

## Does Experience Influence Perception of Dyspnea?

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**OBJECTIVE:** The perception of somatic sensations like dyspnea can be influenced by such factors as an individual's personality, experiences, or ability to adapt to stimuli. Our aim was to determine whether the perception of acute bronchoconstriction is different for patients with asthma and patients who have never experienced an episode of airway obstruction.

**PATIENTS AND METHOD:** We studied 2 groups of patients. The first consisted of 24 subjects with intermittent rhinitis and asthma (10 females and 14 males) with a mean (SD) age of 25 (7) years. All reported not feeling dyspnea at rest on a Borg scale. The second group consisted of 24 subjects who only had rhinitis but no lung disease (no episode of asthma) or dyspnea at rest (12 females and 12 males) with a mean age of 27 (6) years. There were no significant differences between the groups with regard to sex, smoking, economic or educational level, anxiety (determined by the trait portion of the State-Trait Anxiety Inventory), depression (Beck Depression Inventory), or spirometric parameters. All took a histamine bronchial provocation test in which the patient assessed dyspnea on a modified Borg scale after each histamine dose. The provocation dose needed to produce a 20% decrease ( $PD_{20}$ ) in forced expiratory volume in the first second ( $FEV_1$ ) was calculated. We also recorded the dyspnea perception score when  $FEV_1$  fell 5%, 10%, 15%, and 20% ( $PS_{20}$ ).

**RESULTS:** No dyspnea was perceived at  $PS_{20}$  by 12.5% of the asthmatics and by 45% of nonasthmatics ( $P < .0001$ ). The mean  $PS_{20}$  was 2.4 (2.1) (range, 0-7) in the first group and 0.37 (0.48) (range, 0-3) in the second ( $P < .0001$ ). More asthma patients than nonasthmatics perceived dyspnea at all degrees of bronchial obstruction.  $PD_{20}$  was different in the 2 groups (1.6 [2] vs 6.03 [5] for the first and second groups, respectively;  $P < .003$ ), but there was no significant relation between  $PD_{20}$  and  $PS_{20}$  (Spearman's correlation coefficient, 0.19;  $P = .221$ ).

**CONCLUSION:** Our findings support the hypothesis that appropriate perception of dyspnea is grounded in prior experience and learning.

**Key words:** *Dyspnea. Asthma. Perception. Bronchoconstriction.*

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¿Influye la experiencia en la percepción de disnea?

**OBJETIVO:** En la percepción de las sensaciones somáticas, como la disnea, pueden influir factores tales como la propia personalidad del individuo, su experiencia previa o su capacidad de adaptación a los estímulos. El objetivo del presente estudio ha sido conocer si los pacientes con asma perciben una situación de broncoconstricción aguda de forma diferente de los pacientes que nunca han sufrido un episodio previo de obstrucción de la vía aérea.

**PACIENTES Y MÉTODO:** Estudiamos 2 grupos de pacientes. El primero estaba formado por 24 sujetos con rinitis y asma intermitente (10 mujeres y 14 varones, con una edad media  $\pm$  desviación estándar de  $25 \pm 7$  años), que no referían sentir disnea basal en la escala de Borg. El segundo lo formaron 24 pacientes con rinitis sola, sin enfermedad pulmonar (nunca habían sufrido un episodio de asma) ni disnea basal (12 mujeres y 12 varones, edad media de  $27 \pm 6$  años). No había diferencias significativas entre los grupos en cuanto a edad, sexo, porcentaje de fumadores, nivel económico y educativo, ansiedad –determinada por el State-Trait Anxiety Inventory, versión Rasgo (STAI-R)–, depresión (Beck) ni parámetros espirométricos. A todos ellos se les realizó una prueba de broncoprovocación con histamina midiendo la disnea experimentada tras cada dosis del fármaco en una escala modificada de Borg. Se calculó la  $PD_{20}$ , es decir, la dosis de agente broncoconstrictor capaz de producir un descenso del 20% del valor inicial del volumen espiratorio forzado en el primer segundo ( $FEV_1$ ), así como la percepción de disnea con una caída del  $FEV_1$  del 5, el 10, el 15 y el 20% ( $PS_5$ ,  $PS_{10}$ ,  $PS_{15}$  y  $PS_{20}$ , respectivamente).

