Respiratory Disease

Fitness Specialist Course

MedFit CLASSROOM

Respiratory Disease Fitness Specialist Course

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Respiratory Disease Fitness Specialist Course

OBJECTIVE: To educate health and fitness professionals on how to effectively implement exercise training techniques and work with clients that suffer from various respiratory diseases to help develop strength, flexibility, balance, breathing, and improve their quality of life.

Learning Objective 1: Participants will obtain a working knowledge of the anatomy and physiology of the respiratory system and how they are used during exercise.

Learning Objective 2: Participants will be able to identify various respiratory disease types and define the terms associated with the respiratory systems and the very respiratory diseases that affect them.

Learning Objective 3: Participants will be able to explain the causes, signs and symptoms of various respiratory diseases along with traditional treatment techniques, prevention, and management techniques.

Learning Objective 4: Participants will obtain a working knowledge of musculature anatomy and be able to select proper exercises that improve strength, flexibility, balance, breathing, and improve the overall quality of life for their clients with respiratory disease.

Learning Objective 5: Participants will be able to explain the importance of the three planes of movement and how they apply to exercise prescription for those clients who suffer from respiratory disease.

Learning Objective 6: Participants will be able to provide basic nutrition programming to improve their client's quality of life.

Learning Objective 7: Participants will be able to design and prescribe a proper exercise program with progression tracking for those suffering from respiratory disease and be able to cue proper technique and body alignment.

Learning Objective 8: Participants will gain an understanding of the power of leveraging specialized education to monetize their fitness career.

Learning Objective 9: Participants will understand the power of building relationships with like-minded fitness professionals including creating networking opportunities and community relationships.

Objective Outcome: These objectives will be measured by a 100-question written exam requiring the participant to achieve a passing grade of 80%.

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Introduction

Breathing is so vital to life that it happens automatically. Each day, one breathes about 20,000 times, and by the time one is 70 years old, he/she will have taken at least 600 million breaths. According to the World Health Organization (WHO), hundreds of millions of people suffer every day from chronic respiratory diseases (CRD). Currently in the United States, 24.6 million people have asthma (Moorman et al., 2012), 15.7 million people have chronic obstructive pulmonary disease (Ford et al., 1999-2011) while greater than 50 million people have allergic rhinitis and other often-underdiagnosed chronic respiratory diseases. Respiratory diseases do not discriminate and affect people of every race, sex, and age.

While most chronic respiratory diseases are manageable and some even preventable, this is what is known about the nature of chronic respiratory diseases (GOLD, 2016):

- Chronic disease epidemics take decades to become fully established.
- Chronic diseases often begin in childhood.
- Because of their slow evolution and chronic nature, chronic diseases present opportunities for prevention.
- Many different chronic diseases may occur in the same patient (e.g. chronic respiratory diseases, cardiovascular disease and cancer).
- The treatment of chronic diseases demands a long-term and systematic approach.
- Care for patients with chronic diseases should be an integral part of the activities of health services, alongside care for patients with acute and infectious diseases.

According to international guidelines of the American Thoracic Society (ATS) and European Respiratory Society (ERS), exercise training is widely regarded as the cornerstone of pulmonary rehabilitation and is the best available means of improving muscle function and exercise tolerance in patients with CRD. Exercise makes a difference in the life of patients with CRD (Ries, A.L. et al., 2007 and Spruit, M.A. et al., 2013).

While it may seem that exercise as a means for pulmonary rehabilitation is a new concept, the idea began as early as 1895. Dr Denison, professor of Diseases of the Chest and of Climatology at University of Denver, published a book entitled "Exercise and Food for Pulmonary Invalids", in which he emphasized the importance of physical exercise and healthy food for the health of "pulmonary invalids" (Denison C., 1895). This was most probably the first publication in which the use of exercise training as part of disease management especially chronic lung disease was recommended.

More than 50 years later, in 1952, Barach et al. reported that enhancement in capacity to walk without breathlessness can result in a physiological response like a training program in athletes. The same research group again recommended in 1964 the use of exercise training for breathless individuals. (Norehren, T.H. et al., 1964). They also suggested that physical inactivity may play an important role in the observed physical deconditioning. Five years later, Petty et al. (1969) were the first to describe the effects of a comprehensive care program for individuals with "chronic airway obstruction". The program consisted of multidisciplinary baseline evaluation, followed by individual instructions for bronchial hygiene, breathing retraining, graded exercises (daily for 1 hour), and a home visit by a nurse. Finally, outcome evaluation took place during the program, at the end of the program, and one year later. They reported positive effects on multiple outcomes, ranging from daily symptoms and exercise tolerance, up to a return to gainful employment and healthcare utilization. This was the first proof that a comprehensive care program including graded exercise training improved healthcare utilization in patients with “chronic airway obstruction”.

In 1970, Bass, H., et al. were among the first to assess the true change in exercise performance in symptomatic Chronic Obstructive Pulmonary Disease (COPD) patients with dyspnea either during walking at an ordinary pace on level ground or during washing or dressing and with the motivation to lead a more active life.

In 1981, the first official American Thoracic Society (ATS) and European Respiratory Society (ERS) Statement on Pulmonary Rehabilitation was published, in which pulmonary rehabilitation was defined as “an art of medical practice wherein an individually tailored, multidisciplinary program is formulated which through accurate diagnosis, therapy, emotional support and education, stabilizes or reverses both the physio- and psychopathology of pulmonary diseases and attempts to return the patient to the highest possible capacity allowed by his pulmonary handicap and overall life situation” (Hodgkin, J.E. et al., 1981). In 1992 (Donner, C.F. et al), 1999 (ATS), 2006 (Nici, L. et al.) and 2013 (Spruit, M.A. et al.) subsequent updates were published, keeping in line with the ongoing scientific developments. Exercise training was always identified as a cardinal component of pulmonary rehabilitation for patients with COPD.

In 2013, the ATS and the ERS have adopted the following new definition of pulmonary rehabilitation: “Pulmonary rehabilitation is a comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies, which include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence of health-enhancing behaviors.” Pulmonary rehabilitation is implemented by a dedicated, interdisciplinary team, including physicians and other health care professionals; the latter may include physiotherapists, respiratory therapists, nurses, psychologists, behavioral specialists, exercise physiologists, nutritionists, occupational therapists, and social workers. The intervention should be individualized to the unique needs of the patient, based on initial and ongoing assessments, including disease severity, complexity, and comorbidities. Although pulmonary rehabilitation is a defined intervention, its components are integrated throughout the clinical course of a patient’s disease (Spruit, M.A. et al., 2013).

A typical pulmonary rehabilitation (PR) program is referred by a general practitioner and aimed at people who have breathing difficulties caused by a lung condition that affects their ability to do normal activities. Most people who go to PR have chronic obstructive pulmonary disease (COPD). Some studies have shown that people with asthma and other long-term lung diseases such as bronchiectasis or idiopathic pulmonary fibrosis (IPF) also benefit. The duration of a PR program is typically six to eight weeks with two sessions per week lasting between one- and one-half hours. At each session, one will spend about half the time on physical exercise. This will be carefully designed according to one’s needs, so that it provides just the right level of activity. The rest of the time will be spent providing information and tips about living with a lung condition and getting the best out of life. PR is about helping one manage his/her condition. PR is not a cure but will help one feel better and more confident and in control. After one has completed PR, it is important that he/she continues to exercise and lead a healthy lifestyle. It is at this point that the health and fitness professional has the opportunity to help an individual with CRD to continue exercising regularly, stay active, and use the techniques he/she has learned (Pulmonary Rehabilitation and Exercise British Lung Foundation, 2017).

