

## ORIGINAL RESEARCH

## Asthma incidence and accuracy of diagnosis in the Portuguese sentinel practice network

\*Jaime Correia de Sousa<sup>a,b</sup>, Manuel Luciano Silva<sup>b</sup>, Filipa Almada Lobo<sup>c</sup>, John Yaphe<sup>a</sup><sup>a</sup> School of Health Sciences, University of Minho, Braga, Portugal<sup>b</sup> Horizonte Family Health Unit, Matosinhos, Porto, Portugal<sup>c</sup> Porta do Sol Family Health Unit, Matosinhos, Porto, Portugal

Received 30th July 2009; resubmitted 11th December 2009; revised 19th February 2010; accepted 21st February 2010; online 20th April 2010

**Abstract**

**Aims:** Asthma is frequently under-diagnosed with a wide variation in incidence rates. We aimed to assess how physicians in a Portuguese sentinel practice network perform using standardised diagnostic criteria.

**Method:** Patients consulting one of the 43 network physicians with complaints suggestive of asthma were enrolled in the study over a four-year period. Symptom frequency and diagnoses of asthma were tabulated. Diagnostic accuracy was computed by dividing the rate of asthma diagnosis by the true rate using established diagnostic criteria.

**Results:** Over four years, 43 physicians followed 32,103 patients (128,412 patient-years) and diagnosed asthma in 310. The diagnosis was confirmed in 260 cases, giving a true incidence rate of 2.02/1000/year (95% confidence interval 1.8 to 2.2) and an accuracy of diagnosis of 84%.

**Conclusions:** Asthma incidence approaches published rates if accepted criteria are used. Educational efforts to ensure more accurate diagnosis may improve outcomes for asthma patients.

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J Correia de Sousa *et al.* *Prim Care Resp J* 2010; 19(4): 352-357

doi:10.4104/pcrj.2010.00022

**Keywords** asthma, incidence, diagnosis, diagnostic accuracy, family practice, general practice, Portugal**Introduction**

Asthma is the most common chronic disease in childhood worldwide with a high prevalence in other age groups as well, yet there is wide variation in the prevalence and incidence of the condition between and within countries.<sup>1-5</sup> Making the diagnosis of asthma is necessary to ensure correct treatment and improvement in quality of life. Accepted diagnostic criteria for asthma are available but are not widely applied.<sup>6</sup>

One way of standardising the diagnostic process is by the use of research criteria or research protocols by groups of physicians. This is the method used in sentinel research networks in which participating doctors agree on diagnostic criteria for one or more conditions to allow for surveillance or study of these conditions in normal practice. The Portuguese Sentinel Practice Network (PSPN) is one such research network. It has been in existence since 1980 and currently has 145 members.<sup>7</sup> It is a Health

Observation System consisting of family physicians. The objectives of the network are to estimate incidence rates for diseases or conditions occurring in the sentinel physicians' patient lists, to participate in the epidemiological surveillance of diseases occurring in the community, to identify potential outbreaks, and to build a database that allows the epidemiological analysis of diseases with public health interest.

Following the Global Initiative for Asthma (GINA) workshop in 1995,<sup>8</sup> there was an increased awareness in Portugal of the need for better knowledge of the burden of asthma. Multidisciplinary GINA groups were formed in order to disseminate the guidelines and to develop educational activities on asthma diagnosis and control. There were no readily available data on the incidence of asthma in Portugal, and the Portuguese National Plan for Asthma Control<sup>9</sup> had not yet been published. The plan included an appeal for an ongoing epidemiological survey of asthma.

\* **Corresponding author:** Dr Jaime Correia de Sousa, University of Minho, School of Health Sciences, Gualtar Campus, Braga, 4710-057, Portugal  
Tel: 351 253 604823 Fax: 351 253 604862 E-mail: jaimecsousa@gmail.com

In 1999 the PSPN decided to study the incidence of new cases of asthma presented to members of the network over a four-year period. This paper presents data from this network study and explores the question of diagnostic accuracy of asthma by network members. We wished to determine the incidence of asthma in this population and, in particular, to validate the diagnosis of asthma made by general practitioners (GPs) using accepted diagnostic criteria as a standard.