**RESULTADOS:** No percibió disnea con el descenso del 20% en el  $FEV_1$  el 12,5% de los pacientes con asma, frente a un 45% de las personas no asmáticas ( $p < 0,0001$ ). La media de la  $PS_{20}$  en el primer grupo fue de  $2,4 \pm 2,1$  (rango: 0-7) y en el segundo de  $0,37 \pm 0,48$  (rango: 0-3) ( $p < 0,0001$ ). En todos los grados de obstrucción bronquial la disnea percibida por los pacientes con asma fue mayor. La  $PD_{20}$  fue diferente en ambos grupos ( $1,6 \pm 2$  frente a  $6,03 \pm 5$ ;  $p < 0,003$ ), pero no hubo relación significativa entre la  $PD_{20}$  y la  $PS_{20}$  (coeficiente de correlación de Spearman: 0,19,  $p = 0,221$ ).

**CONCLUSIÓN:** Nuestros datos apoyan la hipótesis de que la adecuada percepción de la disnea se fundamenta en aspectos como la experiencia previa y el aprendizaje.

**Palabras clave:** *Disnea. Asma. Percepción. Broncoconstricción.*

## Introduction

Analysis of the neurophysiological processing of stimuli that cause dyspnea is necessary but insufficient for an in-depth understanding of how individuals experience and express the sensation.<sup>1</sup> As Carrieri-Kohlman and Gormley<sup>2</sup> have noted, emotional state and cognitive abilities and/or integrity modulate how a subject lives and copes with sensory impressions that are triggered by an initial stimulus or stimuli. These variables affect the perception of a symptom such as dyspnea and in turn influence how the individual responds and copes.<sup>2</sup> Yet another element affects interpretation, however: the personal experience a subject has acquired over a lifetime with a given sensation.<sup>2,3</sup> The importance of personal experience is evident if we remember that not all dyspnea is the same. The various pathophysiological situations able to cause dyspnea give rise to different sensations of breathing discomfort,<sup>4</sup> which an individual will possibly recognize more readily if there is prior experience.<sup>1,3</sup>

The particularities of asthmatic breathlessness have been a concern of great interest for our research for some years.<sup>5-8</sup> In earlier research we analyzed how dyspnea is perceived by asthmatics in stable periods and the change in their perception after acute bronchial obstruction is induced in the laboratory. Perception of breathlessness has been related to a variety of variables, such as age, attention, degree of air trapping, hyperinflation, and bronchial hyperresponsiveness. In the present study we aimed to analyze a variable that has not been considered to date.

Our hypothesis was that individuals who have not previously suffered an episode of bronchospasm would not recognize induced bronchospasm as readily as do those who have experienced this event. To test the hypothesis we compared differences in perception of dyspnea between a group of patients with intermittent asthma and others who had no lung disease and had never experienced acute airway obstruction.

## Patients and Methods

The subjects were recruited from the caseload of a pneumology outpatient clinic, where patients suspected of asthma and/or rhinitis were referred from a primary care clinic. Patients were recruited if they were older than 15 and younger than 40 years of age and had a confirmed diagnosis of rhinitis or intermittent asthma plus rhinitis (according to 2 sets of criteria: from the Allergic Rhinitis and Its Impact on Asthma group<sup>9</sup> and the Global Initiative for Asthma<sup>10</sup>). The patients were free of dyspnea at rest (score of 0 on a modified Borg scale<sup>11</sup>), had normal lung function values when stable, and had no other disease able to cause dyspnea. Patients diagnosed with intermittent asthma had to have been asymptomatic for at least the last 4 weeks in order to be enrolled, although a history of having experienced acute exacerbation in the past was allowable. Patients diagnosed with rhinitis alone had to have a medical history free of any indication of bronchospasm. Patients meeting these criteria were informed about the general objectives of the study and asked to give their written consent to participation.