Take Introduction Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. About how many times does one breathe throughout the day?
2. By the time one is 70 years old how many breaths will one take?
3. According to the WHO, how many people suffer from respiratory disease?
4. According to Gold (2016) how long does it take to fully establish a chronic respiratory disease epidemic?
5. According to international guidelines of the American Thoracic Society (ATS) and European Respiratory Society (ERS), what is widely regarded as the cornerstone of pulmonary rehabilitation?
6. What was probably the first publication in which the use of exercise training as part of disease management especially chronic lung disease was recommended?
7. What is the definition of pulmonary rehabilitation (PR) adopted in 2013 by the ATS and the ERS?
8. Typically, how long is a PR program and what is the design of the program, i.e., number of sessions per week, breakdown of each session, etc.?
9. Is PR a cure for chronic respiratory disease? Why or why not?

Module I: Theory

Lesson One: Respiratory Anatomy and Physiology

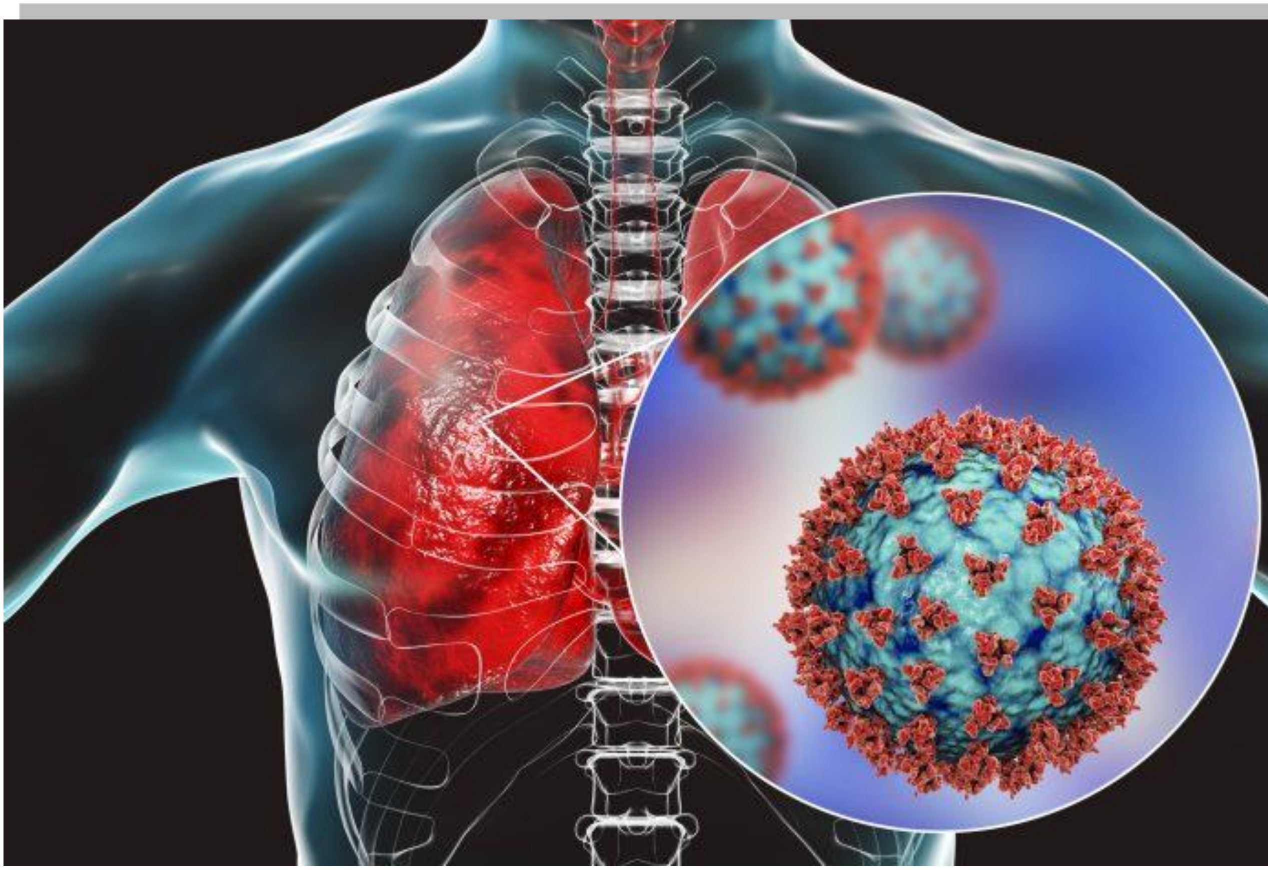
Lesson Two: Respiratory Disease and Epidemiology

Lesson Three: Respiratory Terms

Lesson Four: Respiratory Diseases Listed and Categorized

Lesson Five: COVID-19 Implications

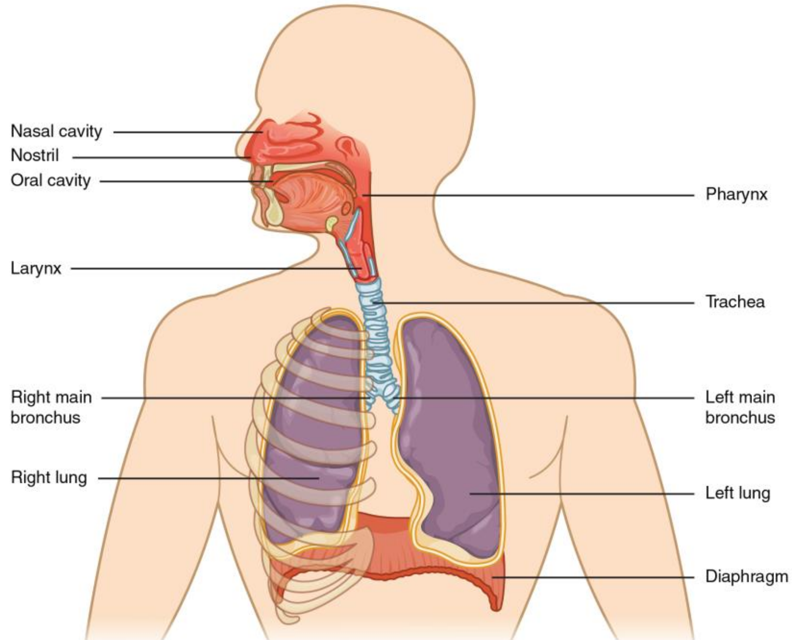
Lesson Six: The Most Common Respiratory Diseases-Signs, Symptoms, Treatments & Preventions



Lesson One

Respiratory Anatomy and Physiology

The lungs and other major organs of the respiratory system function primarily to provide oxygen to body tissues for cellular respiration, remove the waste product carbon dioxide, and help to maintain pH balance. Portions of the respiratory system are also used for non-vital functions, such as sensing odors, speech production, and for straining, such as during childbirth or coughing. The following chapter will list the structures that make up the respiratory system, compare the functions of upper respiratory tract with the lower respiratory tract, and describe how the respiratory system processes oxygen and CO2.



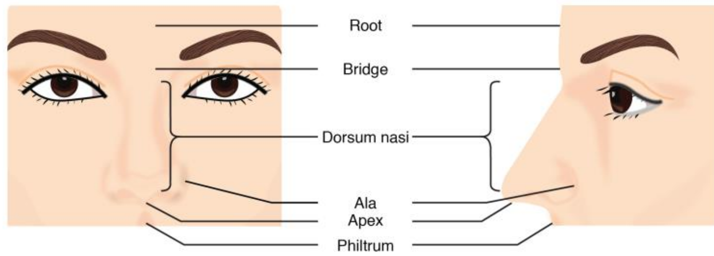
Anatomically, the respiratory system can be divided into two sections, the upper respiratory system and the lower respiratory system. The upper respiratory system includes the mouth, nose, nasal cavities, sinuses, and pharynx. The lower respiratory system includes the larynx, trachea, bronchi, and alveoli in the lungs. The lungs are contained within the thoracic cavity of the human body encased by the rib cage and separated from the abdominal cavity by the diaphragm. A human has two lungs. The right lung consists of three lobes, and the left lung consists of two lobes to make room for the heart. Each lung is surrounded by the pleural cavity which is defined as the space that surrounds the lung. Each pleural cavity is surrounded by a pleural membrane. The pleural membrane has two layers. The visceral or pulmonary pleura covers the outside of the lung and the parietal or costal pleura lines the inside of the chest wall and extends over the diaphragm. (See Figure 1.1)

Functionally, the respiratory system can be divided into a conducting zone and a respiratory zone. The conducting zone of the respiratory system includes the organs and structures not directly involved in gas exchange. The gas exchange occurs in the respiratory zone.

