Original Article

Determining the score and cut-off point that would identify asthmatic adults in epidemiological studies using the asthma module of the International Study of Asthma and Allergies in Childhood questionnaire*

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ABSTRACT

Objective: To validate, for use in asthma prevalence studies, the asthma module of the standardized written questionnaire developed for use in the International Study of Asthma and Allergies in Childhood, establishing the score and cut-off point that would identify asthmatic adults. **Methods:** We interviewed 78 adult outpatients (40 adult asthmatics and 38 age-matched and gender-matched controls) using the asthma module of the International Study of Asthma and Allergies in Childhood questionnaire, which is composed of questions related to eight dichotomous features of asthma. We determined the score and cut-off point required to accurately identify asthmatic adults, calculating sensitivity, specificity and Youden index. The method was validated against the clinical and functional diagnosis of asthma. The reproducibility of individual questions was evaluated by conducting second interviews with half of the patients some weeks later. **Results:** The score ranged from 0 to 14 points. A score = 5 allowed patients with asthma to be distinguished from those without (sensitivity = 93%; specificity = 100%; Youden index = 0.93). Most questions presented satisfactory reproducibility in the second interviews conducted after 48.2 ± 11.1 days (kappa and weighted kappa ranging from 0.43 to 1.00 for individual questions). **Conclusion:** For studies of adult asthma prevalence, the determination/validation of a cut-off point allows an alternative interpretation of the information gathered through the application of the asthma module of the International Study of Asthma and Allergies in Childhood, taking into account the totality of the data rather than responses to individual questions.

Keywords: Asthma/diagnosis; Asthma/epidemiology; International cooperation; Questionnaires

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INTRODUCTION

Written respiratory symptom questionnaires designed to determine the prevalence of asthma in a population have been widely used in epidemiological studies. Among the most comprehensive population studies for the comparison of the prevalence of asthma are the International Study of Asthma and Allergies in Childhood (ISAAC),[1] in which standardized methods for studies involving children and adolescents were established, and the European Community Respiratory Health Survey,[2] which was designed for epidemiological investigation of young adults (from 20 to 44 years of age). Both studies were inaugurated in the 1990s. In Brazil, the ISAAC questionnaire was translated and validated, after which the ISAAC protocol was applied in some areas, providing the first comparative results for children and adolescents.[3] However, there is no comparative epidemiological data available for the adult Brazilian population.

In most such studies, the prevalence or the sensitivity and specificity of the symptoms corresponding to individual questions are taken into consideration, and the questionnaire is not interpreted as a whole. Therefore, no scoring system has been established. In 1998, Solé et al. proposed the use of a scoring system with a cut-off point and validated the asthma module of the ISAAC questionnaire for the identification of children and adolescents with asthma, assuming clinical diagnosis to be the gold standard.[4]

The objective of this study was to validate a method of constructing a scoring system for the asthma module of the standardized written ISAAC questionnaire, in counterpoint to the clinical and functional diagnosis and proposing a cut-off point that would enable us to identify adults with asthma.

METHODS

We interviewed asthma and control outpatients using the translated (Portuguese) version of the asthma module of the ISAAC questionnaire (Annex 1). We calculated the overall score for each individual and the cut-off point. We randomly selected half of the participants of each group and submitted those selected to second interviews, conducted some time after the first, in order to calculate the reproducibility of the instrument.

We evaluated 78 University of São Paulo School of Medicine Hospital das Clínicas outpatients: 40 randomly selected Pulmonology Clinic asthma patients; and 38 Medical Clinic patients (controls). Controls were matched to study subjects in terms of gender and age (± 2 years). Patients reporting a history of or treatment for cardiorespiratory or allergic diseases (asthma or eczema or rhinitis) were excluded. Smokers or former smokers for more than 10 pack-years were also excluded.