## Methods

In 1999 the Portuguese Sentinel Practice Network agreed to conduct a study on the incidence of asthma in network practices. Participation in the network is voluntary and there are two types of co-operation: weekly notification of new cases from the participating practices; or participation in national and international studies proposed by the participants. Data is collected during routine consultations. Network members report findings via the Internet or by using regular mail to a co-ordinating team located at the Portuguese National Institute of Health (INSA). The Portuguese Association of Family Physicians is also a partner in the project.

### Comparison of the study population with the Portuguese population during the study period

The composition of the study population followed by the PSPN was compared to the composition of the Portuguese population in 2003 using national census data<sup>10</sup> and was found to be similar. Young patients aged 0 to 14 years are slightly over-represented in the research network population constituting 15.4% of the network population compared to 14.8% in the general population. Patients over 65 years of age were also over-represented – 18.4% compared to 16% in the general population. Patients in the 15-65 year age group were underrepresented in the study population (66%) compared to the general population (67%). As a result, incidence rates were standardised by age to the Portuguese population in 2003.

Data collected by the reporting physicians during the first network study on asthma (2000-2003) were collated and validated in 2004. A first report was produced in 2005. Because a wide variety of rates of new cases of asthma were reported by study participants, the authors decided to conduct a second study in order to assess the diagnostic accuracy of new cases of asthma and to validate the incidence rate.

During the study period, the population of the sentinel practices remained relatively stable with an increase of 13 patients per practice per year or less than 1% of the average practice size of 1596 patient per doctor (personal communication, Isabel Falcão, Portuguese Sentinel Practice Network).

In 2005, all physicians reporting at least one new case of

asthma during the study period were asked to participate in this study. Data were collected retrospectively from all participants. Physicians were asked to report demographic data on each patient including age and gender. Diagnostic criteria for the diagnosis of new cases of asthma were collected. These included items in the history including cough and night-time wheezing, items in the physical examination such as expiratory wheezing, and items from additional examination such as peak expiratory flow (PEF) measurement, spirometry and skin testing. In addition, data from referrals to hospital specialists and the type of specialist were recorded along with the place of diagnosis of asthma.

The criteria used for the diagnosis of asthma in this study were the GINA criteria published in 2005.<sup>8</sup> A definite diagnosis of asthma was made in the presence of at least one positive item from the medical history, one from physical examination and one from additional tests (see sections 1, 2 and 3 in Table 2). A probable diagnosis of asthma was made if one item was present in only two out of three categories.

The incidence rate per thousand persons was calculated by dividing the number of definite or probable cases of asthma reported by the total number of patients in the population under observation during the four year study period x 1000. The annual incidence was computed by dividing this rate by 4 and was standardised by age and sex for the Portuguese population in 2003. Comparisons of incidence rates by gender were made using the Student t-test with significance set at the  $p < 0.05$  level.

## Results

Over a four-year period, 43 physicians participating in the study followed an average of 32,103 patients per year, representing 128,412 patient years of observation. This represents 0.3% of the 10,569,592 inhabitants living in Portugal in 2005.<sup>11</sup> During the study period, 310 new cases of asthma were reported. The 260 cases reported by the 43 network physicians represent a mean of 5.66 new asthma cases (95% CI 3.95 to 7.37) reported by each physician with a range of 1 to 26 cases reported per physician.

**Table 1. Characteristics of the newly diagnosed asthmatic patients (n=310).**

<b>Mean age</b>	34.1 years, 95% CI [31.51-36.71], sd 23.29
Males	29.08 years, 95% CI [24.92-33.25], sd 24.11
Females	37.79 years, 95% CI [35.54-41.04], sd 22.02
<b>Median age</b>	33 years
<b>Age range</b>	0 to 85 years

T-test for difference in mean age between genders:  $t = 3.30$ ;  $p = 0.001$ ; mean difference 8.7 years; 95% CI [3.52-13.89]

The characteristics of the newly-diagnosed asthmatic patients are presented in Table 1. The mean age of the patients was 34.11 years (95% CI 31.51 to 36.71 years, s.d. 23.29 years, range 0 to 85 years) and 57.7% of the patients were female. The mean age of newly-diagnosed male asthmatics was significantly lower than the mean age of newly-diagnosed females (29 years vs. 38 years,  $p < 0.01$ ).