Conducting Zone

The major functions of the conducting zone are to provide the pathway for incoming and outgoing air, remove debris and pathogens from the incoming air, and warm and humidify the incoming air. Several structures within the conducting zone perform other functions as well. The epithelium of the nasal passages, for example, is essential to sensing odors, and the bronchial epithelium that lines the lungs can metabolize some airborne carcinogens. The following is a list of the anatomy involved in the conducting zone:

- The Nose and its Adjacent Structures
- Pharynx
- Larynx
- Trachea
- Bronchial Tree



The Nose and its Adjacent Structures

The major entrance and exit for the respiratory system is through the nose. The nose is divided into two major sections: the external nose, and the nasal cavity or internal nose. The external nose consists of the surface and skeletal structures that result in the outward appearance of the nose and contribute to its numerous functions. (See Figure 1.2) Underneath the thin skin of the nose are its skeletal features. The nares open into the nasal cavity, which is separated into left and right sections by the nasal septum. The nasal septum is formed anteriorly by a portion of the septal cartilage (the flexible portion you can touch with your fingers) and posteriorly by the perpendicular plate of the ethmoid bone (a cranial bone located just posterior to the nasal bones) and the thin vomer bones (whose name refers to its plough shape).

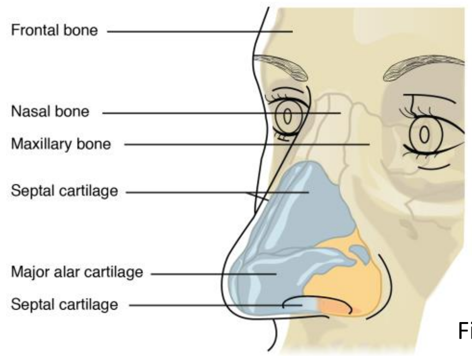


Figure 1.2

Each lateral wall of the nasal cavity has three bony projections, called the superior, middle, and inferior nasal conchae. Conchae serve to increase the surface area of the nasal cavity and to disrupt the flow of air as it enters the nose, causing air to bounce along the epithelium, where it is cleaned and warmed. The conchae and meatuses also conserve water and prevent dehydration of the nasal epithelium by trapping water during exhalation. The floor of the nasal cavity is composed of the palate. The hard palate at the anterior region of the nasal cavity is composed of bone. The soft palate at the posterior portion of the nasal cavity consists of muscle tissue. Air exits the nasal cavities via the internal nares and moves into the pharynx. Several bones that help form the walls of the nasal cavity have air-containing spaces called the paranasal sinuses, which serve to warm and humidify incoming air. Sinuses are lined

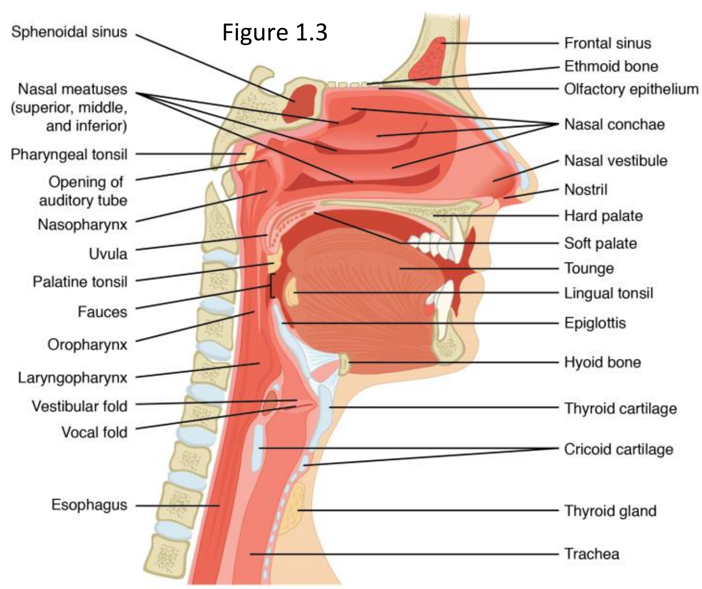


Figure 1.3

with a mucosa. Each paranasal sinus is named for its associated bone: frontal sinus, maxillary sinus, sphenoidal sinus, and ethmoidal sinus. The sinuses produce mucus and lighten the weight of the skull. (See Figure 1.3)

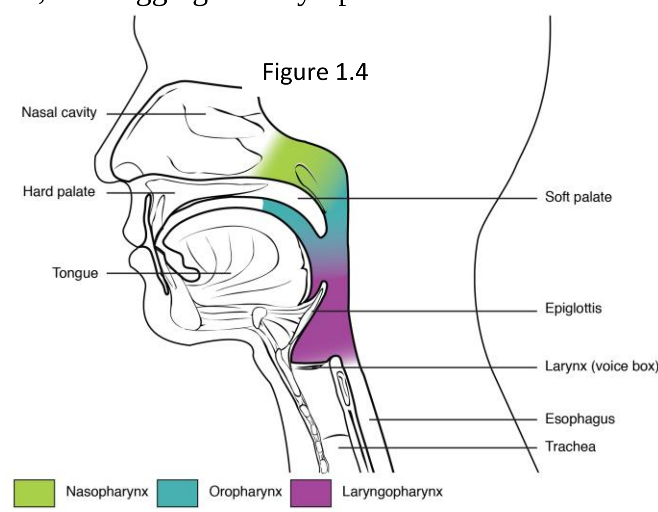
The nares and anterior portion of the nasal cavities are lined with mucous membranes, containing sebaceous glands and hair follicles that serve to prevent the passage of large debris, such as dirt, through the nasal cavity. An olfactory epithelium used to detect odors is found deeper in the nasal cavity.

The conchae, meatuses, and paranasal sinuses are lined by respiratory epithelium composed of pseudostratified ciliated columnar epithelium. The epithelium contains goblet cells, one of the specialized, columnar epithelial cells that produce mucus to trap debris. The cilia of the respiratory epithelium help remove the mucus and debris from the nasal cavity with a constant beating motion, sweeping materials towards the throat to be swallowed. Interestingly, cold air slows the movement of the cilia, resulting in accumulation of mucus that may in turn lead to a runny nose during cold weather. This moist epithelium functions to warm and humidify incoming air. Capillaries located just beneath the nasal epithelium warm the air by convection. Serous and mucus-producing cells also secrete the lysozyme enzyme and proteins called defensins, which have antibacterial properties. Immune cells that patrol the connective tissue deep to the respiratory epithelium provide additional protection. (See Figure 1.3)

Pharynx

The pharynx is a tube formed by skeletal muscle and lined by mucous membrane that is continuous with that of the nasal cavities. The pharynx is divided into three major regions: the nasopharynx, the oropharynx, and the laryngopharynx. (See Figure 1.4) The nasopharynx is flanked by the conchae of the nasal cavity, and it serves only as an airway. At the top of the nasopharynx are the pharyngeal tonsils. A pharyngeal tonsil, also called an adenoid, is an aggregate of lymphoid reticular tissue similar to a lymph node that lies at the superior portion of the nasopharynx. The function of the pharyngeal tonsil is not well understood, but it contains a rich supply of lymphocytes and is covered with ciliated epithelium that traps and destroys invading pathogens that enter during inhalation. The pharyngeal tonsils are large in children, but interestingly, tend to regress with age and may even disappear. The uvula is a small bulbous, teardrop-shaped structure located at the apex of the soft palate. Both the uvula and soft palate move like a pendulum during swallowing, swinging upward to close off the nasopharynx to prevent ingested materials from entering the nasal cavity. In addition, auditory tubes that connect to each middle ear cavity open into the nasopharynx. This connection is why colds often lead to ear infections.

