

Reproducibility of childhood respiratory symptom questions

B. Brunekreef*, B. Groot**, B. Rijcken***, G. Hoek*, A. Steenbekkers*, A. de Boer*

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ABSTRACT: The reproducibility of answers to childhood respiratory symptom questions was investigated by administering two childhood respiratory symptom questionnaires twice, with a one month interval, to the same population of Dutch school children. The questionnaires were completed by the parents of 410 children from 6-12 yrs old. One questionnaire was developed by the World Health Organization (WHO). The other questionnaire was developed for use by school health services and was based mainly on the American Thoracic Society (ATS) questionnaire for respiratory symptoms in childhood. It was called the Child Health Care (CHC) Questionnaire. Half of the parents received a questionnaire in which the WHO questions came first on both occasions, the other half a questionnaire in which the CHC questionnaire came first on both occasions. The reproducibility of the answers was assessed by calculating Cohen's Kappa, a chance-corrected measure of association.

Questions about "wheeze", "asthma", "bronchitis", "cough and phlegm", and "pneumonia" were found to give good to excellent reproducibility, with Kappa values ranging from 0.60-0.96. Questions about "phlegm", "cough", "chest congestion" and "runny/congested nose" were less satisfactory in this respect, with Kappa values generally well below 0.60. The reproducibility of the answers did not depend on the order in which the questionnaires were administered, on the gender or age of the child, or on the smoking habits or educational level of the parents.

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The repeatability of respiratory symptom questions used in studies among children has received little attention. Commonly, respiratory symptom questionnaires for use in studies among children are administered to the parents or guardians. They can be self-administered or interviewer-administered. Well known childhood respiratory symptom questionnaires are those developed by the American Thoracic Society (ATS) [1] and the World Health Organization (WHO) [2]. The repeatability of these questionnaires has not, so far, been systematically evaluated.

In a study from Australia [3], the repeatability of a respiratory symptom questionnaire was assessed by readministering the questionnaire to a subsample of 67 parents, nine weeks after the initial questionnaire. Cohen's Kappa (a chance-corrected measure of repeatability) [4], was reported to be 0.86 for "wheeze" and 0.81 for "productive cough". Other questions were reported to have Kappa's in the range 0.43-0.80, with questions on wheeze generally being more repeatable than questions on productive cough. In a study from the UK [5], a newly developed respiratory symptom questionnaire for children was administered twice to a subpopulation of 200 parents, with an interval of four months. The subpopulation was selected with an increased preponderance of positive answers to key questions on wheeze, cough and shortness of breath on

the first questionnaire. Of the 200 parents invited, 50% returned the second questionnaire. Kappa's ranged from 0.37 for "breathless in the morning" to 0.78 for "wheeze current 12 months".

The aim of our study was to investigate the repeatability of the answers to symptom questions from two respiratory symptom questionnaires in a study among children living in The Netherlands. As both were derived from questionnaires currently in international use, this will hopefully add some information to what little seems to be available on respiratory symptom questionnaire validation in the literature.

Methods

In 1989, an investigation was carried out in Helmond, a town of about 65,000 inhabitants in the southern part of the Netherlands. Helmond was selected because excellent co-operation already existed with the local school health service. The main purpose of the investigation was to compare responses to two different childhood respiratory symptom questionnaires currently in use in the Netherlands.

All 37 primary schools in the town were asked to participate. Only four refused. All parents of children in classes 3 to 8 were invited to complete a

* Dept of Epidemiology and Public Health, University of Wageningen, Wageningen, The Netherlands.

** Municipal Health Dept, Eindhoven, The Netherlands.

*** Dept of Epidemiology, University of Groningen, The Netherlands.

Correspondence: B Brunekreef
University of Wageningen
Dept Epidemiology and Public Health
P.O. Box 238
6700 AE Wageningen
The Netherlands

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questionnaire. In these classes, children are generally 6–12 yrs old. This age range was selected to facilitate comparison of respiratory symptom prevalences with earlier investigations. Of all parents invited, 3,344 filled out the questionnaire, a response of 73%. All nonresponders were asked their reasons for not participating. Generally, the reasons were nonspecific (no time, not interested, *etc.*). The two questionnaires were administered in randomized order to the parents, to find out whether the answers to one questionnaire would be influenced by whether or not it was preceded by the other one. Results of the full investigation will be published elsewhere.