The diagnostic criteria used to make the diagnosis are listed in Table 2 which presents the frequency of symptoms, physical signs and laboratory findings encountered. Recurrent wheezing was the most common symptom recorded. The place of diagnosis and the specialty of the diagnosing physician

are also given in Table 2. The primary care setting was the most common setting for diagnosis (in 60% of cases) with the diagnosis being made by a family physician (GP) in 56.8% of cases. The diagnosis of asthma was positive or probable in 260 new cases of asthma reported. This included 110 males and 150 females.

The corrected asthma incidence rate for all ages was found to be 2.02 cases per 1,000 persons per year (95% CI, 1.8 to 2.2). For males the incidence was 1.8/1,000 persons/year (95% CI, 1.5 to 2.1) and for females 2.23/1,000 /year (95% CI, 1.8 to 2.6). The difference in incidence by gender was statistically significant ( $p = 0.01$ ).

The incidence of asthma by age varied from a maximum of 5.93 in the age group 0 – 4 years to a minimum of 0.93 in those over 75 years (Table 3). Asthma incidence was higher in males in the younger age groups and higher in females in the older ages.

The proportion of patients meeting the diagnostic criteria for asthma is given in Table 4. All diagnostic criteria for asthma were present in 50% of the cases diagnosed. Most criteria were present in 29.7%. The diagnosis was confirmed by a hospital consultant in an additional 4.2% of cases. Therefore, asthma diagnosis was positive or probable in 83.9% of cases.

**Table 2. Diagnostic criteria for asthma used in this study.**

	Number (%) positive
<b>Wheezing</b> High-pitched expiratory whistling sounds—especially in children.	179 (59.7%)
<b>History of one of any of the following:</b>	
Cough (worse particularly at night)	184 (59.4%)
Recurrent Wheeze	216 (69.7%)
Recurrent difficulty in breathing	208 (67.1%)
Recurrent chest tightness	69 (22.3%)
<b>Demonstration of reversibility of airflow obstruction with a short-acting bronchodilator by:</b>	
Clinical observation	214 (69%)
Peak expiratory flow	58 (18.7%)
Spirometry	68 (21.9%)
<b>Who made the diagnosis?</b>	
Family Physician	176 (56.8%)
Pediatrician	28 (9%)
Pneumologist	25 (8.1%)
Allergologist	24 (7.7%)
Other	19 (6.1%)

## Discussion

This study found that the annual incidence of asthma in the general population in Portugal was 2.02 cases/1000 using data collected from a large sentinel practice network. It also found that the accuracy of the diagnosis by family physicians/GPs was 84% using accepted diagnostic criteria. We believe this is the first report of this nature from Portugal.

Asthma incidence studies are infrequent, since the estimation of asthma incidence presents some methodological problems.<sup>12</sup> The European Community Respiratory Health Survey (ECRHS) calculated the incidence of asthma from the reported

**Table 3. Asthma incidence (new cases per 1000 persons) by age, 2000-2003.**

Age group	Males	Incidence	Females	Incidence	M + F	Incidence
00-04	25	7.58	13	4.18	38	5.93
05-09	10	3.11	9	2.71	19	2.91
10-14	11	3.21	6	1.77	17	2.49
15-24	14	1.66	20	2.33	34	2.00
25-34	7	0.69	23	2.22	30	1.47
35-44	15	1.64	27	2.73	42	2.21
45-54	10	1.29	14	1.72	24	1.51
55-64	7	1.13	19	2.62	26	1.94
65-74	8	1.37	13	1.78	21	1.60
75 +	3	0.80	6	1.01	9	0.93
TOTAL	110	1.80	150	2.23	260	2.02

**Table 4. Proportion of patients meeting diagnostic criteria for asthma.**

	n	%
All criteria present	155	50.0
Most criteria present	92	29.7
Diagnosis confirmed by hospital consultant	13	4.2
Diagnosis not confirmed	50	16.1
Total	310	100.0

**Table 5. Asthma incidence standardised by age and sex to Portuguese population of 2003.**

Age group	Males standardised incidence rate/1000/year	Females standardised incidence rate/1000/year
0 to 14 years	4.6	2.8
15 to 64 years	1.2	2.3
65 and over	1.2	1.5

age of the first asthma attack and observed a wide variation; the incidence rate of childhood asthma (0–15 years) varied from 1.3 to 6.7 per 1,000 person-years. The corresponding variation in the incidence of adult onset asthma was from 0.3 to 2.9.<sup>13</sup> Eagan *et al.* recalculated a pooled estimate of the incidence of adult asthma of 4.6 per 1,000 person-years in women and 3.6 per 1,000 person-years in men.<sup>5</sup>