Asthma patients were defined based on their clinical and functional diagnosis, and disease severity was classified in accordance with the criterion recommended by the Global Initiative for Asthma.[5]

Originally written in English, the standardized ISAAC questionnaire was translated into Portuguese by a pediatric pulmonologist (Dr. Renato T. Stein). The suitability of the translation was confirmed in a pilot study involving a group of schoolchildren or their legal guardians. Back-translating the questionnaire to English resulted in few modifications of the original version. Using this version, Solé et al., in their validation study, found a relatively low frequency of positive responses to the question "Have you ever suffered from asthma?" among the patients with physician-diagnosed asthma.[4] This suggested that the term "asthma" was not accepted by various individuals, perhaps because of the incapacitating or incurable nature of the disease, or even because of difficulty in understanding the intermittent and variable manifestations of the disease. In our local culture, asthma patients often use the term "bronchitis" to describe their condition. Therefore, in this study, question 6 was adapted to include the term "bronchitis" ("Have you ever suffered from asthma or bronchitis?"), in order to minimize potential problems related to a lack of patient understanding or acceptance of the term "asthma".

Each of the questions in the questionnaire was assigned a score ranging from zero to two based on the clinical opinion of 20 specialists, including pulmonologists, allergists and general clinicians (all experienced in treating asthma), regarding the importance of the information for the clinical diagnosis of asthma. Information considered unimportant for the clinical diagnosis of asthma was assigned a score of zero, a score of one was assigned to information considered helpful but not fundamental to the diagnosis, and a score of two was assigned to information considered important for the diagnosis of asthma. For each of the questions, the score most frequently assigned became the fixed score for that

question. When two scores were assigned with equal frequency, the final decision was made by consensus of the team that conducted the study. The overall score was the sum of the individual scores by section.

Assuming the clinical and functional diagnosis as the reference method, we calculated the sensitivity (true positives), specificity (true negatives) and positive predictive value for affirmative responses to each question. The sum of assigned scores for each question provided a range of possible individual scores from zero to fourteen. For each of the obtained scores, we calculated the sensitivity, specificity and Youden index (specificity + sensitivity - 1).[6] We also created the "cut-off point" variable and used the Kappa index, the McNemar test and the maximum likelihood ratio test in order to analyze the concordance of this variable with the clinical and functional diagnosis. In addition, we compared the mean scores of asthma patients and controls, using the nonparametric Wilcoxon test and the nonparametric median test. We used discriminant analysis in order to obtain the value of the cut-off point that best separated the "asthma" group from the "no asthma" group with the lowest classification error. McNemar's test, together with the Kappa coefficient, was used in order to confirm the concordance between variables. This test indicates whether there are discordant pairs off the diagonal or not. For 2 x 2 tables, we used the Agree feature of the SAS software program. The null hypothesis was that in which the proportions off the diagonal were the same (pi. = p.i) in counterpoint to the alternative hypothesis, in which they were different. If all pairs were on the diagonal, the Kappa coefficient would be equal to 1 and McNemar's test would be equal to 0 and, therefore, there would be no discordant pairs.[7] The reproducibility of the questionnaire in the second interview was analyzed using the Kappa coefficient. For all analyses the level of significance was set at $p < 0.05$. We used the statistical software program SAS, version 8.20, 2000.[8]

The Ethics Committee of the University of São Paulo School of Medicine approved the study. All participants were advised of the objectives and procedures of the study, agreed to participate and gave written informed consent.

RESULTS

Annex 2 shows the distribution of the scores assigned by the specialists, the percent distribution and the final score for each question. For question 3b ("Have you had between 1 and 3 asthma attacks in the past year?"), the number of specialists who considered this information important for the diagnosis of asthma (ten) was equal to that of those considering it helpful but not fundamental. The study team concluded that this information was important and therefore assigned a score of two to this question. Similarly, seven specialists considered question/statement 4a ("I have not been awoken by an attack within the last year.") important for the diagnosis of asthma, and seven did not. We decided to attribute a score of zero to this information, indicating that the absence of sleep disturbance caused by wheezing attacks was not important for the diagnosis of asthma.

Table 1 shows the main characteristics of the participating patients. There was predominance of females (approximately 68%) and of nonsmokers (approximately 80%) in both groups. Most of the asthma patients (70%) were diagnosed with moderate to severe asthma when admitted to the outpatient clinic. Of the 78 individuals studied, only one was a smoker (in the control group) and 14 were former smokers (8 asthma patients and 6 controls).

