Aging and Disability Affect Misdiagnosis of COPD in Elderly Asthmatics*

The SARA Study†

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Study objectives: This study investigated to what extent a diagnosis of COPD is erroneously made or the disease remains unrecognized in elderly asthmatic patients, and identified factors leading to misdiagnosis and underdiagnosis of asthma in such patients.

Design: A multicenter study involving 24 Italian pulmonary or geriatric institutions.

Patients: One hundred twenty-eight asthmatic patients (98 women, 76.6%) aged 73 ± 6.4 years (mean ± SD) were selected from the cohort of the Salute Respiratoria nell'Anziano (respiratory health in the elderly) study.

Methods: All patients underwent a clinical evaluation that included clinical history and spirometry with a bronchodilator test. A diagnosis of asthma was based on criteria proposed by international guidelines adapted to the elderly population. A multidimensional geriatric assessment was performed to estimate physical and cognitive impairments and mood state. Finally, the diagnosis of respiratory disease previously made by a doctor, if any, was recorded.

Results: Of asthmatic patients, COPD had been improperly diagnosed in 19.5%, whereas 27.3% of asthmatic patients did not report any previous diagnosis of asthma. The main correlates of misdiagnosis were older age and disability. Conversely, underdiagnosis was associated with better functional conditions, expressed by spirometry, even when wheezing or a significant response to the bronchodilator test occurred.

Conclusions: Asthma in the elderly is frequently confused with COPD. Misdiagnosis can be related to older age and to greater degree of disability. Asthma in patients with mild functional impairment may be underdiagnosed in spite of overt respiratory symptoms suggestive of asthma.

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Key words: asthma; diagnosis; disability; elderly

Abbreviations: FEV1% = FEV1 percentage of predicted; GDS = geriatric depression scale; MMSE = Mini Mental State Examination; SARA = Salute Respiratoria nell’Anziano; 6MWT = 6-min walking test

For many years, asthma has been considered a disease of childhood or young adulthood, although it is not uncommon in the elderly.1 Elderly asthmatic patients mainly include subjects who acquired the disease during childhood or adolescence and whose disease progressed over time or relapsed after periods of remission; however, the first manifestations of asthma may also occur in the late adulthood or after 65 years of age. The reasons why asthma is rarely diagnosed in the elderly are unclear. The presumed low prevalence of asthma in the elderly can be attributed to greater difficulties encountered when providing a correct diagnosis of asthma in the elderly as opposed to the younger population.1,2 It is likely that factors pertaining to aging play a significant role. This may be, at least in part, attributed to a blunted perception of symptoms at

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†A list of participants and participating institutions is given in the Appendix.
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this age. In addition, respiratory symptoms may be overlooked by physician or, when noted, may not be properly evaluated with functional assessment; however, underestimation of the prevalence of asthma may be due to confusion with COPD. In fact, asthma and COPD share clinical and functional similarities, although their pathologic presentations differ considerably and the two syndromes are, indeed, different diseases. Finally, one cannot exclude the simultaneous occurrence of the two pathologic conditions, given the high prevalence of asthma and COPD and the fact that a smoking habit may be present in both entities. Taken together, these observations imply clinical and therapeutic consequences, in that correct treatment may be omitted or delayed in the elderly population. It is important, therefore, to promptly recognize and, when possible, distinguish the two diseases in order to provide appropriate treatment. This study evaluated to what extent a diagnosis of COPD is erroneously made or the disease remains unrecognized in elderly asthmatic patients, and identified the factors leading to misdiagnosis and underdiagnosis of asthma in such patients.

**Materials and Methods**

**Subjects**

We studied a subgroup of 128 asthmatic subjects (98 women, 76.6% aged 73 ± 6.4 years (mean ± SD) enrolled in the Salute Respiratoria nell’Anziano (SARA) [respiratory health in the elderly] study. This is a multicenter Italian project aimed at investigating various aspects of chronic airway diseases in the elderly population. Twenty-four pulmonary or geriatric institutions, distributed throughout Italy, took part in the investigation (see Appendix). All eligible subjects ≥ 65 years old and attending the above-cited institutions between January 1, 1996, and December 1998 were enrolled in the SARA study. Data from individual centers were collected by a coordinating center at the Cattedra di Malattie dell’Apparato Respiratorio of the University of Palermo, which was also responsible for the quality control, the retrieval, and the final processing of data.