Figure 1.4

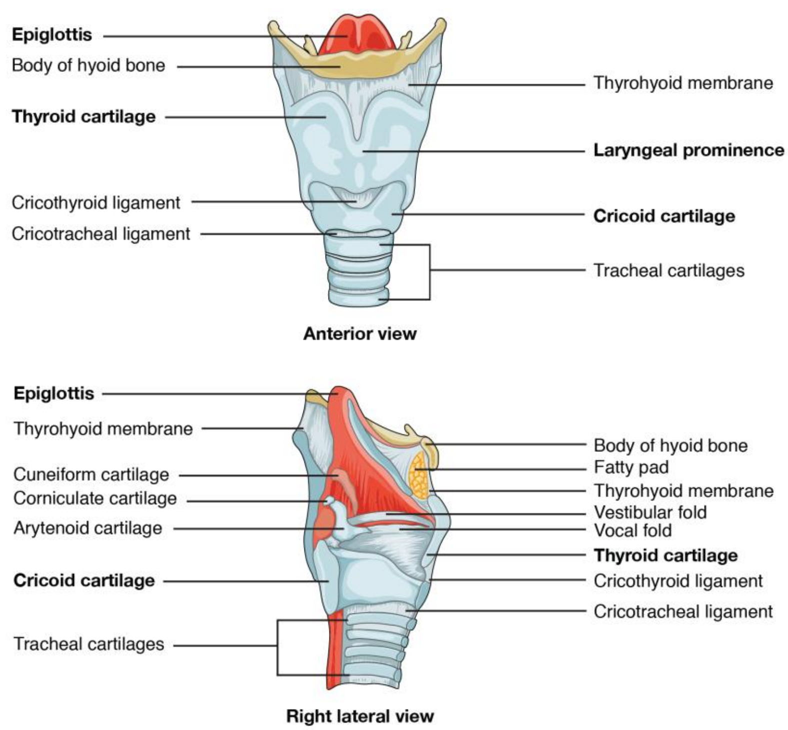


The oropharynx is a passageway for both air and food. The oropharynx is bordered superiorly by the nasopharynx and anteriorly by the oral cavity. The fauces is the opening at the connection between the oral cavity and the oropharynx. As the nasopharynx becomes the oropharynx, the epithelium changes from pseudostratified ciliated columnar epithelium to stratified squamous epithelium. The oropharynx contains two distinct sets of tonsils, the palatine and lingual tonsils. A palatine tonsil is one of a pair of structures located laterally in the oropharynx in the area of the fauces. The lingual tonsil is located at the base of the tongue. Similar to the pharyngeal tonsil, the palatine and lingual tonsils are composed of lymphoid tissue, and trap and destroy pathogens entering the body through the oral or nasal cavities. (See Figure 1.4)

The laryngopharynx is inferior to the oropharynx and posterior to the larynx. It continues the route for ingested material and air until its inferior end, where the digestive and respiratory systems diverge. The stratified squamous epithelium of the oropharynx is continuous with the laryngopharynx. Anteriorly, the laryngopharynx opens into the larynx, whereas posteriorly, it enters the esophagus. (See Figure 1.4)

Larynx

The **larynx** is a cartilaginous structure inferior to the laryngopharynx that connects the pharynx to the trachea and helps regulate the volume of air that enters and leaves the lungs (See Figure 1.5). The structure of the larynx is formed by several pieces of cartilage. Three large cartilage pieces—the thyroid cartilage (anterior), epiglottis (superior), and cricoid cartilage (inferior)—form the major structure of the larynx. The **thyroid cartilage** is the largest piece of cartilage that makes up the larynx. The thyroid cartilage consists of the **laryngeal prominence**, or "Adam's apple," which tends to be more prominent in males. The thick **cricoid cartilage** forms a ring, with a wide posterior region and a thinner anterior region.



Three smaller, paired cartilages—the arytenoids, corniculates, and cuneiforms—attach to the epiglottis and the vocal cords and muscle that help move the vocal cords to produce speech. (See Figure 1.5)

The **epiglottis**, attached to the thyroid cartilage, is a very flexible piece of elastic cartilage that covers the opening of the trachea. When in the "closed" position, the unattached end of the epiglottis rests on the glottis. The **glottis** is composed of the vestibular folds, the true vocal cords, and the space between these folds. (See Figure 1.6) A **vestibular fold**, or false vocal cord, is one of a pair of folded sections of mucous membrane. A **true vocal cord** is one of the white, membranous folds attached by muscle to the thyroid and arytenoid cartilages of the larynx on their outer edges. The inner edges of the true vocal cords are free, allowing oscillation to produce sound. The size of the membranous folds of the true vocal cords differs between individuals, producing voices with different pitch ranges. Folds in males tend to be larger than those in females, which create a deeper voice. The act of swallowing causes the pharynx and larynx to lift upward, allowing the pharynx to expand and the epiglottis of the larynx to swing downward, closing the opening to the trachea. These movements produce a larger area for food to pass through, while preventing food and beverages from entering the trachea. Continuous with the laryngopharynx, the superior portion of the larynx is lined with stratified squamous epithelium, transitioning into pseudostratified ciliated columnar epithelium that contains goblet cells. Similar to the nasal cavity and nasopharynx, this specialized epithelium produces mucus to trap debris and pathogens as they enter the trachea. The cilia beat the mucus upward towards the laryngopharynx, where it can be swallowed down the esophagus.

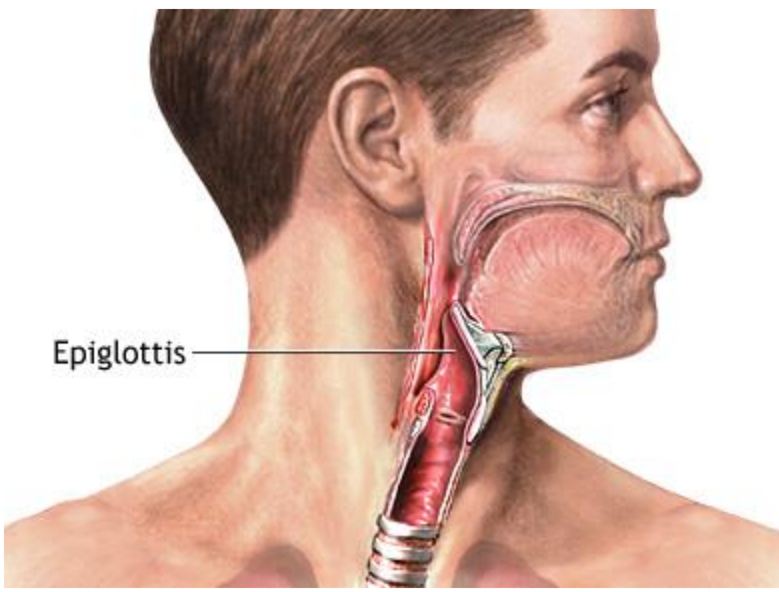


Figure 1.6

Trachea

The trachea (windpipe) extends from the larynx toward the lungs. (See Figure 1.7a) The **trachea** is formed by 16 to 20 stacked, C-shaped pieces of hyaline cartilage that are connected by dense connective tissue. The **trachealis muscle** and elastic connective tissue together form the **fibroelastic membrane**, a flexible membrane that closes the posterior surface of the trachea, connecting the C-shaped cartilages. The fibroelastic membrane allows the trachea to stretch and expand slightly during inhalation and exhalation, whereas the rings of cartilage provide structural support and prevent the trachea from collapsing. In addition, the trachealis muscle can be contracted to force air through the trachea during exhalation. The trachea is lined with pseudostratified ciliated columnar epithelium, which is continuous with the larynx. The esophagus borders the trachea posteriorly.