In a subsample of the population, the questionnaires were readministered after one month to evaluate the reproducibility of the answers. Respondents from four of the schools were asked to fill out the questionnaire again after a one month interval. The schools were chosen on the expectation of a more than average willingness to co-operate on the basis of the response rate to the first questionnaire. Out of 471 parents approached, 410 (87%) filled out the questionnaire again. Questionnaires were distributed through the schools on both occasions, and children were asked to bring the completed questionnaires back to school. The initial questionnaire was administered in February 1989.

Two questionnaires were evaluated. One was the WHO questionnaire for respiratory symptoms in childhood [2], with slight modifications such as the separation of bronchitis and pneumonia over two questions instead of one. The other was a questionnaire that was more recently developed for use in investigations by community youth health services in The Netherlands. It was inspired partly by the ATS questionnaire for childhood respiratory symptoms, and partly by the well known Medical Research Council (MRC) questionnaire. It will be referred to as the "Child Health Care Questionnaire" or "CHC Questionnaire" in the remainder of this paper. About half of the population received a questionnaire in which the WHO questions were asked first, the other half a questionnaire in which the CHC questionnaire came first. The distribution of the two questionnaires over the study population was strictly random. The parents participating in the reproducibility study were given the questionnaires in the same order as on the first occasion. An exact translation of the questions is available from the authors.

The data were analysed by cross-tabulation. Questions 13, 16 and 28 were dichotomized before analysis, answers of one or more being recoded to "positive". The agreement was calculated, indicating the proportion of respondents giving the same answer to the same question on both occasions. Cohen's Kappa was also calculated. As indicated in the introduction, this is a chance-corrected measure of agreement between the two answers. For interpretation of Kappa values, LANDIS and KOCH [6] have suggested that Kappa values of <0.4 indicate relatively poor agreement, values of 0.4–0.6 indicate moderate

agreement, 0.6–0.8 good agreement, and 0.8–1.0 excellent agreement.

As Cohen's Kappa is sensitive to the symptom prevalence to some extent, and also to asymmetrical imbalance in marginal totals, it has been recommended to calculate indices for average positive and negative agreement as well [7, 8]. The index for average positive agreement is equal to twice the number of positive agreements divided by the total number of positive answers on both occasions. The index for average negative agreement is equal to twice the number of negative agreements divided by the total number of negative answers on both occasions. However, for the data at hand, the index for average positive agreement was higher by a few percentage points at most than Kappa, and the index for average negative agreement was virtually equal to the over-all agreement, so that it was decided not to present these indices for our data.

Results

The age and gender distribution of the children participating in the repeatability study was equal to the age and gender distribution of the whole study population. Of the children participating in the repeatability study, 53% had one or two smoking parents, compared to 53% of the whole study population. The educational level of the parents of children in the repeatability study was somewhat higher. Table 1 shows the prevalence of reported respiratory symptoms for the children in the repeatability study and for the whole study population. For most symptoms, the prevalence was somewhat lower in the children participating in the repeatability study. Table 1 also shows the prevalence of respiratory symptoms for the 61 children who did not respond to the second questionnaire. There were no clear differences between the responders and the nonresponders to the second questionnaire in terms of prevalence of respiratory symptoms reported on the first questionnaire.

Table 2 shows the results of the repeatability analysis for the childhood respiratory symptom questions that were investigated. Except for "runny nose", the agreement was >0.90 because for most symptoms the prevalence was <10%. The proportionate agreement was mostly determined by those negating symptoms on both occasions. The Kappa statistic was low for some questions on cough, chest congestion and phlegm from the CHC questionnaire. Reproducibility was only moderate for questions on cough and a runny nose from the WHO questionnaire, and for some questions on cough, shortness of breath and a runny nose from the CHC questionnaire. Reproducibility was generally good to excellent for all questions on shortness of breath, wheeze, attacks of shortness of breath, asthma, bronchitis and pneumonia from the WHO questionnaire, and for the questions on "cough and phlegm", wheeze, asthma, and most questions on shortness of breath from the CHC questionnaire.