General exclusion criteria of the SARA study were as follows: severe hepatic failure (B and C grades of Child index); severe renal failure (plasma creatinine level > 2 mg/dL), severe cognitive, and/or sensory impairment; hospitalization for any reason within the previous 6 months; and malignant neoplasms. At the end of recruitment, a total of 1,971 subjects were classified into two groups: 734 subjects with chronic respiratory diseases, including patients with asthma, COPD, and simple chronic bronchitis, and 1,237 subjects without any respiratory disease.

In the entire study population, clinical history related to pulmonary diseases was recorded using a respiratory questionnaire derived with some modifications from the International Union Against Tuberculosis and Lung Diseases Questionnaire. Physical examination and spirometry were included in the diagnostic assessment. Pulmonary function tests were performed with a standardized technique in all centers. The specific technique for performing spirometry, as well as all the other practical aspects of experimental set-up, including quality control procedures, were the object of a specific training course, as described elsewhere. Participating centers were provided with an identical fully computerized, water-sealed Stead-Wells spirometer (Baires System; Biodedic; Padua, Italy) that fulfills the American Thoracic Society 1994 recommendations for diagnostic spirometry. The pulmonary function tests consist of baseline spirometry and postbronchodilator test (reversibility test) performed using fenoterol, 100 μg, administered through a space chamber. The degree of reversibility was calculated as percentage increase from the baseline condition. As previously published, reliable data, in terms of acceptability and reproducibility of FEV1 and FVC, were obtained in the vast majority of patients. Indeed, the rate of acceptability was 84% and 82% in patients with and without respiratory diseases, respectively. The rates of FEV1 and FVC reproducibility were 94% and 88% in patients with respiratory diseases, and 96% and 91% in those without respiratory diseases, respectively.

For the purpose of the present study, a subgroup of asthmatic patients was selected. The criteria used to diagnose asthma were as follows: (1) FEV1 > 80% of predicted, history of wheeze in the preceding year, and absence of history of chronic cough and sputum; (2) FEV1 < 80% of predicted, FEV1 increase > 12% after fenoterol, 100 μg, and absence of history of chronic cough and sputum; (3) FEV1 < 80% of predicted, FEV1 increase < 12% after bronchodilator, history of wheeze in the last year, and absence of history of chronic cough and sputum. We also excluded all subjects with smoking history ≥ 5 pack-years. Category 3 is justified by observations reported in the international guidelines for diagnosis of asthma in the elderly: many elderly patients with asthma have a persistent degree of airflow obstruction even when optimally treated, and episodic wheezing in the absence of history of smoking is a useful sign of asthma in this population.

**Comparison of the Diagnoses**

On the basis of the preexisting diagnosis of respiratory disease that had been made by other physicians and reported by the patients, our sample of asthmatics was classified in three groups. The asthma group included patients who reported a previous diagnosis of asthma, as well as those who had received both asthma and COPD diagnoses. The COPD group included patients who reported only a previous diagnosis of COPD and/or emphysema. Finally, the none group included patients without any previous diagnoses of respiratory diseases. Our diagnosis of asthma was then compared to the previous diagnoses.

**Multidimensional Assessment**

Multidimensional assessment included the following: social and environmental status, personal history (smoking habit, quality of sleep, respiratory symptoms, and treatment regimen), evaluation of physical functioning by 6-min walking test (6MWT), assessment of cognitive impairment with Mini Mental State Examination (MMSE), and mood state by geriatric depression scale (GDS). Evaluation of disability was made by the Barthel index. This is an ordinary scale scoring from 0 (complete dependence) to 100 (complete independence) that takes in account feeding, bathing, grooming, dressing, bladder control, toileting, chair/bed transfer, mobility, and stair climbing.

