

The use of spirometers and peak flow meters in the diagnosis and management of asthma among Spanish pediatricians. Results from the TRAP study

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The objective of this study was to determine the level of adherence of pediatricians in Spain to the Spanish National Guidelines for Asthma Treatment with regard to the use of a peak flow meter (PEFR) or a spirometer in the diagnosis and management of asthma in childhood and to analyze sources of variations in these practices. A prospective survey (consisting of demographic and asthma knowledge sections) was conducted over a 2-wk time interval of 3000 pediatricians throughout the country. At least one part of the questionnaire was completed and returned by 2773 individuals (92.4%), with 2347 (78.2%) answering both sections; results are for this population. Around 62% of the pediatricians reported having a peak flow meter or a spirometer in their office; however, only 33% and 48% of them used the devices for the diagnosis and treatment of asthma, respectively. There was a significant association between being older (36–55 yr old) and using PEFR or spirometry for the diagnosis (OR: 1.35, 95% CI 1.11–1.66) and the management (OR 1.47, 95% CI 1.22–1.77) of asthma. Males used a peak flow meter or a spirometer more often than females for the diagnosis (37.8% vs. 30.9%, $p = 0.001$) and management of asthma (52.0% vs. 45.6%, $p = 0.008$). Pediatricians with formal pediatric residence training used these devices more for the diagnosis (OR: 1.39, 95% CI 1.09–1.75) and management (OR: 1.58, 95% CI 1.27–1.96) than those without. Working in a hospital was also related with more peak flow meter or spirometer use than working in health centers (OR: 2.08, 95% CI 1.71–2.54 for diagnosis; OR: 1.83, 95% CI 1.50–2.22 for management). About one-third of the Spanish pediatricians surveyed use spirometers and/or peak flow meters for diagnosing asthma and about half use one of these devices occasionally for managing the disease. Independent factors favoring their use are: age 36–55 yr, male gender, working in a hospital setting, and having been trained in a formal pediatric residence program.

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Abbreviations: CI, confidence interval; FEV1, forced expiratory volume in 1 s; GINA, Global Initiative for Asthma; NAEPP, National Asthma Education and Prevention Program; PEFR, peak expiratory flow rate; TRAP, Treatment and Resources in Asthma among Pediatricians.

The use pulmonary function testing for the diagnosis of asthma, especially the peak expiratory flow rate (PEFR) and forced expiratory volume in 1 s (FEV1), is encouraged by current national guidelines as necessary due to the lack

of recognition of symptoms by the patients or their parents, especially when asthma is severe and longstanding or during exacerbations (1). Moreover, according to the recent Global Initiative for Asthma (GINA) guidelines, the measurement of the airflow limitation, its reversibility, and its variability is critical in establishing a clear diagnosis of asthma (2). With respect to the management and follow-up of asthma, there are conflicting recommendations as to the use PEFr measurements in self-management plans for patients (3–5). Still there is little doubt that FEV1 or PEFr measurements should be regularly used by physicians to follow their patients, although adjusting therapy based only upon PEFr should be avoided (6). Again GINA guidelines consider these measurements the best way to monitor asthma, equivalent to other parameters used to monitor other chronic diseases: blood pressure to monitor hypertension or blood glucose to monitor diabetes (2).

Despite these clear statements by internationally recognized professional bodies on the use of pulmonary function tests, for example, by the National Heart Lung and Blood Institute's National Asthma Education and Prevention Program (NAEPP) (7) in the US, an initial 1998 survey of pediatricians in Massachusetts showed that 37% of them did not consider pulmonary function measures necessary for the diagnosis of asthma (8). In a later survey of all physicians providing primary care to children in Washington, Illinois, and Massachusetts, 75% reported using office measurement of PEFr for diagnosis and 72% for following asthma (9). However, a more recent survey in Thailand (10) found that only 23% of pediatricians indicated that they would measure PEFr for evaluating asthma.

Much influenced by the GINA and the NAEPP guidelines, the Spanish National Guidelines for Asthma Treatment have since 1995 advocated measuring pulmonary function (PEFr or FEV1) in the diagnosis and management of asthma (11). These guidelines recommend the use of those devices whenever possible according to the child's cooperation for follow-up and diagnosis. Specifically the bronchodilator test is highly recommended for diagnosing asthma. On the other hand it is warned against the excessive confidence on the variability of PEFr measurements at home. The aim of this study was to determine the adherence of Spanish pediatricians to these recommendations and to assess sources of variations in these practices.

