HOSPITAL PHYSICIAN®

PULMONARY DISEASE BOARD REVIEW MANUAL



# Obesity and Lung Disease

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## Table of Contents



**Cover Illustration by Dean Vigyikan**



next page

# Obesity and Lung Disease

## INTRODUCTION

The occurrence of obesity is increasing at an alarming rate in the United States. The most recent National Health and Nutrition Examination Survey reported that 34.9% of the American population is obese.[1] This trend has serious medical consequences because being overweight or obese is associated with significant morbidity and mortality. The risk for hypertension, dyslipidemia, coronary heart disease, diabetes mellitus, gallbladder disease, gout, arthritis, some types of cancer, or respiratory dysfunction and disease is greater in obese than in nonobese patients.

This article will address the effects of obesity on the respiratory system, specifically focusing on lung physiology and pulmonary function. Respiratory disorders closely associated with obesity will also be reviewed.

### PARAMETERS DETERMINING OBESITY

Although different parameters have been used to quantify and categorize obesity, the two most often used are the body mass index (BMI) and the weight/height ratio (WHR). The BMI is the ratio of weight (in kilograms) to height (in meters) squared. The National Center for Health Statistics has defined obesity as a BMI greater than 27.8 in men and greater than 27.3 in women.[2] Morbid obesity is defined as a BMI greater than 31.1 in men and greater than 32.3 in women. WHR is defined as the ratio of weight (in kilograms) to height (in centimeters). There is a linear relationship between WHR and the weight expressed as percentage ideal. For example, WHRs of 0.6, 0.8, and 1.0 kg/cm correspond to body weights that are approximately 150%, 200%, and 250% of the ideal. The main advantage of using the BMI and WHR is that the need to look up ideal body weight for a patient is eliminated.

### PHYSIOLOGIC EFFECTS OF OBESITY ON CHEST WALL MECHANICS

The effect of obesity on lung function is complex, determined in part by the degree of obesity, the age of the patient, and the distribution of body fat (ie, central or peripheral). Respiratory compliance depends on the mechanical properties of both the lungs and the chest wall. In obese patients, an increase in body weight, especially in the chest wall and abdomen, increases the stiffness of the chest wall, thereby decreasing respiratory compliance. This negative effect is compounded when the patient is in a supine position. Other mechanisms potentially responsible for increased chest wall stiffness and decreased respiratory compliance include an increase in pulmonary blood volume and closure of dependent airways. The abnormality in chest wall mechanics and the resultant decrease in respiratory compliance together lead to increased mechanical work of breathing.

## CASE 1 PRESENTATION

A 40-year-old woman is evaluated because of symptoms of extreme fatigue and dyspnea on exertion that have been worsening over the past year. She reports no fever, chills, or productive cough. She has a history of hypertension, hyperlipidemia, chronic sinusitis, and obesity. Her medications include atorvastatin calcium, cisapride, omeprazole, and amlodipine besylate.

Physical examination shows a morbidly obese woman in no acute distress. Vital signs are height 64 in (163 cm), weight 339 lb (154 kg), blood pressure 160/90 mm Hg, pulse 95 bpm, respiratory rate 24 breaths/min, and oxygen saturation while breathing room air 95%. There is mild congestion of both nostrils. The oropharynx is crowded with a low-lying palate, and there is erythema of the posterior pharynx. Entry of air into both bases of the lungs is decreased. Cardiac examination reveals sinus rhythm without any murmurs or gallops. The abdomen is obese, and there is trace bipedal edema.

Results of pulmonary function testing show a forced vital capacity (FVC) of 2.07 L (44% of the predicted value), a forced expiratory value in 1 second ($FEV_1$) of 1.56 L (55% of the predicted value), an $FEV_1$/FVC ratio that is 98% of the predicted value, a total lung capacity (TLC) of 3.10 L (66% of the predicted value), and a ratio of carbon monoxide diffusing capacity to alveolar volume ($D_{LCO}$:$V_A$) that is 103% of the predicted value. A cardiac stress test and echocardiogram show no abnormalities.

- **How does obesity affect pulmonary function values?**

### PULMONARY FUNCTION TESTING

#### Pulmonary Mechanics and Lung Volumes

Several studies[3–6] investigating the effects of obesity on the respiratory system have reported decreased