**Comparison of Early Onset and Late-Onset Asthma**

Age of onset of asthma was determined on the basis of the year of the first onset of dyspnea. A clear-cut answer to this question was given by 105 patients, while the remaining 23 patients were
not able to answer. Thereafter, we arbitrarily classified these 105 subjects in two groups: 48 patients with an early onset (before the age of 60 years) and 57 patients with a late onset (after the age of 60 years). The cutoff point of age 60 years was chosen because overt manifestations of COPD usually occur in late adulthood; therefore, asthmatic patients > 60 years old were expected to be more frequently misrecognized as affected by COPD.

Statistical Analysis

Differences in anthropometric, multidimensional, and functional characteristics between the groups with and without a previous diagnosis of asthma and between early and late-onset asthma were evaluated using $\chi^2$ for dichotomous variables and analysis of variance (or Kruskal-Wallis) for continuous variables having normal distribution and homogeneous variance. In case of comparison between the three groups, differences were tested using the Bonferroni correction.

RESULTS

Mean FEV$_1$ percentage of predicted (FEV$_1$/% in the entire sample was 70.7 ± 25.7%, and mean FEV$_1$/FVC was 65.6 ± 13.3% (mean ± SD). Airway obstruction (FEV$_1$/FVC < 70%) was detected in 60% of participants. The mean percentage increase in FEV$_1$ after reversibility test was 14.4 ± 15.7%, with 50% showing an increase > 12%.

Diagnosis of Asthma

Among the 128 asthmatic patients, only 68 patients (53.1%) had received a correct diagnosis of asthma (asthma group), while 25 patients (19.5%) reported a wrong diagnosis of COPD and/or emphysema (COPD group); in 35 patients (27.3%), the respiratory disease had never been diagnosed previously (none group). The three groups did not differ in terms of gender: the prevalence of female patients was 24.1%, 29.3%, and 29.3% in the asthma group, the COPD group, and the none group, respectively. As presented in Table 1, patients classified in the COPD group had a mean age significantly higher (76.0 ± 6.5 years, $p < 0.05$) than that of the other two groups, while patients with a correct diagnosis of asthma had a higher prevalence of history of allergy (50.7%, $p < 0.001$) and a higher degree of FEV$_1$ reversibility (18.6 ± 18.1%, $p < 0.01$). Finally, patients without any previous diagnosis of respiratory diseases showed FEV$_1$/FVC higher than that of the other two groups (72.2 ± 11%, $p < 0.01$). A total of 76% of asthma group patients were currently using at least one bronchodilator, vs 15.3% of patients in the COPD group ($p < 0.001$) and 7.9% in the none group ($p < 0.001$). Groups did not differ in terms of prevalence of selected comorbid conditions (Table 1).

The results of multidimensional assessment (Table 2) pointed out that patients with a wrong diagnosis of COPD had a significantly higher degree of disability when compared to the other two groups, as expressed by a lower Barthel index (89.1 ± 8.8, $p < 0.05$). No significant differences for MMSE, GDS scores, and for distance walked during 6MWT were recorded.

Respiratory Symptoms

As expected, the most prevalent asthma-like symptom in the whole sample was the occurrence

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Table 1—Anthropometric, Functional, and Clinical Characteristics of Asthmatics Subclassified According to the Previous Diagnosis*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Asthma Group</th>
<th>COPD Group</th>
<th>None Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No.</td>
<td>68</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>Age, yr</td>
<td>72.1 ± 6</td>
<td>76.0 ± 6.1$\dagger$</td>
<td>72.9 ± 6.3</td>
</tr>
<tr>
<td>Male gender, %</td>
<td>23.5</td>
<td>26.0</td>
<td>20.0</td>
</tr>
<tr>
<td>FEV$_1$%,</td>
<td>67.4 ± 25.4</td>
<td>62.8 ± 21.8</td>
<td>82.7 ± 25.3$\dagger$</td>
</tr>
<tr>
<td>FEV$_1$/FVC</td>
<td>63.3 ± 13.6</td>
<td>62.6 ± 12.8</td>
<td>72.2 ± 11.0$\dagger$</td>
</tr>
<tr>
<td>$\Delta$FEV$_1$/%</td>
<td>18.6 ± 18.1$\dagger$</td>
<td>12.3 ± 9$\dagger$</td>
<td>7.1 ± 10.2$\dagger$</td>
</tr>
<tr>
<td>History of allergy, %</td>
<td>50.7$\dagger$</td>
<td>16.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Current use of at least one bronchodilator, %</td>
<td>76</td>
<td>15.3$\dagger$</td>
<td>7.9$\dagger$</td>
</tr>
<tr>
<td>Prevalence of select comorbid diseases, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>27.7</td>
<td>36.0</td>
<td>34.3</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>9.2</td>
<td>20.0</td>
<td>5.7</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>9.2</td>
<td>12.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>3.1</td>
<td>12.0</td>
<td>11.4</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>12.3</td>
<td>24.0</td>
<td>8.6</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>7.7</td>
<td>24.0</td>
<td>8.6</td>
</tr>
<tr>
<td>Hemiparesis</td>
<td>1.5</td>
<td>12.0</td>
<td>2.9</td>
</tr>
</tbody>
</table>