Materials and methods

Questionnaires

A random sample of 3000 pediatricians (about half of all Spanish pediatricians) was surveyed using a questionnaire directed at how they diagnose and treat asthma in children ('Treatment and Resources in Pediatric Asthma', TRAP study). Considering that pediatricians in Spain deal with children from birth to 14 yr, all of them have the opportunity to use spirometers and peak flow meters for diagnosing and treating asthmatic patients in ages enough to be able to perform a correct expiratory maneuver. The questionnaire was designed by the Spanish Pediatric Asthma Study Group, which is composed of representatives of all Spanish Pediatric Societies that have any relationship to asthma. With regard to the use of PEFr (peak flow meter) and/or spirometer, the questions included in the questionnaire are given in the correspondent results tables.

Delivery

The questionnaires were distributed by pharmaceutical company representatives covering all of Spain, and collected within two weeks. The 153 representatives who distributed the questionnaires could easily reach 3000 pediatricians in that short time. No instructions were given about what specific pediatrician should be contacted. It is important to mention that the participating pharmaceutical representatives specialized not only in asthma medications, but also other drugs used in pediatric general practice, such as antibiotics. The only instruction given to the representatives was to deliver all the questionnaires given as soon as possible.

The questionnaires included two parts: one regarding knowledge of the diagnosis and treatment of asthma ('asthma questionnaire'); the other a 'demographic questionnaire'. The latter contained questions about age, sex, type of training in pediatrics, type of health setting, and area of work (rural or urban). Pediatricians were also asked about their interest in asthma with the question: 'Do you have a special interest in asthma?' With this part of the questionnaire we intended to identify which demographic subgroups – if any – should be preferably addressed if future interventions were designed. No names or identifying data were asked in any of the questionnaires to facilitate their anonymity.

Data analysis

The relationship between the demographic variables and the questions about PEFR or spirometer use were assessed by means of the Pearson's chi-square test expressing the results either in percentages or in odds ratios (ORs). The specific associations were established by means of the typified residuals of each specific cell in the contingency tables. In order to group the best trained and more experienced pediatricians, age was arranged in two different groups: 36–55 yr and the rest. On average, in Spain, a pediatrician ends his/her residency by the age of 30. An additional 5 yr would be enough time to acquire some non-supervised experience. We chose 55 yr for the upper age limit to include the 20 most productive years of a professional life. The younger ones were considered less experienced and the older ones less likely to be updated in the current diagnosis and treatment of asthma. Pediatricians now practicing in Spain have two different ways of having acquired their specialty training. These two ways are the 'pediatric residence' (present system, requiring 4 yr of formal academic training in pediatrics) and the 'non-residential pediatric specialty' (previous system, which required attendance at regular classes for 2 yr together with supervised work in a pediatric setting – either in a hospital or in an outpatient clinic). A logistic regression was performed to evaluate which demographic variables were most important for using a peak flow meter or a spirometer in asthma diagnosis or management.

Results

Participation rate and demographic characteristics of the sample

At least one of the two questionnaires was recovered in 2773 individuals (2619 'demographic questionnaires' and 2501 'asthma questionnaires'). There were 2347 pediatricians who returned both questionnaires, meaning a participation rate for useful data of 78.2%. Two hundred and seventy-two individuals had demographic data but not asthma questionnaires and were considered as non-respondents. There were no significant differences between respondents and non-respondents in terms of group age, gender, type of specialty training, years of specialty practice, and place of work (Table 1). However, the non-respondents had significantly less specific interest in asthma than the respondents (Table 1). The geographical distribution of the participating pediatricians by Autonomic

Table 1. Demographic characteristics of respondents and non-respondents

	Respondents (n = 2347) (%)	Non-respondents (n = 272) (%)	p
Male gender	43.2	42.4	0.577
Pediatric residence specialty	61.8	59.6	0.145
Age group 36–55 yr	75.5	73.1	0.689
Work in a hospital	22.8	23.5	0.823
Urban setting	71.7	78.3	0.067
Interest in asthma	80.4	70.6	<0.001

Regions was comparable to the actual distribution of the whole population of pediatricians. For example, pediatricians from Andalucía represented 21.6% of the total sample, whereas pediatricians from Madrid, Cataluña, and Valencia represented 8.8%, 14.4%, and 9.4%, respectively.