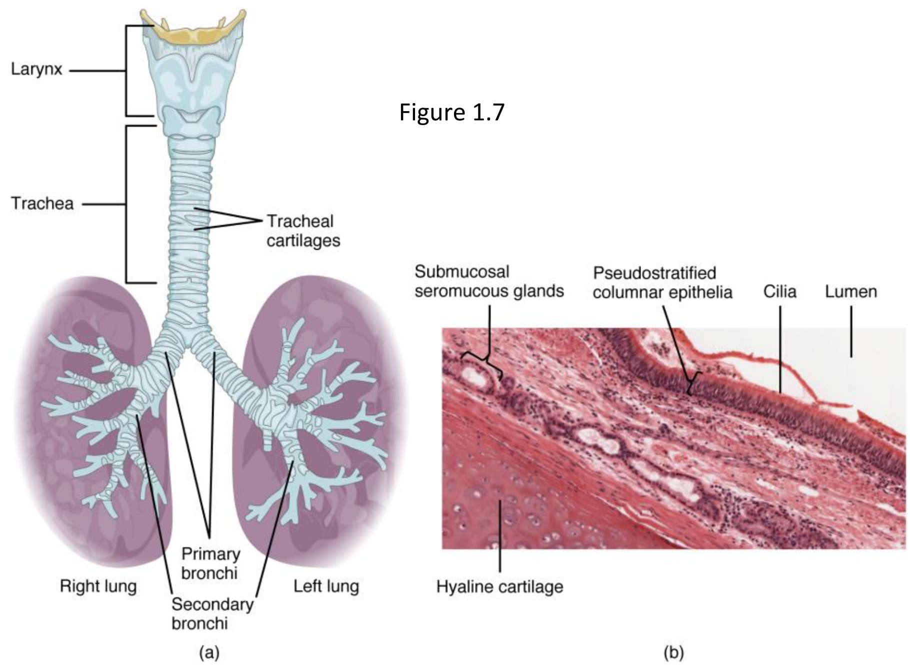


Figure 1.7

Bronchial Tree

The trachea branches into the right and left primary **bronchi** at the carina. (See Figure 1.8) These bronchi are also lined by pseudostratified ciliated columnar epithelium containing mucus-producing goblet cells (See Figure 1.7b). The carina is a raised structure that contains specialized nervous tissue that induces violent coughing if a foreign body, such as food, is present. Rings of cartilage, similar to those of the trachea, support the structure of the bronchi and prevent their collapse. The primary bronchi enter the lungs at the hilum, a concave region where blood vessels, lymphatic vessels, and nerves also enter the lungs. The bronchi continue to branch into a bronchial tree. A bronchial tree (or respiratory tree) is the collective term used for these multiple-branched bronchi. The main function of the bronchi, like other conducting zone structures, is to provide a passageway for air to move into and out of each lung. In addition, the mucous membrane traps debris and pathogens.

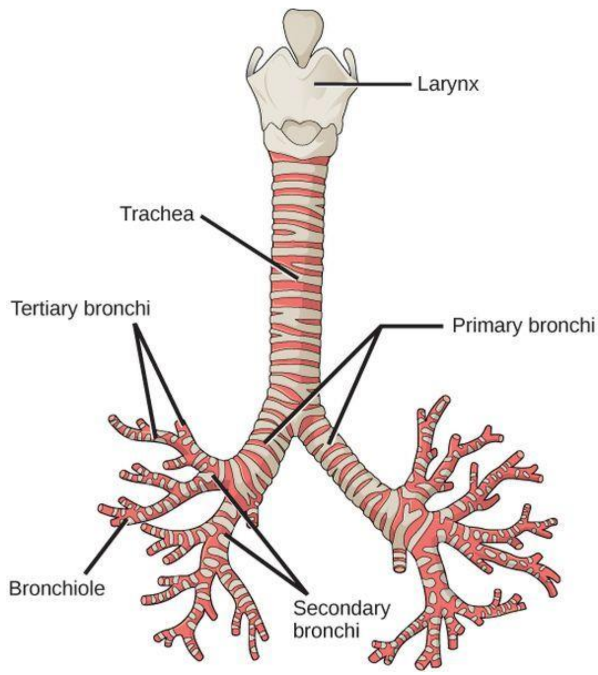


Figure 1.8

A bronchiole branches from the tertiary bronchi. Bronchioles, which are about 1 mm in diameter, further branch until they become the tiny terminal bronchioles, which lead to the structures of gas exchange. There are more than 1000 terminal bronchioles in each lung. The muscular walls of the bronchioles do not contain cartilage like those of the bronchi. This muscular wall can change the size of the tubing to increase or decrease airflow through the tube.

Respiratory Zone

In contrast to the conducting zone, the respiratory zone includes structures that are directly involved in gas exchange. The respiratory zone begins where the terminal bronchioles join a respiratory bronchiole, the smallest type of bronchiole (Figure 1.9), which then leads to an alveolar duct, opening into a cluster of alveoli. The following is a list of the anatomy involved in the conducting zone:

- Terminal Bronchioles
- Alveoli

Alveoli

An alveolar duct is a tube composed of smooth muscle and connective tissue, which opens into a cluster of alveoli. An alveolus is one of the many small, grape-like sacs that are attached to the alveolar ducts. An alveolar sac is a cluster of many individual alveoli that are responsible for gas exchange. An alveolus has elastic walls that allow the alveolus to stretch during air intake, which greatly increases the surface area available for gas exchange. Alveoli are connected to their neighbors by alveolar pores, which help maintain equal air pressure throughout the alveoli and lung. (See Figure 1.9)

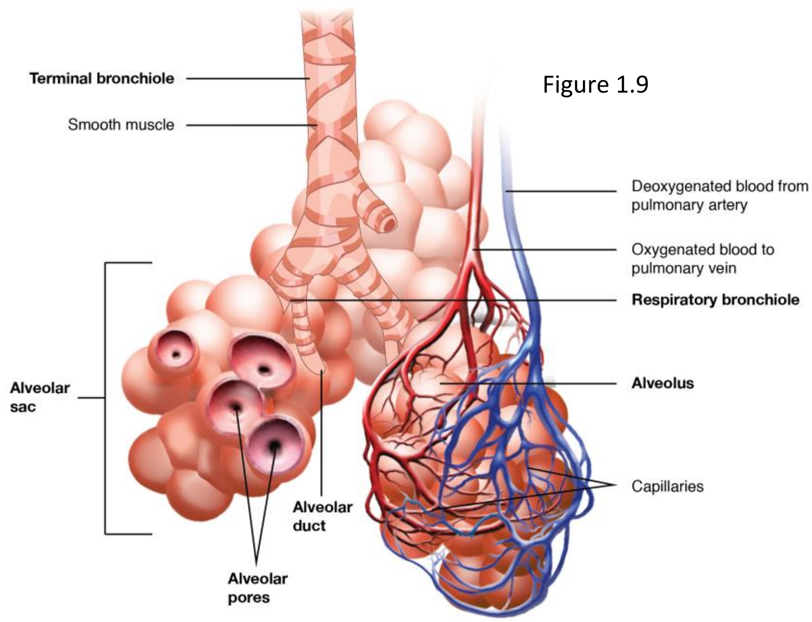


Figure 1.9

Respiration

The air humans breathe is made up of several gases. Oxygen is the most important for keeping us alive because body cells need it for energy and growth. Without oxygen, the body's cells would die. Carbon dioxide is the waste gas produced when carbon is combined with oxygen as part of the energy-making processes of the body. The lungs and respiratory system allow oxygen in the air to be taken into the body, while also enabling the body to get rid of carbon dioxide in the air breathed out. Respiration is the set of events that results in the exchange of oxygen from the environment and carbon dioxide from the body's cells. The process of taking air into the lungs is inspiration, or inhalation, and the process of breathing it out is expiration, or exhalation.