Patients who gave informed consent filled in data collection sheets according to the study protocol. The material collected included *a*) the self-administered trait form of the State-Trait Anxiety Inventory (STAI-T)<sup>12</sup> and the Beck Depression Inventory,<sup>13</sup> and *b*) information relevant to educational and socioeconomic levels. The latter 2 parameters were categorized on scales of 1 to 5, where 1 indicated "no formal education" and "low socioeconomic level" and 5 indicated "higher education" and "higher socioeconomic level." Next, spirometry was carried out according to the recommendations of the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR)<sup>14</sup> to rule out airways obstruction; finally, each patient underwent a bronchial challenge test to analyze perception of dyspnea after acute bronchoconstriction as described by Boulet et al.<sup>15</sup> The bronchoconstrictor was histamine phosphate, administered according to the technique described by Cockcroft and colleagues.<sup>16</sup> Once it had been ascertained that inhaling placebo caused less than a 5% change from baseline in forced expiratory volume in 1 second (FEV<sub>1</sub>), the patient was asked to inhale increasing concentrations of aerosolized histamine phosphate for 2 minutes. The test began with a challenge at a concentration of 0.03 mg/mL and the maximum possible dose was at 32 mg/mL. Following a 1-minute rest after each dose, the patient was asked to perform 2 forced expiratory maneuvers to check for change in FEV<sub>1</sub>. At the start of the test and before each dose administered, the patient was asked to assess breathlessness at that moment on the modified Borg scale. The patient was free to choose any score on the scale, although detailed instructions had been given earlier to ignore other types of sensations such as nasal discomfort, disagreeable tastes, cough, or throat irritations. The test ended when FEV<sub>1</sub> had fallen to 20% of the baseline value (PD<sub>20</sub>) obtained when placebo was inhaled. At that moment, 600 µg of salbutamol was administered from a pressurized canister and chamber in order to reverse the effects of bronchoconstriction. Reversal was checked 20 minutes later by spirometry. For reasons evidently related to the design of the study, only individuals who would experience a fall in FEV<sub>1</sub> of at least 20% could be enrolled. To effect that change, very high concentrations of histamine (32 mg/mL) were reached if necessary.

The measurement of an individual's perception of bronchoconstriction was carried out, as described in previous studies,<sup>6</sup> by way of the following 4 parameters: *a*) the dyspnea perception score on the Borg scale when FEV<sub>1</sub> had decreased 20% from baseline (PS<sub>20</sub>), *b*) the dyspnea perception score on the Borg scale when FEV<sub>1</sub> had decreased 15% (PS<sub>15</sub>), *c*) the score upon a fall in FEV<sub>1</sub> of 10% (PS<sub>10</sub>), and *d*) the score upon a fall of 5% in FEV<sub>1</sub> (PS<sub>5</sub>).

## Statistical Analysis

Data for all variables were entered into a database to be managed with the SPSS statistical package, version 11, for Windows. As appropriate, either analysis of variance or the  $\chi^2$  was used to detect between-group differences for all the variables considered.

## Results

A total of 48 patients were studied, 24 with rhinitis and intermittent asthma and 24 with only rhinitis. The general characteristics of the 2 groups are shown in

Table 1. Both groups were composed of young adults, between 20 and 30 years old, who reported similar periods of time elapsing since onset of disease and who had comparable FEV<sub>1</sub> values at rest when stable. The 2 groups were similar as to the distribution of males and females and smokers and nonsmokers. Educational and socioeconomic levels were also similar. Scores on the anxiety and depression questionnaires were likewise comparable. The only differences detected were in degree of bronchial hyperresponsiveness: the PD<sub>20</sub> values of patients with rhinitis and asthma (1.6 [2]) were significantly lower than those with only rhinitis (6.03 [5]) (*P*<.003).

