What is the correlation between the results of the CARAT (Control of Allergic Rhinitis and Asthma Test) and the ones of lung function tests?


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ABSTRACT

Asthma is a widespread disease that affects 300 million people worldwide. In Portugal, 1,08 million people have had the disease at some time in their lives.

Controlled asthma is considered to be the state in which the patient displays but minimal symptoms, having little to no need of rescue medication, and no impairment whatsoever in day-to-day activities.

The CARAT (Control of Allergic Rhinitis and Asthma Test) questionnaire and Lung function tests (current standard in clinical evaluation of asthmatic patients’ condition) aim to quantify and assess the degree of control of allergic rhinitis and asthma in adult patients.

We will conduct a study to find if the CARAT questionnaire’s results are directly correlated to the ones of lung function tests, which will assess its suitability to assess control of asthma in adults, alongside them.

For the study itself, we will utilize data retrieved from the Immunoallergology database of the São João Hospital, regarding the CARAT questionnaire, we will have access to three scores: total score, higher and lower airway score; as for lung function tests, we will have access to FEV1, %PredFEV1, FVC, (FEV1/FVC), and FENO values. This data was gathered between February and July 2011 from 431 patients previously diagnosed with both asthma and allergic rhinitis or just asthma that had done Carat questionnaire and the spirometry test around the same time.
At the end of this study, we hope to find a possible correlation between the scores obtained in the CARAT questionnaire and the results of lung function tests. If a correlation is found the assessment of asthma control will be more widespread, due to the online availability of the CARAT questionnaire, the fact that it is cost-free, and that it can be done from the comfort of one’s home, with less need for professional help. The combination of these factors would lead to a noticeable improvement in both the life quality of asthmatics and resource management in healthcare institutions involved in the control of asthma. This would mean a better follow-up of the evolution of the patient’s situation, and it would help decreasing the number of patients who got worst because they couldn’t make the exams as often as they should.

**KEY-WORDS:** Asthma, Respiratory Function Tests, CARAT test, comparative study

**INTRODUCTION**

**BACKGROUND**

Asthma could be defined as a chronic inflammatory disease, allergic or non-allergic, affecting the respiratory track, that may originate, in susceptible individuals, wheezing, dyspnoea and coughing [1-3]. These symptoms are commonly associated with generalized, but variable, airway obstruction, which may be reversible spontaneously or through treatment [1]. Patients with asthma have a higher risk for anxiety or depression and frequently have psychological distress [4, 5].

Controlled asthma [6] is considered to be the state in which the patient displays but minimal symptoms, having little to no need of rescue medication, and no impairment whatsoever in day-to-day activities [1,2].

Asthma is a widespread disease that affects 300 million people worldwide [2,7]. In Portugal, 1.08 million people [7] have had the disease at sometime in their lives. The majority of Portuguese asthmatic patients (57%) have the disease controlled.

The role of the health care professional is to establish each patient’s current level of treatment and control, and then adjust treatment [8] to gain and maintain control. Asthma patients should experience no or minimal symptoms (including at night), have no limitations on their activities
(including physical exercise), have no (or minimal) requirement for rescue medications, have near normal lung function, and experience only very infrequent exacerbations\textsuperscript{[2]}.

According to a previous study\textsuperscript{[9]}, in which a total of 1812 patients were assessed; 809 (45\%) had controlled asthma, and 1003 (55\%) had uncontrolled asthma. Most patients had health care coverage and received care from a general practitioner; a large proportion of patients with controlled asthma (74\%) and patients with uncontrolled asthma (65\%) reported never receiving an asthma action plan.

The CARAT questionnaire\textsuperscript{[10,11]} is undertaken by asthmatic individuals, as a novelty way of controlling their symptoms, after receiving treatment for this disease. Such test consists of a questionnaire, in which the patient grades their condition regarding several symptoms related to asthma and allergic rhinitis (being that the latter is irrelevant for this study). For validity reasons, this is restricted to adults. This questionnaire can be answered at home because it is available in the internet.

Lung function tests\textsuperscript{[12]} are the current standard in clinical evaluation of asthmatic patients' condition, measuring several variables, such as air intake volume, inhalation and exhalation speed, and efficiency of gas exchanges in the alveoli. For this study, the only relevant test is spirometry\textsuperscript{[12,13]}, which measures exhalation speed and exhaled air volume.

Previous attempts at similar approaches\textsuperscript{[14,16-24]}, such as the ACT (asthma control test)\textsuperscript{[17,25-34]} in assessing asthma control have been made before, and served as a guiding aid for this study.

**JUSTIFICATION**

The CARAT test is available online\textsuperscript{[10]}, which allows the patient to control its own disease without the need for medical intervention, whereas lung function tests are only available in some health care institutions, this requires medical intervention. Moreover, the use of the CARAT test allows a closer and more frequent approach. Using CARAT as a supplement to, or replacement for, other tests could decrease medical costs and increase life quality. However, the CARAT test has a certain degree of subjectivity, which may make it less accurate than lung function tests\textsuperscript{[14]}. Given the current need to improve financial efficiency in hospital management, and the potential savings inherent to the CARAT test, when compared to the current standard of lung function tests, we saw a need to investigate the accuracy of this test as a standardized control method of asthmatic patients' condition, with the final aim of determining whether these tests would prove to be a suitable replacement (partial or complete) for the aforementioned, more expensive and more time-consuming lung function tests\textsuperscript{[7,15-17]}. 


