



## Respiratory Symptom Perception Differs in Obese Women With Strong or Mild Breathlessness During Constant-Load Exercise

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**Background:** During constant-load exercise, some otherwise healthy obese women report substantially more dyspnea on exertion (DOE) than do others. The objective of this study was to investigate whether qualitative differences exist between the sensations of dyspnea felt by these women.

**Methods:** Seventy-eight women were categorized based on their ratings of perceived breathlessness (RPBs) (Borg 0-10 scale) after 6 min of 60-W cycling. Thirty-four women rated RPB  $\geq 4$  (+DOE) ( $34 \pm 7$  years,  $36 \pm 5$  kg/m<sup>2</sup> BMI), and 22 women rated RPB  $\leq 2$  (-DOE) ( $32 \pm 7$  years,  $37 \pm 4$  kg/m<sup>2</sup> BMI). Twenty-two women rated RPB as 3 (RPB = 3) ( $34 \pm 7$  years,  $34 \pm 4$  kg/m<sup>2</sup> BMI) and were grouped separately to allow for a better delineation of the +DOE and the -DOE groups. After the exercise test, subjects were asked to pick three of 15 statements that best described their respiratory sensations.

**Results:** The +DOE and the -DOE groups were characterized differentially ( $P < .05$ ) by the respiratory clusters "Breathing more" (82% of -DOE vs 41% of +DOE), "Shallow" (36% vs 6%), and "Heavy" (14% vs 53%). All four descriptors in the cluster "Work/Effort" were chosen more frequently by women in the +DOE group than by women in the -DOE group. Although relative exercise intensity was higher in the +DOE women ( $75\% \pm 13\%$  vs  $67\% \pm 10\%$  of oxygen uptake at peak exercise,  $41 \pm 10$  L/min vs  $31 \pm 8$  L/min as % maximal voluntary ventilation,  $83\% \pm 7\%$  vs  $76\% \pm 7\%$  of peak heart rate), none of these variables was significantly associated with RPB.

**Conclusions:** Not only is the intensity of dyspnea significantly different between the +DOE and the -DOE groups, but so are the self-reported qualitative aspects of their dyspnea. Women in the +DOE group reported an increased sensation of the work of breathing relative to women in the -DOE group, which may be associated with the elevated RPB. *CHEST* 2014; 145(2):361-369

**Abbreviations:** DOE = dyspnea on exertion; HR = heart rate; MVV = maximal voluntary ventilation; RPB = rating of perceived breathlessness;  $\dot{V}CO_2$  = CO<sub>2</sub> output;  $\dot{V}E$  = minute ventilation;  $\dot{V}O_2$  = oxygen uptake;  $\dot{V}O_{2,peak}$  = oxygen uptake at peak exercise; VT = tidal volume

Dyspnea is defined as a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity; these sensations originate from interactions among multiple physiologic, psychologic, social, and environmental factors and may induce secondary physiologic and behavioral

responses.<sup>1,2</sup> Dyspnea on exertion (DOE) is a very common symptom in obesity.<sup>3</sup> In one large epidemiologic survey, 80% of obese adults reported breathlessness after climbing two flights of stairs compared with 16% of nonobese control subjects.<sup>4</sup> Another survey (N = 16,692) found that 36% of obese adults experienced dyspnea when walking up a hill.<sup>5</sup> Our laboratory

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has reported previously that 37% of otherwise healthy obese women had an elevated intensity of dyspnea during constant-load cycling exercise.<sup>6</sup>

In addition to intensity, dyspnea also encompasses qualitatively distinct sensations, and this symptom perception is the end result of a series of processes including neural activation, integration, and interpretation.<sup>7</sup> As such, it has been shown that healthy adults and patients with breathlessness can be distinguished based on their qualitative descriptors of dyspnea.<sup>8-11</sup> However, as we reported previously, the quality of respiratory sensation during exercise in otherwise healthy obese men was not different in those with or without DOE.<sup>12</sup> It is unknown whether respiratory sensations during exertion are similar or different in obese women, who differ from obese men in fat distribution<sup>13</sup> and have greater respiratory limitations than do men, especially during exercise.<sup>14,15</sup> These sex differences, such as differences in chest wall fat (ie, visceral vs subcutaneous), work of breathing, respiratory pressures, pulmonary function, respiratory muscle strength, and ventilatory capacity could make the relative demand for breathing more strenuous in obese women, especially obese women with DOE, who have a greater oxygen cost of breathing.<sup>6,12-14,16,17</sup> Based on these potential sex differences, it is important to investigate whether there are differential responses in respiratory sensations during exertion in obese women unlike in obese men, especially in work/effort.