Table 2 shows the frequencies of positive responses for each of the questions, as well as the respective sensitivities, specificities and positive predictive values. The questions related to wheezing within the last 12 months, one or more wheezing attacks within the last 12 months, sleep disturbance within the last 12 months and difficulty in speaking caused by wheezing within the last 12 months showed the highest specificity (Sp = 1.00). These questions also showed the highest positive predictive values. The question presenting the most sensitivity was that related to a history of wheezing (Se = 1.00), followed by that related to a history of asthma or bronchitis (Se = 0.98).

Figure 1 shows the frequency of overall scores in asthma patients and control individuals as well as the respective sensitivities, specificities and Youden index values of those scores. The descriptive analysis of the figure shows that a score higher than four was only found in individuals with asthma. However, we found that a score of three or four included both asthma patients and control individuals, which might cause a mistaken classification in both groups.

Complementary analyses were carried out in order

to facilitate the comparison of the two groups and better define the cut-off point. The mean score, median and maximum and minimum score for individuals with asthma were 11.8, 12.5, 3 and 14, respectively, whereas the same items for the control group were 0.95, 0, 0 and 4, respectively. The Wilcoxon test and the median test revealed statistically significant differences in the scores between the two groups, with a higher score for individuals with asthma ($Z = -7.58$, $p < 0.0001$; and $Z = 1.60$, $p < 0.0001$, respectively).

Using the discriminant analysis to identify the possibility of mistakenly classifying an individual (data not shown), we found that, when the cut-off point was set at three, the probability of classifying an individuals with asthma as an individual without asthma was 98.4%, decreasing to 84.8% when the cut-off point was set at four. At a cut-off point of five or higher, there were no ambiguous cases (Figure 1).

Evaluating the results of the various analyses, we found that, setting the cut-off point at five, sensitivity decreased by only 0.02, whereas specificity increased by 0.11. In addition, a cut-off point of five corresponds to the highest Youden index, which allows an evaluation of the sensitivity and specificity, assuming that they both have the same general significance, and is the best isolated validation measure for the comparison of the differences in the prevalence of asthma between populations.[10] In contrast, there is an error, albeit small (3.75%), in the estimation of the prevalence of asthma in population studies when the cut-off point is set at four. Therefore, the results of the present study suggest the adoption of a more conservative criterion, with a cut-off point set at five points. In other words, individuals should be classified as having asthma when their overall score is equal to or greater than five.

For determining concordance, we randomly chose 20 individuals with asthma and 20 control individuals. The chosen individuals were submitted to a second interview over the telephone, after a mean interval of 48.2 ± 11.1 days. The concordance of responses was analyzed using the Kappa coefficient for each question, a total number of 40 observations. There was good concordance between the responses for most of the questions (Kappa coefficient ranging from 0.61 to 1.00). Question 5 (related to difficulty in speaking due to wheezing) showed moderate concordance (Kappa coefficient = 0.43, $p = 0.0661$) (data not shown).

DISCUSSION

The use of a cut-off point for the asthma module of the ISAAC questionnaire, using a set of data regarding symptoms, was sufficient to discriminate between individuals without asthma and individuals "clinically and functionally diagnosed with asthma". An overall score of five or more points was found to present 93% sensitivity and 100% specificity. As a result, this method can be a useful tool for the optimization of the triage of individuals with asthma

TABLE 1

Characteristics of asthma patients and controls

Characteristic	Asthma patients (n = 40) n (%)	Controls (n = 38) n (%)
Gender		
Female	27 (67.5)	26 (68.4)
Male	13 (32.5)	12 (31.6)
Age (years) (mean ± SD)	36.7 ± 13.8	36.7 ± 14.0
Minimum age-maximum age	(18-65)	(16-66)
Classification:		
Mild	6 (15.0)	NA
Moderate	18 (45.0)	NA
Severe	10 (25.0)	NA
Unidentified	6 (15.0)	NA
Smoking		
Smokers	0 (-)	1 (2.6)
Nonsmokers	32 (80.0)	31 (78.9)
Former smokers	8 (20.0)	6 (15.8)