Nevertheless, analysis of the perception of dyspnea after provocation of acute bronchoconstriction in the laboratory revealed important differences between the two groups of patients. Whereas only 3 patients (12.5%) among those with both rhinitis and asthma had PS<sub>20</sub> values indicating no breathlessness, 11 of the 24 (45%) with only rhinitis chose 0 on the modified Borg scale at the 20% level of bronchoconstriction (*P*<.001) (Figure). Furthermore, values for PS<sub>5</sub>, PS<sub>10</sub>, PS<sub>15</sub>, and PS<sub>20</sub> were all significantly lower in patients with only rhinitis than in patients with both diseases. At equal levels of obstruction and for all the levels of bronchial provocation dose during the test, the dyspnea perception scores of patients with only rhinitis were notably lower than the scores of patients who also had intermittent asthma (Table 2). PS<sub>20</sub> values ranged from 0 to 7 for patients with rhinitis and asthma and from 0 to 3 for patients with only rhinitis.

We calculated Spearman's correlation coefficient between PS<sub>20</sub> and PD<sub>20</sub> to be 0.19; the relation between the 2 parameters was not statistically significant (*P*=.221).

**Discussion**

As the influence on breathlessness of factors such as age, emotional balance, preexisting airway obstruction, and dyspnea at rest is well established, we took care to check that none of these variables differed between the 2 groups of patients enrolled. Thus, the differences observed can be attributed to the prior experiences that individuals had had with dyspnea caused by acute bronchial obstruction. For comparison with patients who had intermittent asthma we used a group of patients with rhinitis because in such subjects it would be easier to effect a clinically significant fall in FEV<sub>1</sub> in the lung function laboratory using a nonspecific bronchial challenge.

Greater dyspnea was perceived by asthmatics at all degrees of bronchial obstruction reached during the challenge test; that is to say, no matter what the decrease in FEV<sub>1</sub>, it was perceived less intensely by individuals without prior experience of asthma. It still remains to be determined whether the 2 groups of persons perceive dyspnea in similar ways. Studies that have examined the language of dyspnea systematically have shown that descriptors of that symptom used by healthy persons are not quite the same as those used by

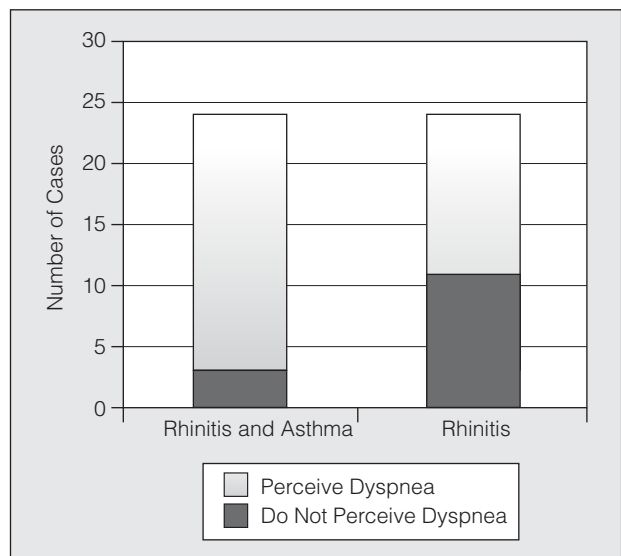


Figure. The bars show the number of patients who perceived no change in dyspnea when acute bronchial obstruction of 20% had been reached.

patients with cardiopulmonary diseases.<sup>17-20</sup> We assume that if we had analyzed language descriptors of breathing discomfort in the 2 groups in the present study, we would have also found differences.

TABLE 1  
General Characteristics of Patients With Asthma and Rhinitis and Patients With Asthma Only\*

|                                    | Asthma and Rhinitis (n=24) | Rhinitis Only (n=24) | P     |
|------------------------------------|----------------------------|----------------------|-------|
| Age, years                         | 25 (7)                     | 27 (6)               | NS    |
| Active smokers                     | 9                          | 10                   | NS    |
| Sex, male/female                   | 12/12                      | 14/10                | NS    |
| Time since onset of disease, years | 9.8 (4.7)                  | 7.9 (5.1)            | NS    |
| Educational level†                 | 3.1 (0.59)                 | 3.2 (0.49)           | NS    |
| Socioeconomic level‡               | 3.05 (0.49)                | 3.17 (0.48)          | NS    |
| FEV <sub>1</sub> , % reference     | 105 (19)                   | 108 (20)             | NS    |
| Anxiety, STAI-T                    | 18.32 (9)                  | 24.06 (11.37)        | NS    |
| Depression, Beck score             | 4.85 (4)                   | 5.6 (2.1)            | NS    |
| PD <sub>20</sub> , mg/mL           | 1.6 (2)                    | 6.03 (5)             | <.003 |