Table 1. - Prevalence of respiratory symptoms in complete study population (n=3,344), in participants in the repeatability study (n=411) and in nonrespondents of the repeatability study (n=61)

Question no.	Symptom description	Prevalence n=3,344	Prevalence n=411	Prevalence n=61
World Health Organization Questionnaire				
1	Morning cough	9.4	5.5	8.3
2	Day/night cough	18.9	13.2	18.6
3	Chronic cough	4.7	1.0	5.0
4	Ever shortness of breath	8.0	6.9	6.6
5	<i>idem</i> last 12 months	5.9	5.7	4.9
6	Ever wheeze	17.9	16.1	18.0
7	<i>idem</i> , last 12 months	10.0	10.5	8.3
8	Ever attacks of shortness of breath with wheeze	10.2	9.0	11.5
9	<i>idem</i> , last 12 months	5.9	5.1	6.6
10	Ever runny/congested nose	16.5	16.5	18.3
11	<i>idem</i> , last 12 months	5.4	4.2	10.0
12	Doctor diagnosed asthma	4.0	2.7	3.3
13	Asthma attacks last year	2.4	1.2	3.2
14	Asthma medication	1.8	0.7	1.7
15	Doctor diagnosed bronchitis	17.9	15.4	15.3
16	Bronchitis last year	7.4	5.4	8.2
17	Doctor diagnosed pneumonia	5.5	6.1	6.7
18	Pneumonia last year	1.4	0.7	1.6
Child Health Care Questionnaire				
19	Cough usually	6.6	3.7	6.7
20	Cough 3 months	2.2	0.7	0.0
21	Chest congestion	2.7	0.7	1.7
22	Chest congestion 3 months	1.0	0.2	0.0
23	Phlegm	2.0	1.0	1.7
24	Phlegm 3 months	0.8	0.0	1.7
25	Cough and phlegm	10.2	8.1	6.6
26	Cough and phlegm >3 weeks	2.1	1.2	1.6
27	Wheeze last 12 months	10.9	11.2	10.0
28	Asthma attacks last 12 months	4.2	2.9	1.6
29	Shortness of breath	9.7	7.6	11.7
30	Unusual shortness of breath	5.3	3.9	5.0
31	Shortness of breath when playing	7.1	5.6	6.8
32	Shortness of breath when walking on level ground	2.5	1.7	0.0
33	Congested or runny nose	22.8	21.2	21.7
34	Congested or runny nose for 3 months	4.4	3.7	5.0

As it could be argued that some of the imperfect reproducibility for the childhood questions could be due to a different parent or guardian completing the questionnaire on the second occasion, a further analysis was restricted to those questionnaires completed by the same individual on both occasions. This was the case for 345 children. Kappa values were generally somewhat higher in this group than in the population as a whole, but differences were not large. Except for some questions on "cough" and "runny nose", the reported prevalence of symptoms on the two occasions was comparable.

As two different questionnaires were evaluated, it could be argued that the order in which they were administered could have influenced the results of the repeatability analysis. Table 3 shows the separate Kappa values for the two different questionnaires. There was no indication that the Kappa values depended on the order of administration of the questionnaires. A similar analysis indicated that the gender and age of the children, the smoking habits and the educational level of the parents had no effect on the Kappa values either (results not shown).

Table 2. - Agreement between answers to childhood respiratory symptom questions asked twice over a one month period to the parents of a population of 411 Dutch children from 6-12 yrs old