SD: standard deviation; NA: not applicable

TABLE 2

Distribution of positive responses to the questions on the International Study of Asthma and Allergies in Childhood questionnaire in the asthma and control groups

Question	Asthma patients (n = 40) n (%)	Controls (n = 38) n (%)	Se	Sp	PPV
1. History of wheezing	40 (100.0)	11(29.0)	1.00	0.71	0.78
2. Wheezing within the last year	37 (92.5)	0 (-)	0.93	1.00	1.00
3. One or more attacks	37 (92.5)	0 (-)	0.93	1.00	1.00
4. Sleep disturbance due to wheezing	34 (85.0)	0 (-)	0.85	1.00	1.00
5. Difficulty in speaking due to wheezing	22 (55.0)	0 (-)	0.55	1.00	1.00
6. History of asthma or bronchitis	39 (97.5)	4 (10.5)	0.98	0.89	0.91
7. Wheezing upon exertion	33 (82.5)	3 (7.9)0.83	0.92	0.92	
8. Nocturnal cough	28 (70.0)	11 (29.0)	0.70	0.71	0.72

Se: sensitivity; Sp: specificity; PPV: positive predictive value

in prevalence studies, motivating studies in this age bracket and thereby allowing the collection of data that would permit future investigations on specific causes and consequent preventive interventions. A series of studies on the prevalence of asthma in children and adolescents have recently been published in Brazil, although such studies have not been conducted in the adult population. We believe it is imperative that we understand how the disease behaves in young adults, especially if we consider the occupational risk of contracting the disease in this age group.

Deliberately, the evaluated sample was not representative of the general population, particularly because of the exclusion of smokers for more than 10 pack-years and of patients diagnosed with allergic or cardiorespiratory diseases. However, the final sample did include individuals who had had recent respiratory infections and those who were obese, as well as those who had smoked for less than 10 pack-years, and even those with underlying or undiagnosed asthma. This procedure was part of the method that aimed to evaluate the characteristics of two distinct populations by means of a statistical analysis that would determine a cut-off point to discriminate between the two. The selection of asthma patients from a specialized clinic provided good reliability that those patients truly had asthma, although there is no recognized gold standard for the diagnosis of this disease.[11] We do not believe that the predominance of moderate and severe asthma among the asthma patients increased the cut-off point since the score of individual questions did not vary proportionally with the severity of the symptoms: scores of fourteen points for mild asthma, as well as scores of three points for moderate asthma, were found. However, we determined that false-negative results may be obtained when the cut-off point is set at a score of five points since there were two patients with moderate persistent asthma and one patient with mild asthma who scored lower than five points. This was undoubtedly to the result of successful treatment. In a real-life situation, such as

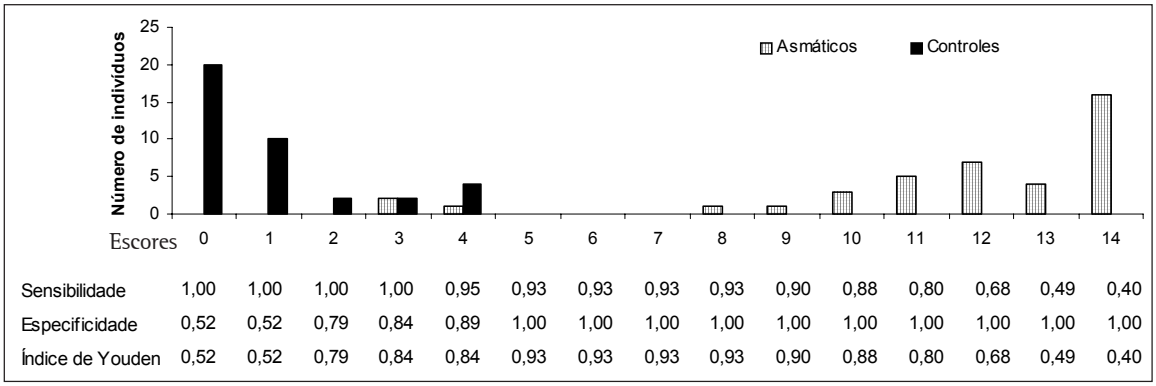

Figure 1 - Overall score obtained by adults with asthma and adult controls on questions 1 to 8 of the asthma module of the International Study of Asthma and Allergies in Childhood questionnaire, together with their respective sensitivities, specificities and Youden index values

in a borderline case, we would be able to find an equivalent situation.