*Data are reported as mean ± SD unless otherwise indicated. $p > 0.05$ when not reported. $\Delta$FEV$_1$ = increase of FEV$_1$ after reversibility test. $\dagger$$p < 0.05$. $\ddagger$$p < 0.01$. $\spadesuit$$p < 0.001$. 

Clinical Investigations
wheezing in the last 12 months, which was one of the inclusion criteria; this symptom was reported by 115 patients (89.8%). Dyspnea on exertion, reported by 102 patients (79.7%), represented the second most frequent symptom. Nocturnal awakenings for cough (61 subjects, 47.6%), dyspnea at rest during the day (51 subjects, 39.8%), chest tightness in the morning (50 subjects, 39.1%), nocturnal awakenings because of dyspnea (46 subjects, 35.9%), and cough in the morning (23 subjects, 18.0%) were also present.

The occurrence of wheezing and cough in the morning did not differ among the three groups (Fig 1). Conversely, nocturnal awakenings for cough, dyspnea at rest during the day, and chest tightness in the morning were significantly more prevalent in patients with a correct previous diagnosis; conversely, dyspnea on exertion and nocturnal awakenings for dyspnea were significantly less frequent in the subgroup of patients who had not received any diagnosis.

Table 2—Main Results of Multidimensional Assessment in Different Diagnostic Subgroups*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Asthma Group</th>
<th>COPD Group</th>
<th>None Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barthel index</td>
<td>91.5 ± 10.2</td>
<td>89.1 ± 8.8</td>
<td>94.7 ± 4.7</td>
</tr>
<tr>
<td>MMSE</td>
<td>26.5 ± 4.0</td>
<td>25.2 ± 4.4</td>
<td>21.1 ± 2.8</td>
</tr>
<tr>
<td>GDS</td>
<td>4.8 ± 3.7</td>
<td>4.8 ± 4.2</td>
<td>5.1 ± 3.4</td>
</tr>
<tr>
<td>6MWT, m</td>
<td>300.1 ± 132.2</td>
<td>281.4 ± 155.3</td>
<td>290.0 ± 104.2</td>
</tr>
</tbody>
</table>

*Data are reported as mean ± SD. 
†p < 0.05.

Recently Acquired and Long-standing Disease

The early onset asthma group had a mean duration of disease of 29.1 ± 15.2 years, whereas the late-onset group reported a symptomatic disease lasting 5.4 ± 3.6 years (p < 0.0001). Early onset and late-onset groups differed in terms of age (early onset, 70.1 ± 4.0 years; late onset, 73.9 ± 5.5 years; p < 0.001) and history of allergy (early onset, 52.2%; late onset, 23.6%; p < 0.01). However, the two groups did not differ for gender distribution, degree of airway obstruction (assessed by FEV1% or FEV1/FVC), and postbronchodilator reversibility.