AIMS

Our main goal is to evaluate the correlation between CARAT questionnaire and lung function test results in asthmatic adults who have done both. We also aim to assess whether any specific lung function test variable has a greater impact on CARAT results.

POPULATION

Asthmatic patients from "Centro Hospitalar do Porto", male and female. Should be over 18, able to read and to fill in the questionnaire.

Patients were excluded if they had not been diagnosed with Asthma. The initial database provided was in compliance with all but the last of these criteria. As such, the number of patients was reduced from 431 to 319, after excluding those with a diagnosis of rhinitis only, and those on whom data was missing.
The final group consisted of 319 patients, of which 103 were men and 216 were women. Regarding the diagnosed pathology, 71 suffered solely from asthma, while 248 had allergic rhinitis as well. 219 were atopic, 73 were not, and information was missing in the remaining 47.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at the date of the exam</td>
<td>42.87</td>
<td>15.12</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>72.81</td>
<td>15.07</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.14</td>
<td>10.05</td>
</tr>
<tr>
<td>%PredFEV1</td>
<td>91.86</td>
<td>21.96</td>
</tr>
<tr>
<td>CARAT upper airway</td>
<td>5.79</td>
<td>3.34</td>
</tr>
<tr>
<td>CARAT lower airway score</td>
<td>11.18</td>
<td>4.95</td>
</tr>
<tr>
<td>Global CARAT score</td>
<td>16.97</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Table 1 – Demographic study of the population

METHODS

This study is classified as analytic, as we will investigate the existence of a cause-effect relationship, observational, due to the inexistence of any sort of manipulation on the characteristics of participants, and cross-section, since all measurements were taken in a single moment.

For the study itself, we used data retrieved from the Immunoallergology database of the São João Hospital (patients remained anonymous). This gave us access to the results of the CARAT questionnaire and lung function tests of each patient, as well as other relevant information such as height, weight, birth date, gender, and which of the two related pathologies the patient has (asthma and/or allergic rhinitis). It should be noted that only asthmatic patients are relevant to the study. Regarding the CARAT questionnaire, we had access to three scores: total score, higher airway (rhinitis-related) score, and lower airway score (asthma-related). As for lung function tests, we had access to FEV1 – Forced Expiratory Volume (1st Second)\(^{[13]}\), percentage of predicted FEV1, FVC – Forced Vital Capacity, FEV1/FVC – Tiffeneau index, and FENO (exhaled nitric oxide)\(^{[9,35]}\) values. Bronchodilation test results were also present.

This data was collected between February and July 2011, from the available information in the Immunoallergology service’s Doctor’s Support System (SAM – from Portuguese Sistema de Apoio ao Médico). Diseases shown were diagnosed in person by the physician. Both plain text medical history files and ICD-9-coded diagnoses were used. In some cases, information was missing. Patients were selected as shown in the Population section.
The selected data then underwent statistical treatment using IBM SPSS Statistics 20, in order to assess the existence of a possible correlation between the aforementioned values, so that we could then formulate our own conclusions on the suitability of the CARAT questionnaire as an asthma control assessment method, complementary to lung function tests.

The statistical analysis included Pearson correlations between different values (shown further in the Results section). The significance cutoff was defined as 0.05. Each correlation was assessed for statistical significance.

RESULTS

Graph 1: Correlation between CARAT lower airway score and %PredFEV1

Graph 2: Correlation between Global CARAT score and %PredFEV1
DISCUSSION

In this study, our main aim was to establish a correlation between the results of the CARAT questionnaire and those of lung function tests. Therefore, we used Pearson’s correlation method to test the strength of %PredFEV1 and CARAT scores’ association.

The results of the correlation between the global CARAT score and the %PredFEV1 were not significant. We did not expect to find a strong association here, due to the fact that we were analyzing both parts of the CARAT questionnaire, which includes a rhinitis-related set of questions, supposedly unrelated to lung function.

Even though the correlation between the CARAT upper airways results and percentage of predicted FEV1 was significant (p=0.013), the correlation coefficient was negative (-0.138). This would suggest that a higher control score regarding rhinitis would imply a worse lung function state, even though it is a relatively weak correlation. This was an unexpected result, since this correlation was done with the intent of displaying an absence of relationship between these two variables, as an additional support for the proper separation of the questionnaire scores. Apart from that, the suggested relationship is opposite to the one that was acknowledged as a possibility (improper separation of the questionnaire scores, which would lead to a positive relationship between upper airway scores and LFT results, suggesting that asthma and rhinitis control could not be separated). As such, we believe that this may be due to a confounding parameter we are not aware of.

As shown in previous studies (ACT [22], for instance) we found a significant correlation (p<0.001) between the Lower Airway scores and the %PredFEV1. However, the correlation
coefficient is of a considerably low value (0.205). This can be interpreted to mean that the degree to which the variation in CARAT's scores is associated to variation in %PredFEV1 is only 4% (R² Linear = 0.042). The fact that asthma control is influenced by many factors, such as stress and allergies, as well as the broader set of factors besides lung function involved in it, may explain these low values. Regardless of this result, we believe that an increased number of participants in future studies could attenuate the influence of the aforementioned external factors.

For future research, we believe that a more detailed and dedicated study about the negative correlation between the results of the upper airway CARAT scores and %PredFEV1 should be done, with the intent of finding if the correlation is indeed present, as it might be a side effect of this study's limitations.

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