The positive predictive values are dependent on the proportion of ill patients within the study population, which, in our study, was approximately 50%. Lower prevalences of asthma are expected to be found in population-based surveys. Therefore, we performed simulations in order to estimate the positive predictive values in populations with proportions of 5%, 10% and 15% of the disease.[1] For question 1 (related to cumulative wheezing) and for question 6 (related to asthma/bronchitis), the positive predictive values (post-test probability) were relatively low. For cumulative wheezing, they were 0.32, 0.49 and 0.69, respectively. However, for recent wheezing, the maximum positive predictive value remained unchanged (PPV = 1.00) for the various prevalences since the high specificity of the question determined it to be so. We highlight the fact that the sensitivity and specificity values for the adopted cut-off point were similar to the values for recent wheezing. Consequently, the positive predictive value for the cut-off point would also maintain its maximum value for populations in which prevalence of the disease is low.

Theoretically, the question "Have you ever had an asthma attack?" was formulated to measure the frequency of physician-diagnosed asthma within the population. The term "asthma" has a quite limited use in our culture, and we could not ignore the extensive popular use of the term "bronchitis" to describe this condition. Therefore, this question would not reflect the real asthma situation in our population, and the modification adopted in the present study was justified. As a consequence, direct comparison of the results of the present study with those of other studies is not possible. Comparing our results to those found in a previous study involving adolescents and employing the same method but using the original question (referring only to the history of asthma),[4] we found that, in our sample, the prevalence of positive responses to this question was higher, both among individuals with asthma and among individuals without asthma. In other words, among adults with asthma, the prevalence of "asthma or bronchitis" was 98% in our study versus a 70% prevalence of "asthma" among the adolescents evaluated in the previous study.[4] The authors of that study found that, in the "no asthma" group, the incidence of asthma/bronchitis among adults was 11%, and that there were no positive responses to the "asthma" question among adolescents.[4] In addition, the modification of this question in the present study resulted in the prevalence of asthma/bronchitis being higher than that of recent wheezing, again contrasting with the results of the above-mentioned study. A higher prevalence of asthma/bronchitis in relation to that of recent wheezing has also been found in other studies that added the term "bronchitis" to this question.[12-13] This modification certainly caused the question to be more sensitive and less specific, although this was based on conceptual parameters, not on statistical ones, due to the reasons above mentioned. However, in the present method, the sum of all the data was more important than any individual question. In addition, we prioritized sensitivity, to the detriment of specificity, since we predict its use as a triage instrument, facilitating and optimizing costs for a second step, when other objective and specific methods, such as the evaluation of bronchial responsiveness, are recommended. However, we admit that retaining the original question and including another question - "Have you ever had bronchitis?" - would allow the analysis of the results as a group, as well as providing an estimate of the degree of knowledge or acceptance of the condition by the patients, while maintaining the joint analysis for the determination of the score.

Under the particular circumstances of this study, in which the interviewer was in a specialized center for the treatment of asthma and asked the patient whether he had ever had an asthma attack, we realized that negative responses from asthma patients did not always mean that these patients did not know or did not accept the disease, but that they understood two different points in time exemplified by two different reactions: "I have asthma today but I did not have it before" or "I have asthma today, but I used to have bronchitis".