Descriptive results

The descriptive analysis is shown in Table 2. There was a significant association between being in the 36–55 yr age group and reporting the use of peak flow meter or spirometer in the diagnosis (OR 1.35, 95% CI 1.11–1.66) or management (OR 1.47, 95% CI 1.22–1.77) of asthma (Tables 3 and 4). Curiously, there was no association between any of the two age groups and having been trained in the use of the devices (data not shown). Age group was also associated with the pediatricians' preference in acquiring training in the use of a peak flow meter or spirometer: younger (< 36 yr) and older (> 55 yr) pediatricians preferred seminars more than the middle age group and more experienced (36–55 yr) pediatricians (24.4% vs. 19.5%, respectively, $p = 0.01$) and also preferred a literature review more (4.3% vs. 2.4%, respectively, $p = 0.015$) as ways of incorporating the peak flow meter or spirometer into their clinical practice.

Associations between demographic characteristics and the use of spirometers or PEFR measuring devices

In the bivariate analysis gender seemed also to influence some of the variables related to the use of the devices. First, there was a strong association between being a female pediatrician and not having a peak flow meter or a spirometer when compared with male pediatricians (OR 1.45, CI 95% 1.21–1.74), although there were no differences in relation to having been trained to use them (OR 1.09, IC 95% 0.91–1.29). Again, more male pediatricians than females said they use the devices for asthma diagnoses (37.8% vs.

Table 2. Descriptive statistics of the use of a spirometer or a peak flow meter in the diagnosis and management of childhood asthma among Spanish pediatricians. Answers to question 6 were not exclusive

1. Do you have a peak flow meter or a spirometer in your office?		
Yes	62.3%	
No	34.4%	
NA	3.3%	
2. Have you been trained to use a peak flow meter or a spirometer?		
Yes	51.4%	
No	44.2%	
NA	4.3%	
3. Do you regularly use a peak flow meter or a spirometer when <i>diagnosing</i> asthma?		
Yes	33.4%	
No, I do not have one	27.3%	
No, although I have one	14.7%	
No, I think it is not useful	1.4%	
No, I have too much workload	14.7%	
NA	8.5%	
4. Do you think you should be trained in the use of those devices?		
Yes	55.3%	
No, I have been already trained	32.8%	
No	5.5%	
NA	6.3%	
5. Do you occasionally use a peak flow meter or a spirometer when <i>managing</i> asthma?		
Yes	48.0%	
No, I do not have one	24.4%	
No, although I have one	9.6%	
No, I feel it is not useful	0.9%	
No, I have too much workload	9.5%	
NA	7.5%	
6. What would you need to incorporate a peak flow meter or a spirometer in your usual practice for diagnosing and managing asthma?		
	Yes	No/NA
I am using them	38.6%	61.4%
A workshop	23.0%	77.0%
A seminar	20.7%	79.3%
A literature review	2.9%	97.1%
I would not use them	5.6%	94.4%

NA, not available.

Table 3. Pediatricians' characteristics that relate with the use of a spirometer or a peak flow meter in the diagnosis of asthma

	Crude OR	95% CI	Adjusted* OR	95% CI
Age group 36–55 yr	1.35	1.11–1.66	1.53	1.20–1.92
Male	1.36	1.14–1.63	1.21	1.00–1.51
Pediatric residence specialty	1.39	1.09–1.75	1.30	0.98–1.61
Work in hospital	2.08	1.71–2.54	2.09	1.67–2.62
Interest in asthma	1.61	1.24–2.09	1.67	1.24–2.25

OR: odds ratio.

*Adjusted by: age group, gender, way of specialty, type of health setting, area of work, and special interest in asthma.

30.9%, respectively, $p = 0.001$) or management (52.0% vs. 45.6%, respectively, $p = 0.008$). Significantly more male pediatricians declared that they should not be trained for using the devices in the future than females (8.4% vs. 4.2%, respectively, $p < 0.001$). In addition, there were

Table 4. Pediatricians' characteristics that relate with the use of a spirometer or a peak flow meter in the management of asthma

	Crude OR	95% CI	Adjusted* OR	95% CI
Age group 36–55 yr	1.47	1.22–1.77	1.67	1.34–2.08
Male	1.29	1.09–1.53	1.28	1.05–1.56
Pediatric residence specialty	1.58	1.27–1.96	1.53	1.19–1.94
Work in hospital	1.83	1.50–2.22	1.84	1.47–2.30
Interest in asthma	1.63	1.29–2.06	1.66	1.27–2.18

OR: odds ratio.

*Adjusted by group, gender, way of specialty, type of health setting, area of work, and special interest in asthma.

some differences between genders in relation to the way of acquiring the knowledge to use the pulmonary function devices: a workshop (17.9% vs. 26.6%, $p < 0.001$) and a seminar (17.6% vs. 23.0%, $p = 0.002$) were significantly chosen more frequently by females than males, respectively.