Air is inhaled through the mouth or through the nose. Cilia lining the nose and other parts of the upper respiratory tract move back and forth, pushing foreign matter that comes in with air (like dust) either toward the nostrils to be expelled or toward the pharynx. The pharynx passes the foreign matter along to the stomach to eventually be eliminated by the body. As air is inhaled, the mucous membranes of the nose and mouth warm and humidify the air before it enters the lungs.

When you breathe in, the diaphragm moves downward toward the abdomen, and the rib muscles pull the ribs upward and outward. In this way, the volume of the chest cavity is increased. Air pressure in the chest cavity and lungs is reduced, and because gas flows from high pressure to low, air from the environment flows through the nose or mouth into the lungs.

In exhalation, the diaphragm moves upward, and the chest wall muscles relax, causing the chest cavity to contract. Air pressure in the lungs rises, so air flows from the lungs and up and out of respiratory system through the nose or mouth.

Every few seconds, with each inhalation, air fills a large portion of the millions of alveoli. In a process called diffusion, oxygen moves from the alveoli to the blood through the capillaries (tiny blood vessels) lining the alveolar walls. Once in the bloodstream, oxygen gets picked up by the hemoglobin in red blood cells. This oxygen-rich blood then flows back to the heart, which pumps it through the arteries to oxygen-hungry tissues throughout the body.

In the tiny capillaries of the body tissues, oxygen is freed from the hemoglobin and moves into the cells. Carbon dioxide, which is made by the cells as they do their work, moves out of these cells into the capillaries, where most of it becomes dissolved in the plasma of the blood. Blood rich in carbon dioxide then returns to the heart via the veins. From the heart, this blood is pumped to the lungs, where carbon dioxide passes into the alveoli to be exhaled.

Summary

In summary, the respiratory system is responsible for obtaining oxygen and getting rid of carbon dioxide and aiding in speech production and in sensing odors. From a functional perspective, the respiratory system can be divided into two major areas: the conducting zone and the respiratory zone. The conducting zone consists of all of the structures that provide passageways for air to travel into and out of the lungs: the nasal cavity, pharynx, trachea, bronchi, and most bronchioles. The nasal passages contain the conchae and meatuses that expand the surface area of the cavity, which helps to warm and humidify incoming air, while removing debris and pathogens. The pharynx is composed of three major sections: the nasopharynx, which is continuous with the nasal cavity; the oropharynx, which borders the nasopharynx and the oral cavity; and the laryngopharynx, which borders the oropharynx, trachea, and esophagus. The respiratory zone includes the structures of the lung that are directly involved in gas exchange: the terminal bronchioles and alveoli.

The lining of the conducting zone is composed mostly of pseudostratified ciliated columnar epithelium with goblet cells. The mucus traps pathogens and debris, whereas beating cilia move the mucus superiorly toward the throat, where it is swallowed. As the bronchioles become smaller and smaller, and nearer the alveoli, the epithelium thins and is simple squamous epithelium in the alveoli. The endothelium of the surrounding capillaries, together with the alveolar epithelium, forms the respiratory membrane. This is a blood-air barrier through which gas exchange occurs by simple diffusion.

Take Module I Lesson 1 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. What is the primary function of the lungs and other major organs of the respiratory system?
2. What are some non-vital functions of the respiratory system?
3. What are the two sections of the respiratory system? List the organs/parts of each section.
4. The lungs are made up of how many lobes? How many on the right side and how many on the left side?
5. What is called the space around the lungs?
6. Functionally, the respiratory system can be divided into how many zones? Generally describe them and list the anatomy for each.
7. What is the purpose of the nose and it's adjacent structures?
8. What is the function of the pharynx?
9. What tis the function of the larynx?
10. What is the function of the epiglottis?
11. What is the function of the trachea?
12. What is the function of the bronchial tree?
13. What is the function of the alveoli?
14. Define and describe respiration.

Lesson Two

Respiratory Disease Epidemiology

Respiratory disease is a common and significant cause of illness and death around the world. In the US, approximately 1 billion "common colds" occur each year (Bloom, B., Jones, L.I., Freeman, G., 2013). A study found that in 2010, there were approximately 6.8 million emergency department visits for respiratory disorders in the U.S. for patients under the age of 18 (Blackwell, D.L., Lucas, J.W., Clarke, T.C., 2014). In 2012, respiratory conditions were the most frequent reason for hospital stays among children (NHLBI, 2012).

Asthma and chronic obstructive pulmonary disease (COPD) are significant public health burdens. Specific methods of detection, intervention, and treatment exist that may reduce this burden and promote health. Asthma is a chronic inflammatory disorder of the airways characterized by episodes of reversible breathing problems due to airway narrowing and obstruction. COPD is a preventable and treatable disease characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases (typically from exposure to cigarette smoke).

Several additional respiratory conditions and respiratory hazards, including infectious agents and occupational and environmental exposures, are covered in other areas of Healthy People 2020. Examples include tuberculosis, lung cancer, acquired immunodeficiency syndrome (AIDS), pneumonia, occupational lung disease, and smoking. Sleep health is now a separate topic area of Healthy People 2020 (ODPHP, 2018).

Currently more than 25 million people in the United States have asthma (Bloom et al., 2013 and Blackwell et al., 2014). Approximately 15.7 million adults have been diagnosed with COPD, and approximately 12 million people have not yet been diagnosed (NHLBI, 2012). The burden of respiratory diseases affects individuals and their families, schools, workplaces, neighborhoods, cities, and states. Because of the cost to the health care system, the burden of respiratory diseases also falls on society; it is paid for with tax dollars, higher health insurance rates, and lost productivity. Annual health care expenditures for asthma alone are estimated at $20.7 billion (NHLBI, 2009). This statistics for asthma continue to grow with the CDC reporting $50.1 billion (2022) and the American Thoracic Society reporting around $80 billion (2018).

Other emerging issues in Chronic Respiratory Diseases include:

- Assessing the impact of climate change (temperature extremes, the increased geographic span of allergens, and air quality) on asthma causation and exacerbations
- Increasing importance of indoor air quality as a cause of work-related respiratory symptoms and asthma in a service economy
- Increasing use of nanotechnology and resulting exposures to engineered nanoparticles
- Increasing exposures to respiratory hazards such as isocyanates used in “green” building materials
- Applying knowledge about gene-environment interactions and epigenetics to respiratory disease prevention
- Using knowledge about primary causes of asthma (determination of distinct asthma

phenotypes) in developing effective prevention strategies, such as weight control and allergen avoidance

- Developing novel treatments to alter the progression of disease severity and, ultimately, to prevent asthma onset
- Using personalized medicine (tailoring treatment to a patient's specific phenotype, genetics, and history)
- Identifying new respiratory hazards, as has been done during the last decade for diacetyl and other butter-flavoring chemicals; nylon, rayon, and polypropylene flock; and World Trade Center dust
- Improving COPD awareness and clinical case-finding in the population at large, and in the health care delivery system at the state and local levels
- Establishing a surveillance system for COPD
- The short-term impact the of Covid-19 pandemic in addition to the long term effects on society

Module I Lesson 2 Study

Trends in prevalence and incidence of chronic respiratory diseases from 1990 to 2017

Xie M, Liu X, Cao X, Guo M, Li X. Trends in prevalence and incidence of chronic respiratory diseases from 1990 to 2017. Respir Res. 2020 Feb 11;21(1):49. doi: 10.1186/s12931-020-1291-8. PMID: 32046720; PMCID: PMC7014719.

Read entire article here.

Background

Chronic respiratory diseases (CRDs) are leading causes of morbidity worldwide. However, the spatial and temporal trends in prevalence and incidence of CRDs have not been estimated.

Methods

Based on data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2017, we analyzed the prevalence and incidence trends of CRDs from 1990 to 2017 according to age, sex, region and disease pattern. Furthermore, the correlations between the incidence and the World Bank income levels, sociodemographic index (SDI), and human development index (HDI) levels were analyzed to assess the factors affecting incidence.