One of the most widely compared pieces of data in multicenter studies, including studies of adults, is that regarding the question related to recent wheezing. There is an equivalent question in the European Community Respiratory Health Survey and in the questionnaire of the multicenter study for the investigation of the prevalence of chronic obstructive pulmonary disease in the main metropolitan areas in Latin America (Latin American Pulmonary Obstruction Investigation Project).[14] We highlight the high

sensitivity (93%) and specificity (100%) found for this question in the study population. Although the sample was not representative, we share the understanding that epidemiological studies on asthma should mainly compare the prevalence of asthma among population groups, using standardized methods, rather than seeking to estimate the "true prevalence of asthma".[11]

We found few previous studies that used the asthma module of the ISAAC questionnaire (either partially, in its entirety or adapted) for adults.[15-18] The fact that the questionnaire had already been translated into Portuguese, and that the information brought to light through its use was equivalent to that of the European Community Respiratory Health Survey justified our decision to use this instrument. By comparing our results to those of the validation study conducted by Solé et al. (1998), we observed similar sensitivity and specificity for the proposed method. However, there was no adequate consensus among the specialists since agreement among those specialists was less than 70% for nine of the thirteen items under study. Regarding question 3b (related to having had 1 to 3 wheezing attacks in the last year), the decision of the study team to assign a higher score was based on the understanding that, for the diagnosis of asthma, a wheezing attack within the last year is more important, regardless of the number of attacks, which could be important for estimating asthma severity.[4] As for question 4a (related to sleep disturbance caused by wheezing), the study team decided that the absence of this piece of data would have no effect on the identification of asthma patients, and we therefore assigned a score of zero to this question.

A possible memory and seasonality bias, as well as a bias caused by disease control interfering with the questionnaire responses, is illustrated by the observations made in the second interview of a patient with mild persistent symptoms. During the first interview, carried out in March, the patient denied having experienced wheezing within the last 12 months. However, in the second interview, carried out almost 2 months later, coinciding with the period of lower temperatures, the patient reported having had a wheezing attack the day before the interview. Several interviewed patients had been treated as outpatients for more than a year, which might have resulted in the absence of symptoms in the last twelve months and, consequently, in the reduction of the total score. This was especially true among patients diagnosed with intermittent or mild persistent asthma at the time of their admission as outpatients.

As we mentioned above, although the predominance of moderate to severe asthma seemed not to have resulted in an increase in the cut-off point, this could have established higher prevalences for individual questions related to asthma severity (questions 3, 4 and 5). This was shown when we compared our results to the prevalences of the same questions in another study of adolescents,[4] in which prevalences ranged from 55% to 93% among adults and from 15% to 85% among adolescents. The individual analysis of these questions may, therefore, be affected by a selection bias, although this problem seemed to be reduced when the scoring system was used. We found no studies evaluating the distribution of patients with mild, moderate and severe asthma in the general population.

Second interviews showed good reproducibility for most of the questions, despite the relatively long interval between the two interviews.

Another limitation of the present study was the fact that the sample size was not calculated statistically, instead following the design used in the Solé et al. study, which compared 33 asthma patients in the 13-14 age bracket with 33 age-matched controls.

The method employed in the present study created a paradox: it increased the sensitivity of an individual question by the inclusion of the term "bronchitis" and increased the specificity of the analysis of the group of questions by setting the cut-off point at five, excluding those patients who might have had asthma but presented scores of three or four points. As a consequence, we were able to detect false-negative results caused by cultural aspects of the population studied, especially among low-income individuals, as well as to include possible variations of the manifestation of the disease. Unfortunately, there is still a slight possibility that asthma patients were excluded from the analysis. According to the scoring of the questions, this would only happen if the individual presented wheezing within the last year and none of the other investigated symptoms, or if the individual presented nocturnal dry cough. Comparing the definition of asthma detected by recent wheezing to that defined by the scoring method, we would have expected to find a slightly lower prevalence of the disease using the scoring method. However, in a study

involving 374 cleaning staff members and using the scoring method, 11.1% of the workers had experienced recent wheezing, and 11.4% scored higher than five points.[19] This indicated that none of the participants presented recent wheezing alone or recent wheezing with nocturnal dry cough, although some did present recent wheezing together with other asthma symptoms.

