

## Obesity and Lung Volumes: Searching for Solutions and Optimal Performance

Obesity is a chronic disease that can affect just about every organ system in the body. The occurrence of obesity is influenced by many factors, including genetics, metabolism, behavior, environment, culture, and socioeconomic status. Obesity is not simply the consequence of excessive calorie consumption and inadequate physical activity. The measurement of obesity is typically the body mass index (BMI,  $\text{kg}/\text{m}^2$ ). A BMI  $\leq 25 \text{ kg}/\text{m}^2$  is considered optimal,  $\geq 30 \text{ kg}/\text{m}^2$  indicates obesity, and  $\geq 40 \text{ kg}/\text{m}^2$  indicates morbid obesity. The prevalence of obesity has increased significantly during the recent decades and is projected to continue to increase in the future. Accordingly, obesity has become a public health concern of epidemic proportions. Obesity is not just a concern for adults. Tremendous resources are also being directed toward understanding and preventing childhood obesity. That effort is mainly focused on preventing today's obese children from becoming a new generation of obese adults.

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Multiple health problems are associated with obesity, including diabetes mellitus, ischemic heart disease, hypertension, stroke, several types of cancer, gallbladder disease, hypercoagulability, osteoarthritis, complications of pregnancy, and an overall higher mortality. More than 400,000 people in the United States die each year as the result of issues related to obesity.<sup>1</sup>

Caring for obese patients presents several unique challenges. Specialized equipment and consideration of altered anatomy and physiology are required for transportation, diagnostic testing, physical examination, and medication dosing of obese patients. This contributes to an increased cost of \$92.6 billion annually, and approximately half of those costs are covered by Medicaid and Medicare.<sup>2</sup>

So how does the obesity epidemic impact the readers of *RESPIRATORY CARE*? Obesity is linked to a wide range of conditions, including asthma, obesity hypoventilation syndrome, pulmonary embolism, aspiration pneumonia, and obstructive sleep apnea. Higher BMI is associated with lower vital capacity, total lung volume, and functional residual capacity (FRC).<sup>3</sup> The weight of the chest wall,

and the effect on the thoracic cavity of the large abdomen, restrict respiratory expansion in obese patients. If an obese patient requires mechanical ventilation, higher pressure is required to expand the chest wall and prevent atelectasis. Morbid obesity is associated with prolonged mechanical ventilation and extends the weaning period in medical and surgical critical care patients.<sup>4,5</sup>

In a study in this issue of *RESPIRATORY CARE*, Benedik et al<sup>6</sup> evaluate the effect of body-position changes on FRC in overweight and obese patients. Pulmonary function tests were performed on healthy subjects in the sitting, 30° Fowler's, and supine positions. The main finding is that moving the subject from supine to 30° Fowler's position did not increase the FRC. Benedik et al make a valid point that some of the textbook equations that predict FRC differences in the sitting, Fowler's, and supine positions date from the 1950s, when the prevalence of obesity was 10%, as compared to current estimates of obesity prevalence as high as 66%. Benedik et al also measured waist-to-hip ratio (a measurement of body fat distribution) and found that a higher waist-to-hip ratio was associated with higher closing capacity in all positions, and with a higher closing-capacity-to-FRC ratio when supine. This provides helpful insight into caring for sedentary hospitalized patients who are prone to pulmonary impairment.

The work by Benedik et al<sup>6</sup> is an important step toward finding solutions to optimize pulmonary function testing in obese patients. As with any physical performance and diagnostic testing, patient comfort is an essential consideration, but must be balanced with optimal body position to produce accurate test results that will lead to the correct care plan. The Benedik et al study also should give us an appreciation that intrapulmonary shunt may cause oxygenation impairment in obese patients. The 30° Fowler's position yielded the lowest oxygenation saturations, which possibly signals further compromise of the cardiopulmonary system. It would have been interesting to follow the subjects longer, to further evaluate the relationship between BMI and pulmonary function, especially if weight reduction occurred in several subjects.

The research by Benedik et al adds to the increasing body of literature devoted to understanding the pulmonary impairment associated with obesity. The study should increase clinicians' awareness of the potential effects of obe-

sity on lung function. Further study is required to identify the optimal position for treatment and diagnostic tests. That information will not only yield more accurate test results and treatment, but will give us information for patient education.

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The author declares no conflicts of interest.

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