between the findings with the written and video questionnaires.

The third finding of this study was that asthma appeared to be more severe in the Australasian than in the European centres. This pattern was found consistently with both the written and video questionnaires, and is consistent with the work of MITCHELL *et al.* [2], who observed that asthma symptoms appeared to be more frequent in children in Auckland than in South West Thames.

Finally, it should be noted that the findings for severe asthma in this study are generally consistent with data on international patterns of asthma mortality in the 5–34 yrs age group [16]. These show that asthma mortality in this age-group has been relatively high in New Zealand and Australia; mortality per 1,000,000 in the 5–14 yrs age group during 1985–1989 was 2.3 in Germany, 3.5 in England and Wales, 6.4 in Australia, and 8.3 in New Zealand (although the New Zealand mortality rate has fallen recently [20], and is now similar to that in England and Wales).

These patterns should be interpreted with considerable caution, since asthma mortality rates are affected by many other factors besides asthma prevalence and severity (for example, in recent decades several asthma mortality epidemics have been attributed to the introduction of particular asthma drugs [21]). Nevertheless, it is of interest that the international patterns found in this study are generally consistent with data on mortality and admission rates, and with the relatively widespread and frequent use of beta-agonists in New Zealand and Australia [22]. This may be a consequence of the higher prevalence of severe or frequent asthma found in this study; on the other hand, the data are also consistent with the hypothesis that regular use of inhaled bronchodilators may itself increase the prevalence of severe asthma [23–25].

In summary, the current study illustrates the feasibility of international comparisons of the prevalence of

asthma symptoms in childhood, using simple standardized instruments. It also illustrates the potential value of such standardized international comparisons in identifying differences and similarities between countries and regions, and thus indicating hypotheses which warrant further study. In particular, possible explanations for the differences in asthma severity between the European and Australasian centres observed in this study, include differences in exposure to risk factors for asthma, and differences in asthma management.

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