Question no.	Symptoms description	Missing values*	Numbers in category**				Prevalence		PA†	Kappa	95% CI Kappa
			++	+-	-+	--	1st	2nd			
World Health Organization Questionnaire											
1	Morning cough	16	12	10	6	367	5.6	4.6	0.96	0.58	0.48-0.68
2	Day/night cough	14	25	27	14	331	13.1	9.8	0.90	0.49	0.40-0.59
3	Chronic cough	13	1	3	2	392	1.0	0.8	0.99	0.28	0.18-0.38
4	Ever shortness of breath	7	18	10	10	366	6.9	6.9	0.95	0.62	0.52-0.71
5	<i>idem</i> , last 12 months	8	13	8	8	374	5.2	5.2	0.96	0.60	0.50-0.70
6	Ever wheeze	3	51	15	11	331	16.2	15.2	0.94	0.76	0.66-0.86
7	<i>idem</i> , last 12 months	5	31	11	4	360	10.3	8.6	0.96	0.78	0.69-0.88
8	Ever attacks of shortness of breath with wheeze	1	27	10	9	364	9.0	8.8	0.95	0.71	0.62-0.81
9	<i>idem</i> , last 12 months	1	16	5	5	384	5.1	5.1	0.98	0.75	0.65-0.85
10	Ever runny/congested nose	4	39	28	17	323	16.5	13.8	0.89	0.57	0.47-0.67
11	<i>idem</i> , last 12 months	5	8	9	9	380	4.2	4.2	0.96	0.45	0.35-0.54
12	Doctor diagnosed asthma	3	8	3	2	395	2.7	2.5	0.99	0.76	0.66-0.85
13	Asthma attacks last year	4	4	1	3	399	1.2	1.7	0.99	0.66	0.57-0.76
14	Asthma medication	4	2	1	1	403	0.7	0.7	1.00	0.66	0.57-0.76
15	Doctor diagnosed bronchitis	3	53	10	9	338	15.4	15.2	0.95	0.82	0.72-0.92
16	Bronchitis last year	3	16	6	6	380	5.4	5.4	0.97	0.71	0.61-0.81
17	Doctor diagnosed pneumonia	1	22	3	2	383	6.1	5.9	0.99	0.89	0.79-0.99
18	Pneumonia last year	2	2	1	1	405	0.7	0.7	1.00	0.66	0.57-0.76
Child Health Care Questionnaire											
19	Cough usually	4	4	11	8	384	3.7	2.9	0.95	0.27	0.18-0.37
20	Cough 3 months	4	1	2	0	404	0.7	0.2	1.00	0.50	0.41-0.58
21	Chest congestion	4	2	1	6	398	0.7	2.0	0.98	0.36	0.27-0.44
22	Chest congestion 3 months	4	1	0	1	405	0.2	0.5	1.00	0.67	0.57-0.76
23	Phlegm	3	0	4	3	401	1.0	0.7	0.98	-††	
24	Phlegm 3 months	3	0	0	1	407	0.0	0.2	1.0	-	
25	Cough and phlegm	3	24	9	9	366	8.1	8.1	0.96	0.70	0.61-0.80
26	Cough and phlegm >3 weeks	4	3	1	1	402	1.0	1.0	1.00	0.75	0.65-0.84
27	Wheeze last 12 months	3	32	14	6	356	11.3	9.3	0.95	0.73	0.64-0.83
28	Asthma attacks last 12 months	3	11	1	0	396	2.9	2.7	1.00	0.96	0.86-1.05
29	Shortness of breath	2	25	6	9	369	7.6	8.3	0.96	0.75	0.65-0.85
30	Unusual shortness of breath	4	15	1	3	388	3.9	4.4	0.99	0.88	0.78-0.97
31	Shortness of breath when playing	3	14	9	8	377	5.6	5.4	0.96	0.60	0.50-0.70
32	Shortness of breath when walking on level ground	6	3	4	4	394	1.7	1.7	0.98	0.42	0.32-0.52
33	Congested or runny nose	7	50	36	20	298	21.3	17.3	0.86	0.56	0.46-0.65
34	Congested or runny nose for 3 months	10	7	8	2	384	3.7	2.2	0.98	0.57	0.48-0.67

*: missing on one or both occasions; **: ++ positive on both occasions; +- positive on first occasion only; -+ positive on second occasion only; -- negative on both occasions; †: PA= proportionate agreement, sum of ++ and -- divided by total non-missing; ††: Kappa not calculated when there were no subjects reported to be symptomatic on both occasions. CI: confidence interval.

Table 3. – Agreement between answers to symptom questions asked twice over a one month period to the parents of a population of 411 Dutch children from 6–12 yrs old

Question no.	Symptom description	Full population	WHO list first	Child list first
World Health Organization				
1	Morning cough	0.58	0.69	0.49
2	Day/night cough	0.49	0.36	0.57
3	Chronic cough	0.28	—*	0.66
4	Ever shortness of breath	0.62	0.59	0.64
5	<i>idem</i> last 12 months	0.60	0.58	0.61
6	Ever wheeze	0.76	0.83	0.67
7	<i>idem</i> , last months	0.78	0.75	0.83
8	Ever attacks of shortness of breath	0.71	0.69	0.74
9	<i>idem</i> , last 12 months	0.75	0.74	0.75
10	Ever runny/congested nose	0.57	0.57	0.57
11	<i>idem</i> , last 12 months	0.45	0.45	0.43
12	Doctor diagnosed asthma	0.76	0.80	0.74
13	Asthma attacks last year	0.66	1.00	0.59
14	Asthma medication	0.66	1.00	0.49
15	Doctor diagnosed bronchitis	0.82	0.86	0.78
16	Doctor diagnosed bronchitis	0.71	0.77	0.67
17	Doctor diagnosed pneumonia	0.89	0.94	0.86
18	Pneumonia last year	0.66	1.00	0.49
Child Health Care Questionnaire				
19	Cough usually	0.27	0.38	0.14
20	Cough 3 months	0.50	—	1.0
21	Chest congestion	0.36	—	0.66
22	Chest congestion 3 months	0.67	—	1.0
23	Phlegm	—	—	—
24	Phlegm 3 months	0.00	—	—
25	Cough and phlegm	0.70	0.80	0.63
26	Cough and phlegm >3 weeks	0.75	0.80	0.66
27	Wheeze last 12 months	0.73	0.77	0.69
28	Asthma attacks last 12 months	0.96	1.00	0.94
29	Shortness of breath	0.75	0.71	0.78
30	Unusual shortness of breath	0.88	0.66	1.0
31	Shortness of breath when playing	0.60	0.55	0.65
32	Shortness of breath when walking on level ground	0.42	—	0.53
33	Congested or runny nose	0.56	0.45	0.63
34	Congested or runny nose for 3 months	0.57	0.53	0.60