#### Internal validity

Portuguese family physicians have relatively stable patient lists. The age-gender distribution of the lists is updated yearly and reported to the Portuguese Sentinel Practice Network (PSPN) coordination centre. The PSPN uses the participating physicians' lists as a denominator for estimating incidence rates. Whenever participating doctors are absent for prolonged periods from their practices, their lists are removed from the denominator for statistical purposes. During the study period there was a mean change in list size of less than 1% per year per practice.

#### Questionnaire / diagnostic criteria

The diagnostic criteria for asthma used in this study were the criteria listed in the 2005 GINA guidelines. They have been adapted further for use in primary care by the IPCRG in 2006<sup>14</sup> and further updated by GINA in 2008.<sup>15</sup> Future study of asthma incidence should use the latest diagnostic criteria.

#### Comparison of findings with other published studies

This study found an annual incidence of asthma of 2.02 cases per 1000 population per year. This is higher than the rate of 0.95 reported among older adults in the US,<sup>16</sup> 1.6 among adults in Finland,<sup>17</sup> or 1.08 among adults in Sweden.<sup>18</sup> However, it is less than the rate of 5.53 reported among adults in Spain.<sup>19</sup> The figures in this study are similar to findings among adult patients in two studies conducted in the USA.<sup>20,21</sup>

**Table 6. Comparison of asthma incidence rate (new cases per 1000 people) between the PSPN study and the study by McWhorter *et al.*<sup>21</sup>**

Age group (years)	PSPN, 2004	McWhorter, 1988 <sup>21</sup>
25-34	1.5	1
35-44	2.2	1.4
45-54	1.5	1.9
55-64	1.9	3.1
65-74	1.6	3.7
Total	1.75	2.1

It is difficult to compare incidence among similar age groups in different studies because of the different age intervals used. Eagan *et al.* reviewed data from several studies in 2005 and presented a comparison of the findings. Very few studies have comparable data to the present one in terms of the age groups covered. The paper by McWhorter *et al.*<sup>21</sup> has comparable data which can be seen in Table 6.

Table 7 presents data from different sources in order to allow a comparison with the PSPN study.

There are several questions arising from the high incidence of asthma in small children found here. There are considerable diagnostic difficulties in this age group. Often physicians diagnose asthma at an older age and retrospectively attribute the onset of asthma to a specific year. In the PSPN study the incidence rate in the age group 1-14 years was 3.74 cases per 1000 per year, considerably higher than the 1.4 cases/1000/year found by Yunginger *et al.* in 1992.<sup>20</sup> The PSPN study observed a higher incidence rate in the age group 0 – 4 years (5.93 cases/1000/year). It is possible that some of the children diagnosed with asthma were suffering from recurrent wheezing or bronchiolitis. These findings raise the possibility of over-reporting in this age group.

In this study, the incidence rate among patients over 65 years of age is 1.31/1,000/year. This is slightly higher than the incidence found in the USA in 1997.<sup>20</sup> Eagan *et al.* also suggest that the incidence of asthma in the elderly has previously been under-estimated.<sup>5</sup>

Our findings follow the pattern reported previously – with higher rates of asthma in boys than in girls and lower rates in men than in women.<sup>22</sup>

#### Accuracy of diagnosis

Given the difficulties in diagnosing asthma, one of the aims of the present study was to validate the diagnosis of asthma made by GPs working in the primary health care setting. While a number of studies suggest that there is under-diagnosis of asthma in children, adolescents and adults, little research has been conducted on the over-diagnosis of asthma. Symptoms similar to those seen in asthma can be found in other lung diseases such as emphysema and chronic