\*Data are given as mean (SD) or as number of patients. FEV<sub>1</sub> indicates forced expiratory volume in 1 second; NS, not significant; STAI-T, trait form of the State-Trait Anxiety Inventory.  
†Classified on a scale of 1 to 5, where 1 indicates "no education" and 5, "higher education."  
‡Classified on a scale of 1 to 5, where 1 indicates "low socioeconomic level" and 5, "high socioeconomic level."

TABLE 2  
Dyspnea Perception Scores on a Borg Scale During a Histamine Bronchial Provocation Test\*

|                  | Asthma and Rhinitis (n=24) | Rhinitis Only (n=24) | P      |
|------------------|----------------------------|----------------------|--------|
| PS <sub>5</sub>  | 0.49 (0.69)                | 0.02 (0.1)           | <.002  |
| PS <sub>10</sub> | 1.1 (1.31)                 | 0.06 (0.18)          | <.0001 |
| PS <sub>15</sub> | 1.89 (1.9)                 | 0.20 (0.35)          | <.0001 |
| PS <sub>20</sub> | 2.4 (2.1)                  | 0.37 (0.48)          | <.0001 |

\*Data are given as mean (SD). PS<sub>5</sub>, PS<sub>10</sub>, PS<sub>15</sub>, and PS<sub>20</sub> indicate the dyspnea perception scores when forced expiratory volume in the first second fell 5%, 10%, 15%, and 20% below baseline, respectively.



Another finding that merits attention is that 45% of those who had never experienced bronchospasm noted nothing even when their airways were obstructed by 20%. When we studied a group of asthmatics who were "poor perceivers" of dyspnea, on the other hand, they had a significantly lower rate of failure to perceive bronchial obstruction (12.5%),<sup>6</sup> and that rate was consistent with another study in the literature.<sup>15</sup>

In that study, of a large series of asthmatic patients, in which we analyzed their perception of dyspnea with the same method used in the present study, we found the PS<sub>20</sub> of asthmatics to bear a relation to PD<sub>20</sub>, among other parameters.<sup>6</sup> Under that assumption, the differences perceived between the 2 groups studied here could be attributable to differences in PD<sub>20</sub>; stated in another manner, we might think that patients with both rhinitis and asthma perceive more dyspnea than patients with only rhinitis because their PD<sub>20</sub> is lower. Therefore, we analyzed the correlation between those 2 parameters in the present study and the result obtained was that in fact there was no correlation between them; that is to say, the differences in PS<sub>20</sub> between the 2 groups studied here are not attributable to PD<sub>20</sub>. In our experience, PD<sub>20</sub> and PS<sub>20</sub> are significantly related in patients with moderate and severe asthma, but not in persons with mild intermittent asthma or nonasthmatics.

Our results support the hypothesis that appropriate perception of dyspnea is based on prior experience. This finding may have practical implications because it suggests the possibility of educational programs in which breathlessness perception can be learned. Appropriate training and learning of perception can be applied in asthmatics with perception disorders. It should be borne in mind that such patients belong to the group of asthmatics whose disease is "difficult to control"<sup>21</sup> and who are at risk for hospitalization for asthma and life-threatening crises.<sup>22,23</sup> According to recently-published guidelines for difficult-to-control asthma,<sup>24</sup> inappropriate perception of dyspnea is one of the causes of this type of asthma rather than a consequence attributable to it. Although there remains much to study with regard to dyspnea in our asthmatic patients, we believe that the incorporation of psychological methods into the therapeutic arsenal might facilitate more optimal control of the disease.

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