Significantly more pediatricians trained within the 'pediatric residence' had peak flow meters or spirometers in their offices as compared with pediatricians trained in a 'non-residential pediatric specialty' (69.5% vs. 57.1%, respectively, $p < 0.001$). Also, significantly more pediatricians in the first group thought that they should be trained in the use of those devices (9.1% vs. 5.7%, respectively, $p = 0.034$). In the same direction, more 'pediatric residence' trained than 'non-residential pediatric specialty' trained pediatricians used a peak flow meter or a spirometer for the diagnosis (39.5% vs. 29.3%, respectively, $p = 0.001$) and management (52.6% vs. 41.2%, respectively, $p < 0.001$) of asthma. As might be expected, there was a strong association between being a 'pediatric residence' pediatrician and having an age in the range of 36–55 yr (OR 1.43, CI 95% 1.14–1.83).

There were no differences in having a spirometer or a peak flow meter in their offices between pediatricians who reported to work in the public or private hospitals or in private practices (72.9% vs. 71.6% vs. 70.9%, respectively). However, the percentages decreased for pediatricians working in healthcare centers (62.8%) or in ambulatory offices (57.9%). As the answer to the question on the work setting was not exclusionary it is quite possible that a certain number of pediatricians with private offices have one of those devices in the hospital or in the health center where they also work. For instance, 18.7% of pediatricians working in public hospitals also have their own private practice, and this percentage goes up in the case of private hospitals (36%). In the case of non-hospital pediatricians, the figures vary greatly depending on the system, being much higher among pediatricians working

in ambulatory offices (26.9%) than in the health-care centers (9.5%). There were no differences related with having a spirometer or a peak flow meter and work in a rural or urban area (63% vs. 64%, respectively, $p = \text{NS}$).

In the sample analysed, a large majority of the pediatricians surveyed reported a high interest in asthma (80.4%). There were no differences in age group, gender or place of work, and interest for asthma (data not shown). A slightly higher interest in asthma was reported by pediatricians specialized via 'pediatric residence' than those via 'non-residential pediatric specialty' (86% vs. 81%, respectively, $p = 0.02$).

Multivariate analysis

In the logistic regression analysis, variables that were independently related to using a peak flow meter or a spirometer for the diagnosis or management of asthma were the age group 36–55 yr, being a male pediatrician, specialty obtained via 'pediatric residence' (only for the management), working in a hospital, and having a special interest for asthma (Tables 3 and 4). When sub-analyses were performed among those pediatricians who reported to have a peak flow meter or a spirometer, the only variables independently related with the use of these devices in the diagnosis or management of asthma were working in a hospital and having a special interest in asthma (data not shown).

Discussion

This is the first study of Spanish pediatricians' practices related to the use of pulmonary function measurement devices in the treatment and management of pediatric asthma. Further, to the best of our knowledge this is the only large survey evaluating the use of peak flow meter and/or spirometer among pediatricians in an entire country. Unlike other European countries, such as the UK, in Spain many pediatricians work in primary healthcare settings and have to diagnose and treat wheezing children as a first instance before deciding upon an eventual referral to a pediatric allergy or pneumology unit of the regional hospital. Also, they follow up these patients according to the recommendations of the consulting pediatric pneumologist or allergist.

About one-third of the Spanish pediatricians surveyed use spirometers and/or peak flow meters for diagnosing asthma and about half use one of these devices occasionally for managing the disease. It must be kept in mind that primary care pediatricians deal daily with an

appreciable number of children with a great number of different diseases, and often under pressure from families; so these apparently low figures are encouraging. Pediatricians understand (according to the Spanish guidelines) that the use of PEFR or spirometers is referred to those children that are able to cooperate. Unfortunately, the questionnaire did not specify the ages of the asthmatic patients, and only asked about their 'regular' use for the diagnosis and the 'occasional' use for the follow-up. Independent factors favoring the use of these devices for the diagnosis and management of asthma are: 36–55 yr old, male gender, working in a hospital, having been trained via the pediatric residence program, and being interested in asthma.

A first potential limitation of this study is that it is a self-reported survey and so the diagnostic and/or treatment attitudes described in relation to asthma could have been biased to the theoretical ideal advocated in the current guidelines. To minimize this bias it was thoroughly stressed to the pediatricians that the questionnaire was only useful if they answered what they were 'really doing instead of what they think they should do'. Moreover, the questionnaire was anonymous, therefore the pediatricians could feel freer to answer the way they treat and manage asthma. Still, we cannot definitively rule out a possible bias of 'socially acceptable' answers, a potential bias that is always present in this type of study.