Furthermore, the inability to perceive, or a tendency to overperceive, respiratory sensations could be detrimental. In patients with asthma, underperception of bronchoconstriction leads to a delay in seeking help, inadequate use of effective medications, and possibly death, whereas overperception of symptoms results in overuse of medical services and potential iatrogenic side effects.<sup>7,18,19</sup> In obesity, overperception of dyspnea during exertion could be an important factor contributing to exercise avoidance, the inability to lose weight, and/or reduced adherence to an exercise program, thus, resulting in more weight gain. However, it is not just the intensity of dyspnea, but also the quality of the sensation that affects the person's willingness to exercise. For example, it has been shown that between air hunger and the work/effort of breathing, air hunger is significantly more unpleasant than maximal respiratory work.<sup>20</sup> It is unclear which quality/qualities of breathlessness occur in obese women, but any of them could contribute to exercise avoidance in obese individuals. Therefore, it is important to understand the origins of this increased sensation of dyspnea and why some individuals are more prone to experience this "detrimental" perception.

We hypothesized that the work/effort of breathing would be a significant complaint in women with DOE. The objective of this study was to investigate whether

self-reported qualitative differences exist between the sensations of dyspnea experienced during constant-load exercise by otherwise healthy obese women with strong vs mild DOE.

## MATERIALS AND METHODS

Participants were part of a larger, interventional study. Obese women were screened based on BMI (ie,  $>30$  kg/m<sup>2</sup>). Exclusion criteria included a history of smoking, asthma, cardiovascular disease, sleep disorders, or musculoskeletal abnormalities that would preclude maximal exercise. Volunteers participating in regular vigorous exercise (exercise more than two times a week with a specific athletic goal) during the preceding 6 months were also excluded. In accordance with the University of Texas Southwestern Institutional Review Board (STU122010-108), written informed consent was obtained before participation.

For the current study, participants visited the laboratory on two separate occasions. On visit 1, they performed hydrostatic weighing and pulmonary function testing. On visit 2, they performed constant-load and incremental exercise testing.

### *Subject Characteristics, Body Composition, and Pulmonary Function*

Standard measures of height and weight were taken. Hydrostatic weighing was performed as described previously to determine percent body fat, lean body mass, and total body fat mass.<sup>6,13</sup> Standard pulmonary function testing, including spirometry, lung volume, and diffusing capacity, was performed according to American Thoracic Society guidelines.<sup>21</sup>

### *Intensity and Quality of Respiratory Sensations During Constant-Load 60-W Exercise*

Before the exercise test, participants were given the following written instructions for rating the intensity of perceived breathlessness:

The number 0 represents no breathlessness. The number 10 represents the strongest or greatest breathlessness that you have ever experienced. Each minute during the exercise test you will be asked to point to a number, [...], which represents your perceived level of breathlessness at the time. [...]

Exercise testing began with subjects seated on an electronically braked cycle ergometer with 3 min of resting baseline measurements, after which a 6-min constant-load exercise cycling test at 60 W was initiated. This exercise work rate was chosen based on a prior study in obese women who obtained ventilatory threshold at approximately 60 W.<sup>17</sup> The rating of perceived breathlessness (RPB) was collected every 2 min of the test using the modified Borg scale,<sup>22</sup> and the last value recorded was used for analysis. Following the exercise test, subjects completed a dyspnea questionnaire to examine the quality of their respiratory sensations if their RPB  $>0$ . The questionnaire consisted of 15 descriptors relating to dyspnea adapted from Mahler et al.<sup>10</sup> (Fig 1, left panel). Subjects were instructed to select the "top 3 descriptors that best describe the respiratory sensations [they] felt during the exercise." Cardiorespiratory responses, including heart rate (HR), BP, minute ventilation ( $\dot{V}_E$ ), and gas exchange (oxygen uptake [ $\dot{V}O_2$ ] and  $CO_2$  output [ $\dot{V}CO_2$ ]), were measured at rest and throughout exercise. Blood lactate concentration ([lactate]) was determined within 1 min after exercise while subjects continued cycling.

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