Table 3 shows the relationship between age at onset and diagnostic subgroups of asthmatic patients. The subgroup with the correct diagnosis had a longer duration of the disease than patients with a misdiagnosis of COPD and those with no diagnosis (21.2 ± 17.7, 9.7 ± 8.0, and 8.3 ± 9.5 years, respectively; p < 0.001). Furthermore, approximately one third of patients were correctly recognized as asthmatic, but only 1 of 20 COPD group patients and 1 of 23 none group patients dated the onset of symptoms before age 40 years (p < 0.01), confirming that the onset of symptoms later in life was more commonly associated with a misdiagnosis of COPD.

Discussion

The present study shows that in our population, one of five elderly asthmatic patients receives an
improper diagnosis of COPD, and at least one of four asthmatic patients does not receive any diagnosis of respiratory disease. Older age and disability, together with a less typical clinical pattern, have been shown to significantly affect misdiagnosis, whereas a milder functional impairment appears to be a risk factor for underdiagnosis of asthma in the elderly. Male sex did not qualify as a risk factor for a misdiagnosis of COPD instead of asthma, likely because we used a very conservative diagnosis of asthma that excluded smokers with a ≥ 5 pack-year smoking history.

**Misdiagnosis**

Differential diagnosis between asthma and COPD in elderly subjects may often be a difficult task, mainly because of clinical overlapping of the two pathologic entities, which leads to the so-called "asthmatic bronchitis"; however, the distinction between these two clinical pictures becomes crucial when therapeutic choices are to be determined. It is reasonable, therefore, to attempt to avoid any confusion in diagnosing pulmonary obstructive diseases, since this can result in omission of the optimal treatment for such patients. This is also confirmed by the results of this study: the increased usage of bronchodilators, which reflects to some extent the better management of the disease, occurs when the correct diagnosis of asthma is made in such population. Our findings support previous observations indicating that older age is one of the major factors that contributes to misdiagnosis of asthma in elderly subjects. The asthmatic phenotype is most often associated with childhood and adolescence, and its clinical and functional importance is believed to decline with aging. For these reasons, it is not surprising that any chronic obstructive disorder of the airways occurring in older patients is more likely to be diagnosed as COPD. An analysis of the Health Care Financing Administration file for the year 1984 through 1991 demonstrated that patients > 64 years old hospitalized with a main diagnosis of asthma in 1984 frequently received a diagnosis of COPD on the occasion of rehospitalization. The reverse change of diagnosis, ie, from COPD to asthma, was less common. The lack of a standardized diagnostic method did not allow for these changes to be explained; however, the large size of the cohort of patients firstly recognized as asthmatics and tracked throughout 7 years lends support to the observation that asthma is a very unstable diagnosis in general clinical practice.

An interesting finding of the present study is represented by the role of physical disability in the diagnosis of elderly asthmatics. Indeed, patients with an erroneous diagnosis of COPD have shown a lower Barthel index, that is, more severe disability than the other two groups. The Barthel index, initially constructed for evaluation of ability to perform daily activities in patients with neuromuscular and musculoskeletal disorders, is now largely employed for the assessment of mobility and self-care in geriatric patients. A possible explanation for the association between disability and erroneous diagnosis of COPD in elderly asthmatics is related to the fact that a high degree of physical impairment often characterizes the late stages of natural history of COPD. However, Enright et al demonstrated that in elderly subjects, even the asthmatic condition can significantly impair daily activities.

Our results point out the relationship between misdiagnosis of COPD and the less typical pattern of asthma in the elderly, expressed by the absence of nocturnal or early morning symptoms, the poor immediate response to the bronchodilator and, finally, the late onset of symptoms (ie, after the age of 60 years). The impact in terms of misclassification between asthma and COPD is obviously related to the absence of established criteria for diagnosing asthma in advanced age, when some fundamental characteristics that are observed in asthma in younger subjects may become less important or even unreliable. In this perspective, Burrows et al showed that the percentage of asthmatics with positive skin test results decreases from 78.7% in subjects aged 6 to 34 years, to 39.6% in those ≥ 55 years old. Similar results have been presented by Braman et al, who described a group of 12 asthmatics with onset of disease after 70 years of age and without history of allergy or immediate positive skin test results. In addition, the criterion of bronchodilator response lacks sensitivity and specificity because some degree of fixed obstruction may be present in elderly asthmatics; however, some level of reversibility may be found in a significant portion of patients with COPD. Finally,