A second potential limitation of this study is that the pediatricians who answered the questionnaire were especially predisposed to participate due to a personal interest in asthma. This does not appear to be the case, as the participation rate among the whole group of pediatricians surveyed was quite high (78%). However, the non-respondents (those having the 'demographic' data but not the 'asthma questionnaire') did have significantly less interest in asthma than the respondents (71% vs. 80% respectively, $p = 0.002$). Therefore, one might speculate that the results of this study probably overestimate the actual use of peak flow meters and spirometers among the entire population of pediatricians in Spain. In the study by Werk et al. (8), surveying all active fellows of the American Academy of Pediatrics living in Massachusetts ($n = 862$) only 66% completed the questionnaires. Moreover, the participation rate was lower in the surveys by Finkelstein et al. (9) (64%) and Vichyanond et al. (10) (44%).

The higher response rate among the pediatricians interested in asthma could reflect a different patient group in some countries. In Spain, each

pediatrician working for the National Health Authority is assigned to a specific population by each Regional Health System and so the population's characteristics of each pediatric office cannot be biased in relation to asthma, unless the population itself is under a special risk factor. With respect to the pediatricians practicing mainly at private offices, they could of course select their population but their number is quite low (16.3%, data not shown), so this hypothetical selection (what we do not feel is generalized) would be of minor influence in the overall results. On the other hand, most of these pediatricians deal with private health companies what make the selection still less likely.

Some doubts could also arise as to the internal validity of the questionnaire. Respondents were asked three times in different questions about whether or not they had a peak flow meter or a spirometer. The response offer three different percentages: 34.4%, 27.3%, and 24.4% (Table 2, items 1, 3, and 5). It is quite possible that a certain number a pediatricians who answered 'No' to item 1 simply did not answer to items 3 and 5. The higher 'not available' percentages in the two last items argue in favor of this.

It is very reassuring that a reasonable percentage of the pediatricians surveyed (62%) reported having a spirometer or a peak flow meter in their office, but it is worrying that only 33.4% use one of these devices to diagnose of asthma and around 48% use them for the management of the disease. These figures are lower than those reported by the two American surveys (8, 9) that indicate a use of peak flow meter of about 70%, but are higher than the 17% reported in Thailand (10).

Factors favoring the use of a peak flow meter or a spirometer in the diagnosis and management of asthma among pediatricians in our study are easily anticipated in most cases. Being in the age group of 36–55 yr relates to a more frequent use of the devices. This is probably due to the fact that older pediatricians are not as updated in asthma diagnosis and treatment techniques, and younger pediatricians (only 14% of those surveyed) are not as well established in their practice and change more frequently their practice setting, making it more difficult to start second step techniques. These data are consistent with the findings of the Massachusetts survey, which found that physicians who did not consider pulmonary function testing so important were in practice longer (8).

Having been trained in the 'pediatric residence' program is also a factor that favors the use of peak flow meter or spirometer. This program,

which started in Spain in the mid-1970s, consists of very comprehensive training in a highly structured way for at least 4 yr in secondary or tertiary hospitals and it is more exhaustive and demanding that the 'non-residential pediatric specialty' program, which was shorter and less controlled. This latest program has now practically disappeared, but was simultaneous with the pediatric residence program for more than a decade. Two other easily anticipated factors were found to favor the use of spirometry and/or peak flow meter, namely working in a hospital and having a special interest in asthma.

We are quite aware that PEFR is a poor tool for measuring asthma control, FEV1 being more preferable as it can measure airway obstruction in more peripheral areas. Recently, Brand et al. (12) have stated that 'isolated measurements of PEFR provide an insensitive and, therefore, not very useful assessment of airway obstruction' and that 'monitoring FEV1 repeatedly during scheduled follow up visits has educational value'. Although not being very useful from a clinical point of view, measuring PEFR in the clinic could also be a good educational exercise not only for the child but also for the pediatrician, who could shift to measure FEV1 more easily if recommended to do so and if the appropriate device is available with him/her. According to Brand et al. (12), there is no evidence from appropriate clinical trials that monitoring FEV1 in children improves asthma control, but it seems reasonable to think that it is additional information that could be taken into account in the follow-up of the asthmatic child. From our point of view, FEV1 measurement should be recommended unless there is a clear evidence of its ineffectiveness from appropriate designed clinical trials.

In summary, we have been able to describe the uses of spirometry or peak flow meter in the diagnosis and management of asthma among a large sample of pediatricians in Spain. Our findings indicate a fairly widespread use of those devices, although the situation could be improved, especially among those pediatricians without formal pediatric residence training, those who work in health centers, females, and those with ages less than 36 yr or more than 55 yr. The data of this study will be used to implement strategies in order to enhance their correct utilization.

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