Although the questionnaire seems appropriate for the identification of individuals with asthma, it has little use in the evaluation of clinical relevance and patient impairment, which is important for estimating the cost or severity of the disease in epidemiologic studies. Keeping the original questionnaire intact and adding questions on the use of medication, date of symptom onset, wheezing not concomitant with the flu, and history of bronchitis would make significant contributions to the wider use of this instrument. It would be interesting to test this instrument in a population-based survey in order to determine its validity in a group presenting a wider distribution of symptoms.

Annex 1 - Questionnaire

1. Have you ever experienced wheezing (whistling sounds in your chest)?
   If your answer is NO, go to question 6
2. Have you experienced wheezing (whistling sounds in your chest) within the last 12 (twelve) months?
   If your answer is NO, go to question 6
3. How many wheezing attacks (whistling sounds in your chest) have you had in the past 12 (twelve) months?
   None.....
   1 to 3 attacks.....
   4 to 12 attacks.....
   More than 12 attacks.....
4. In the last 12 (twelve) months, how often have you experienced sleep disturbance due to whistling sounds in your chest?
   Never.....
   Less than 1 night a week.....
   One or more nights a week.....
5. In the last 12 (twelve) months, was your wheezing ever so severe that it prevented you from speaking more than 2 words between breaths?
6. Have you ever had asthma or bronchitis?
7. In the last 12 (twelve) months, have you experienced whistling sounds in your chest after physical exercise?
8. In the last 12 (twelve) months, have you had dry cough at night without having a cold, the flu or a respiratory infection?

Annex 2 - Scores assigned by specialists according to a clinical point of view and the final score for each question

QUESTION	Pumonologist					Alergist								Clínical physician							Summary			
	P1	P2	P3	P4	P5	A1	A2	A3	A4	A5	A6	A7	A8	C1	C2	C3	C4	C5	C6	C7	Score 2 n (%)	Score 1 n (%)	Scote 0 n (%)	Score Final
1. History of wheezing	2	0	2	1	1	1	1	1	1	2	2	1	1	1	2	1	0	1	2	2	7 (35)	11 (55)	2 (10)	1
2. Wheezing within the last 12 months	2	1	2	2	2	2	2	1	2	2	1	1	1	2	2	2	2	1	1	1	12 (60)	8 (40)	0 (-)	2
3. Wheezing attacks																								
3a. No attacks in the last year	0	0	1	1	2	0	2	1	0	0	0	1	2	2	2	2	0	0	1	1	6 (30)	6 (30)	8 (40)	0
3b. 1 to 3 attacks in the last year	1	2	1	1	2	1	2	1	2	1	1	1	2	2	2	2	2	2	1	1	10 (50)	10 (50)	0 (-)	2*
3c. 4 to 12 attacks in the last year	2	2	1	1	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	17 (85)	3 (15)	0 (-)	2
3d. More than 12 attacks in the last year	2	2	1	1	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	17 (85)	3 (15)	0 (-)	2
4. Sleep disturbance due to wheezing																								
4a. Never in the past year o	0	0	1	1	2	0	2	1	0	0	1	2	2	2	2	2	0	0	1	1	7 (35)	6 (30)	7 (35)	0*
4b. < 1 night/week with wheezing	1	2	1	1	2	1	2	1	2	1	2	2	2	2	2	2	2	1	2	2	13 (65)	7 (35)	0 (-)	2
4c. 1 or more nights/week with wheezing	2	2	1	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	17 (85)	3 (15)	0 (-)	2
5. Wheezing-related difficulty in speaking	1	2	0	2	1	2	2	1	2	1	2	2	2	2	1	2	2	2	2	2	14 (70)	5 (25)	1 (5)	2
6. Asthma or bronchitis at any time	2	2	2	2	2	2	1	1	1	1	2	2	2	1	2	1	2	0	1	1	11 (55)	8 (40)	1 (5)	2
7. Wheezing after exercise	1	1	1	1	2	2	2	0	2	2	2	1	1	2	2	2	2	1	2	2	12 (60)	7 (35)	1 (5)	2
8. Nocturnal dry cough	1	1	1	1	1	1	2	0	1	1	2	1	2	2	1	2	1	0	1	1	5 (25)	13 (65)	2 (10)	1

*Final decision regarding the score assigned made by the study team

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