Result

The total number of CRD cases increased by 39.5% from 1990 to 2017, nevertheless, the age-standardized prevalence rate (ASPR) and age-standardized incidence rate (ASIR) showed decreasing trends. The ASIRs of CRD, chronic obstructive pulmonary disease (COPD), pneumoconiosis, and asthma decreased, whereas the ASIR of interstitial lung disease and pulmonary sarcoidosis increased during the past 27 years. Significant differences between males and females in the incidence rates of pneumoconiosis, interstitial lung disease and pulmonary sarcoidosis were observed. Elderly people especially suffered from CRDs, except for asthma. For COPD, the ASIR decreased from low-SDI regions to high-SDI regions. The ASIR of interstitial lung disease and pulmonary sarcoidosis in the high-SDI region was highest and have increased mostly. The ASIRs for pneumoconiosis and asthma were inversely related to the HDI.

Conclusions

In 2017, CRDs were still the leading causes of morbidity worldwide. A large proportion of the disease burden was attributed to asthma and COPD. The incidence rates of all four types of CRDs varied greatly across the world. Statistically significant correlation was found between the ASIR and SDI/HDI.

Take Module I Lesson 2 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. According to Bloom, et. al., (2013), how many "common colds" occur in the U.S.?
2. According to Bloom et al., 2013 and Blackwell et al., 2014, how many people in the U.S. suffer from asthma?
3. According to NHLBI, 2012 how many people have been diagnosed with COPD with how many people not yet being diagnosed?
4. According to NHLBI, 2009 what is the annual health care expenditures for asthma?
5. List 3 other emerging issues in chronic respiratory diseases.

Lesson Three

Respiratory Terms

Definition of Respiratory Disease

Respiratory disease is a medical term that encompasses pathological conditions affecting the organs and tissues that make gas exchange possible, and includes conditions of the upper respiratory tract, trachea, bronchi, bronchioles, alveoli, pleura and pleural cavity, and the nerves and muscles of breathing.

In recent years respiratory disease terminology and vocabulary have been reviewed to determine if doctors are communicating effectively with patients. Interestingly a study conducted in India (Sing, N. et al., 2017) revealed that the exact terminology of the common respiratory diseases is not effectively used by many doctors and most of the patients. The study identified an important gap in patient–doctor communication, and therefore, highlights the need of effective patient education. Although the study was conducted in India, it is imperative to communicate the proper name of the disease and to motivate patients to use the exact name of disease during communication. The patient should be educated about the proper name during regular visits and through patient education programs as well.

The next section lists most common respiratory and respiratory disease terminology and their definitions.

- **Airways-** These are the tubes that carry air in and out of the lungs (bronchi and bronchioles).
- **Alveoli-** Tiny air sacs at the end of the bronchioles. Oxygen in the air you have inhaled passes through the thin walls of the alveoli into the tiny blood vessels (capillaries) surrounding the alveoli.
- **Bronchi/Bronchioles-** The large and small tubes that carry air in and out of the lungs – the airways
- **Carbon Dioxide (CO2)-** A waste gas that is breathed out.
- **Diffusing Capacity of Lungs for Carbon Monoxide (DLCO)-** The effective surface area for gas exchange in the lungs. DLCO is a measure of the ability of gas to transfer from the alveoli across the alveolar epithelium and the capillary endothelium.
- **Dyspnea**- Difficult or labored breathing. The feeling of not being able to catch your breath or get enough air in the lungs.
- **Exacerbation-** When symptoms get temporarily worse in lung conditions.
- **Exercise Tolerance**- Exercise tolerance refers to the exercise capacity of an individual as measured by their ability to endure exercise and/or the maximum workload achieved during the exercise period. Exercise tolerance can be measured accurately during an exercise tolerance test.

- **FEV1 (Forced Expiratory Volume-one)**- This is a measure of how much air can be exhaled in one second following a deep inhalation. This is usually measured during a spirometry test.
- **FVC (Forced Vital Capacity**)- This is a measurement of lung volume (in liters) and represents the volume of air in the lungs that can be exhaled following a deep inhalation. This is usually measured during a spirometry test.
- **FEV1/ FVC Ratio**- This number represents the percent of the lung volume (FVC) that can be exhaled in one second. For example, if the FEV1 is 4 and the FVC is 5, then the FEV1/ FVC ratio would be 4/5 or 80%. This means the individual can breathe out 80% of the inhaled air in the lungs in one second. This is usually measured during a spirometry test.

- **Health Related Quality of Life-** Conceptually, HRQOL incorporates several dimensions experienced by the patient that are affected by disease and health. This includes symptoms, physical function, cognitive performance, psychosocial condition, emotional status, and adaptation to disease. Though the severity of disease is an important determinant of the patient's health, patient perception, and adaptation largely defines the overall quality of life.
- **Hyperinflation**- Occurs when air gets trapped in the lungs and causes them to overinflate. Hyperinflated lungs can be caused by blockages in the air passages or by air sacs that are less elastic, which interferes with the expulsion of air from the lungs.
- **Idiopathic-** This means the cause is unknown.
- **Inhaler-** A device which gives a dose of medication to breathe in.
- **Mucus-** A sticky fluid which protects against particles moving down into the lungs and causing damage.
- **Pulmonary-** To do with the lungs.
- **Pulmonary Rehab**- A program of education and exercise to increase awareness about the lungs and respiratory disease. One learns to achieve exercise with less shortness of breath. For the sake of this course, the term pulmonary rehab may be interchangeable with exercise program.
- **Respiratory-** To do with breathing and the chest.
- **SOB**- Short of Breath
- **Spirometry Test**- A breathing test which measures the amount of air that can be inhaled and then blown out of the lungs (pulmonary or lung function). The test is performed by blowing into a machine at least 3 times to make sure the results are consistent. It cannot provide a specific diagnosis, but it can distinguish between obstructive pulmonary disease involving increased airway resistance (such as chronic bronchitis) and restrictive disorders involving a reduction in total lung capacity resulting from structural or functional changes in the lungs.
- **Sputum-** Mucus or phlegm coughed up from the airways.
- **V – ventilation** – The air that reaches the alveoli.
- **Q – perfusion** – The blood that reaches the alveoli via the capillaries.

- **Ventilation/Perfusion Ratio** (or **V/Q ratio**)- A ratio used to assess the efficiency and adequacy of the matching of two variables. The V/Q ratio can therefore be defined as the ratio of the amount of air reaching the alveoli per minute to the amount of blood reaching the alveoli per minute—a ratio of volumetric flow rates. These two variables, V & Q, constitute the main determinants of the blood oxygen (O_2) and carbon dioxide (CO_2) concentration.
- **Wheeze-** A squeaking or whistling sound when breathing out.

Take Module I Lesson 3 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. Define respiratory disease.
2. Define airways.
3. Define carbon dioxide.
4. Define diffusion capacity.
5. Define dyspnea.
6. Define exacerbation.
7. Define exercise tolerance.
8. Define FEV1.
9. Define FVC.
10. Define FEV1/FVC Ratio.
11. Define hyperinflation.
12. Define idiopathic.
13. What is an inhaler?
14. What is SOB?
15. What is sputum
16. Define V-ventilation
17. Define Q-perfusion
18. Define Ventilation/Perfusion Ratio or V/Q Ratio.
19. Define wheeze

Lesson Four

Respiratory Diseases Listed and Categorized

Respiratory diseases range from mild and self-limiting, such as the common cold, to life-threatening entities like bacterial pneumonia, pulmonary embolism, acute asthma and lung cancer. (CDC, 2015). Diseases and conditions of the respiratory system fall into three main categories: **viruses**, such as influenza, bacterial pneumonia, enterovirus respiratory virus; **chronic diseases**, such as asthma and chronic obstructive pulmonary disease (COPD); and **cancer**, such as pleural mesothelioma.

Categories of Respiratory Disease

Viruses

Respiratory tract infections can affect any part of the respiratory system. They are traditionally divided into upper respiratory tract infections and lower respiratory tract infections.