*: Kappa not calculated when there were no subjects reported to be symptomatic on both occasions. WHO: World Health Organization.

Discussion

The results of this study show that for most childhood respiratory symptom questions, reproducibility was adequate as judged by Kappa values >0.60 . The results also show, however, that there is a certain amount of short-term variability in the answers, that is presumably not related to true changes in symptom status, as questions usually relate to periods of 12 months or more in the past. The reproducibility of the questions on "cough", "phlegm", "chest congestion" and "runny/congested nose" was lower than the reproducibility of most other questions with Kappa values generally well below 0.60. The reporting of cough, phlegm, chest congestion and a runny nose may have been influenced by recent colds. For some symptoms like phlegm, the prevalence was so low that the number of positive responses was 0 or 1. It could be argued that for these questions, the sample size was not large enough to obtain meaningful results. The WHO cough questions had more missing data than the other questions. Possibly, these questions were less easily understood than other questions.

The reported prevalence of most symptoms was small ($<10\%$), so that the Kappa values can be readily compared between symptoms. Also, our study population was not much different, in terms of respiratory symptom prevalence, from the source population, so that the Kappa values are considered to be valid for other populations with similar respiratory symptom prevalences as well.

Our results can, to some extent, be compared to those obtained by CLIFFORD *et al.* [5] in the UK. For "morning cough", these authors found a Kappa of 0.47, for "shortness of breath in current 12 months" a Kappa of 0.60, and for "wheeze in current 12 months" a Kappa of 0.78. In our study, we also found for these three questions, the highest Kappa for the two questions on "wheeze in last 12 months" (0.73 and 0.78), followed by the two questions on "shortness of breath in the last 12 months" (0.60 and 0.75) and the question on "morning cough" (0.58). The exact wording of the questions used by CLIFFORD *et al.* [5] was not given in their paper, so that a complete comparison is not possible. Also, the results of this study are somewhat difficult to interpret because of the selection that was made (*cf.* Introduction). The Kappa statistic has been shown to depend to some extent on the prevalence of the investigated characteristic in the study population [9], and it has been recommended that the repeatability of the characteristic of interest should be studied in populations where the distribution of this characteristic is similar to that of populations in which the measurement technique will be applied. However, despite the different ways in which the study populations were selected, the Kappa values obtained for comparable questions were remarkably similar to the ones found in our study.

When the analysis was restricted to those children for whom the same parent completed the questionnaire on both occasions, Kappa's were somewhat higher than in the group as a whole, but the difference was not striking. Apparently, inconsistencies in reporting from the first occasion to the second were only to a limited extent caused by a different parent or guardian answering the questionnaire.

Childhood respiratory symptom questionnaires are widely used instruments for measuring symptom prevalence in studies relating respiratory symptoms to exposure variables such as air pollution or environmental tobacco smoke. The results of this study show that the repeatability of the answers is acceptable for most questions, as judged by the criteria suggested by LANDIS and KOCH [6]. However, the repeatability is not complete for any question, and it varies from question to question. As a consequence, the power of epidemiological studies to detect differences in symptom prevalence between populations, and to detect significant relationships between exposure variables and respiratory symptoms is to some extent diminished, which should be taken into account when decisions on sample size are being made in the planning phase of a study.

In conclusion, this study shows that for most of the childhood respiratory symptom questions used, the reproducibility was adequate, judged by the Kappa values. Reproducibility improved only marginally when the analysis was restricted to questionnaires completed on both occasions by the same respondent.

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