### Table 3—Natural History Characteristics of the Disease in Different Diagnostic Subgroups*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Asthma Group</th>
<th>COPD Group</th>
<th>None Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No.</td>
<td>62</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>Age of onset, yr</td>
<td>50.8 ± 19.6†</td>
<td>64.3 ± 12.4</td>
<td>62.5 ± 9.2</td>
</tr>
<tr>
<td>Onset before age</td>
<td>19 (30)†</td>
<td>1 (5)</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>40 yr, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onset after age</td>
<td>26 (42)†</td>
<td>15 (75)</td>
<td>16 (70)</td>
</tr>
<tr>
<td>59 yr, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease duration, yr</td>
<td>21.2 ± 17.7‡</td>
<td>9.7 ± 8.0</td>
<td>8.3 ± 9.4</td>
</tr>
</tbody>
</table>

*Data are reported as mean ± SD unless otherwise indicated.

| **p** < 0.01,

| **p** < 0.001.
we were able to demonstrate that the age of asthma onset plays a confounding role; in fact, first onset of asthma at older age is still considered very rare.

**Underdiagnosis**

Approximately one of four asthmatics did not have respiratory disease previously diagnosed. These data confirm previous observations9,10 reporting that in elderly subjects, airway obstruction is frequently underdiagnosed. This finding could be related to the misconception (widely shared both by many elderly patients and by some physicians) attributing the occurrence of respiratory symptoms to the aging process per se. However, symptoms such as dyspnea, wheezing, and cough cannot be attributed to aging, and they must be carefully evaluated in elderly people as well as in younger subjects. A large number of studies have reported that wheezing is the most common symptom of asthma in the elderly9; in addition, international guidelines have incorporated wheezing as one of the most suggestive signs of asthma, especially in nonsmoking elderly patients.11 However, in our series wheezing was often observed even in patients without any previous diagnosis of respiratory disease. In this perspective, the importance of spirometry as the best method to test whether respiratory symptoms are related to airways obstruction cannot be overemphasized.

**Limitations**

Distinguishing asthma from COPD in the elderly is an arduous task. Patients with a ≥ 5 pack-year smoking history were excluded in order to increase the positive predictive value of the diagnostic algorithm, ie, the chance of identifying true asthmatics, while inevitably lowering the negative predictive value, ie, the chance of minimizing the prevalence of false-negative results. Indeed, we are aware that some proportion of asthmatics recruited in the SARA study was missed, but we are reasonably confident that the risk of classifying patients who had COPD as asthmatics was negligible. However, judging a history of productive cough as incompatible with a diagnosis of asthma does not exclude that a few patients with COPD denying such a history but having emphysema might have been classified as asthmatics. Furthermore, patients with a history of wheeze secondary to a viral illness might occasionally have fallen into category 1. However, since a diagnostic “gold standard” is lacking in the elderly, the ongoing follow-up of these patients will probably allow us to reconsider and, if needed, improve the diagnostic criteria.

**Conclusion**

In summary, our results suggest that asthma in the elderly is frequently confused with COPD or not diagnosed. Older age and the greater degree of disability, together with a less typical clinical pattern, appear to be the main causes of misdiagnosis, even when smoking history and chronic sputum are not present. In addition, respiratory symptoms suggestive of asthma, such as wheezing, may be underestimated, especially in patients with mild disease.

**Appendix**

Study coordinators were V. Bellia (Palermo) and F. Rengo (Napoli). Scientific Committee members were R. Antonelli-Incalzi (Rome), V. Grassi (Brescia), S. Maggi (Padua), G. Masotti (Florence), G. Melfilo (Naples), D. Olivieri (Parma), M. Palleschi (Rome), R. Pistelli (Rome), M. Trabucchi (Rome), and S. Zuccaro (Rome).

was Cattedra di Malattie dell’Apparato Respiratorio, Istituto di Medicina Generale e Pneumologia, University of Palermo (V. Bellia) [F. Catalano, N. Scichilone, S. Battaglia, F. Tartamella].

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