**Table 7. Comparison of asthma incidence rate between the PSPN study and other studies.**

Author / year	Location	Age group	Incidence rate /1000	PSPN 2004
McWhorter, 1988 <sup>21</sup>	USA (NHANES I)	25-74	2.1	1.75
Yunginger, 1992 <sup>20</sup>	USA	1-14	1.4	3.7
Bauer, 1997 <sup>16</sup>	USA	>65	0.9	1.3
Ronmark, 1997 <sup>32</sup>	Sweden	35-66	5	
Huovinen, 1999 <sup>17</sup>	Finland	18-45	1.6	
Basagaña, 2001 <sup>19</sup>	Spain	20-44	5.5	
Eagan, 2002 <sup>33</sup>	Norway	15-70	3.2-3.6	
RHINE Study, 2004 <sup>34</sup>	Sweden, Norway, Denmark, Iceland and Estonia	30-54	2.2	
de Marco, 2005 <sup>35</sup>	Italy	20-44	1.5	
Eagan, 2005 <sup>5</sup>	Several countries	Several (pooled data)	3.6-4.6	
Thomsen, 2005 <sup>36</sup>	Denmark	12-41	5.5	

bronchitis.<sup>23</sup> These symptoms may also appear in patients with cardiac failure, pulmonary tumours or hyperventilation syndrome. The diagnostic accuracy found in this study was 83.9%. This figure is lower than that found by Ward *et al.*<sup>24</sup> whose sample was limited to individuals aged 16 – 45 years in order to reduce the effects of diagnostic uncertainty in children and confusion with COPD in older patients. This may explain the difference in the rates.

The accuracy of diagnosis in the present study was higher than that found by Montnémy *et al.* (76.5%),<sup>25</sup> but their study involved over 100 general practices compared to 43 physicians in the current study – and this might explain the differences in diagnostic accuracy between the two studies. Marklung *et al.* reported a diagnostic accuracy of 66% over a two year period,<sup>23</sup> but their study involved only 86 patients compared to 310 in the current study.

We used existing international guidelines<sup>8</sup> for the definition and diagnosis of asthma when the first report of the study was completed in 2005. Due to the limitations of guidelines,<sup>26,27</sup> the difficulties encountered by physicians in adhering to them,<sup>28</sup> and difficulties in clinical practice in managing asthma in line with recommendations,<sup>29</sup> the International Primary Care Airways Group (IPAG) produced its own guidelines for primary care physicians in 2005.<sup>30</sup> Together with the IPCRG guidelines,<sup>14</sup> these provide a more practical approach than the GINA Guidelines. They add clinical assessment, continuity of care, and the best knowledge of the family history to help make the diagnosis of asthma. The IPCRG recommendations<sup>14</sup> remain an excellent tool for the management of asthma and other respiratory conditions in primary care even after publication of the 2006 GINA update.<sup>31</sup>

### Implications for future research

This study has implications for clinicians, researchers and patients. An incidence of 2 new cases per 1000 persons per year with a diagnostic accuracy of 84% suggests that there is considerable under-diagnosis of a common, treatable

condition. Patient education to improve recognition and reporting of important symptoms to their physicians, and education of practitioners in the use of valid diagnostic criteria, may help increase the rate of diagnosis and improve patients' quality of life by providing them with effective treatment. Further research that focuses on effective education for the public and healthcare professionals, and effective application of existing standards for the diagnosis and treatment of asthma, is also required.

### Conclusion

Data from the current study suggest that the diagnoses of asthma made by the family physicians in the PSPN were accurate in 84% of all reported cases with reference to the diagnostic criteria used. The incidence rate reported here falls within the range of values reported in the literature from other countries. Based on these data we may expect 20,250 new cases of asthma per year in Portugal. If so, there is probably marked under-diagnosis of this condition in practice. This suggests the need for an educational campaign to make the diagnostic criteria more widely known and to provide support for practitioners in making the diagnosis. With the effective treatments now available, a campaign for more accurate diagnosis and the application of evidence-based guidelines for treatment would have the potential to improve quality of life for a large segment of the population.

### Acknowledgment

The authors would like to express their gratitude to the family physicians who reported and reviewed data and to the coordinators and staff of the Portuguese Sentinel Practice Network (Médicos Sentinela).

### Conflict of interest declarations

Dr Correia de Sousa has received sponsorship to attend international meetings from Novartis and MSD and honoraria for lecturing and attending advisory boards from AstraZeneca and Altana. His department has received research funding from AstraZeneca. Dr Silva received sponsorship to attend local and international meetings from AstraZeneca and MSD.

## Funding

Funding for the Sentinel Practice Network is provided by the Portuguese Ministry of Health.

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