- Upper respiratory tract infection: The most common upper respiratory tract infection is the common cold. However, infections of specific organs of the upper respiratory tract such as sinusitis, tonsillitis, otitis media, pharyngitis and laryngitis are also considered upper respiratory tract infections.
- Lower respiratory tract infection: The most common lower respiratory tract infection is pneumonia, an infection of the lungs which is usually caused by bacteria, particularly Streptococcus pneumonia in Western countries. Worldwide, tuberculosis is an important cause of pneumonia. Other pathogens such as viruses and fungi can cause pneumonia for example severe acute respiratory syndrome and pneumocystis pneumonia. A pneumonia may develop complications such as a lung abscess, a round cavity in the lung caused by the infection or may spread to the pleural cavity. Poor oral care may be a contributing factor to lower respiratory disease. New research suggests bacteria from gum disease travel through airways and into the lungs.

Chronic respiratory diseases (CRDs)

Chronic respiratory diseases are diseases of the airways and other structures of the lung. They are characterized by a high inflammatory cell recruitment (neutrophil) and/or destructive cycle of infection, (e.g. mediated by Pseudomonas aeruginosa). Some of the most common are asthma, chronic obstructive pulmonary disease, and acute respiratory distress syndrome. CRDs are not curable; however, various forms of treatment that help dilate major air passages and improve shortness of breath can help control symptoms and increase the quality of life for people with the diseases. Restrictive lung diseases are a subcategory of respiratory disease characterized by a loss of lung compliance, causing incomplete lung expansion and increased lung stiffness, such as in infants with respiratory distress syndrome.

Cancer

- Malignant tumors: Malignant tumors of the respiratory system, particularly primary carcinomas of the lung, are a major health problem responsible for 15% of all cancer diagnoses and 30% of all cancer deaths. Most respiratory system cancers are attributable to smoking tobacco.
- The major histological types of respiratory system cancer are:
    - Small cell lung cancer
    - Non-small cell lung cancer
    - Adenocarcinoma of the lung
    - Squamous cell carcinoma of the lung
    - Large cell lung carcinoma
- Lymphoma
- Head and neck cancer
- Pleural mesothelioma, almost always caused by exposure to asbestos dust.
- Other lung cancers (carcinoid, Kaposi's sarcoma, melanoma)

In addition, since many cancers spread via the bloodstream and the entire cardiac output passes through the lungs, it is common for cancer metastases to occur within the lung. Breast cancer may invade directly through local spread, and through lymph node metastases. After metastasis to the liver, colon cancer frequently metastasizes to the lung. Prostate cancer, germ cell cancer and renal cell carcinoma may also metastasize to the lung.

Treatment of respiratory system cancer depends on the type of cancer. Surgical removal of part of a lung (lobectomy, segmentectomy, or wedge resection) or of an entire lung (pneumonectomy), along with chemotherapy and radiotherapy, are all used. The chance of surviving lung cancer depends on the cancer stage at the time the cancer is diagnosed, and to some extent on the histology, and is only about 14-17% overall. In the case of metastases to the lung, treatment can occasionally be curative but only in certain, rare circumstances.

- Benign Tumor: Benign tumors are relatively rare causes of respiratory disease. Examples of benign tumors are:
    - Pulmonary hamartoma
    - Congenital malformations such as pulmonary sequestration and congenital cystic adenomatoid malformation (CCAM).

Obstructive vs. Restrictive Respiratory Disease

Respiratory diseases may also be classified as either obstructive lung disease or restrictive lung disease. Obstructive lung diseases include conditions that make it hard to exhale all the air in the lungs whereas people with restrictive lung disease have difficulty fully expanding their lungs with air. Obstructive and restrictive lung disease share the same main symptom: shortness of breath with exertion.

Obstructive Lung Disease

People with obstructive lung disease have shortness of breath due to difficulty exhaling all the air from the lungs. Because of damage to the lungs or narrowing of the airways inside the lungs, exhaled air comes out more slowly than normal. At the end of a full exhalation, an abnormally high amount of air may still linger in the lungs. Treatments for obstructive lung disease include medication, exercise, and oxygen.

The most common causes of obstructive lung disease are:

- Chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis
- Asthma
- Bronchiectasis
- Cystic fibrosis
- Obstructive lung disease makes it harder to breathe, especially during increased activity or exertion. As the rate of breathing increases, there is less time to breathe all the air out before the next inhalation.

Restrictive Lung Disease

People with restrictive lung disease cannot fully fill their lungs with air. Their lungs are restricted from fully expanding. Restrictive lung disease most often results from a condition causing stiffness in the lungs themselves. In other cases, stiffness of the chest wall, weak muscles, or damaged nerves may cause the restriction in lung expansion. Few medicines help for treatment of restrictive lung disease. Oxygen and mechanical breathing help in obesity related respiratory diseases. In addition, exercise and weight loss can help.

Some conditions causing restrictive lung disease are:

- Interstitial lung disease, such as idiopathic pulmonary fibrosis
- Sarcoidosis, an autoimmune disease
- Obesity, including obesity hypoventilation syndrome
- Scoliosis
- Neuromuscular disease, such as muscular dystrophy or amyotrophic lateral sclerosis (ALS)

Respiratory Diseases Listed and Defined

The following respiratory diseases will be categorized by the anatomical structure that is affected. The most common respiratory diseases will be featured in the next chapter focusing on the signs and symptoms along with the causes, risk factors, treatments, and prevention of those diseases.

Respiratory Diseases Affecting the Airways

The trachea branches into tubes called bronchi, which in turn branch to become progressively smaller tubes throughout the lungs. Diseases that affect the airways include:

- **Cough:** It is normal to cough occasionally, especially if one has a cold, flu or allergies. Coughing has a purpose. It is the body's way of keeping unwanted stuff from getting into the lungs. Coughing helps clear extra mucus from the airways. This extra mucus could be caused by smoking, a cold, nasal or sinus problems, a lung infection or a lung disease like asthma or COPD. A cough may be caused by a condition not related to the lungs, such as heartburn, some medications, or throat irritants (for example, dust, pollution, or chemicals in your workplace or home). Coughing up blood or thick mucus is not normal. If the cough makes one very tired or light-headed or causes chest or stomach pain, one should consult with a doctor. Doctors divide coughing into three groups, based on how long the cough has lasted: acute (coughing less than three weeks), sub-acute (coughing that lasts from three to eight weeks), or chronic (coughing that lasts longer than eight weeks).
- **The common cold** is probably the most common respiratory (breathing) disease. Many different viruses can cause a cold; over a hundred cold viruses (rhinoviruses) have been identified so far. Cold viruses are very contagious. When someone has a cold, there is a lot of the cold-causing virus in their nose and throat. If the person coughs or sneezes, they can spray the virus into the air and infect other people directly. If the person with the cold coughs or sneezes on objects or on their hands, those things can carry the virus too. Cold viruses can live for many hours on objects like toys, door handles, telephones, pens, tissues and more. If a healthy person picks up an object covered with cold germs, then touches their nose, mouth or eyes, they can catch the virus. Cold viruses are around all year long, but one seems to get more colds in the winter. This is because of time spent more indoors in closer proximity to other people and to their germs. Those who are tired, in poor physical condition, exposed to air pollutants or have a chronic lung disease like asthma or COPD, may get colds easier.
- **Rhinoviruses** (RVs) chiefly cause upper respiratory tract infections (URTIs) but may also infect the lower respiratory tract. Rhinoviruses are the most common cause of the common cold. Symptoms include sneezing, a mild fever, headaches, sore throat, cough, muscle aches, and a decrease in appetite. Although rhinovirus infections occur year-round, the incidence is highest in the fall and the spring.
- **Influenza (Flu)** is a highly contagious illness caused by the influenza virus. The influenza virus causes infections of the nose, throat and lungs. In most people, the flu is uncomfortable and tiring. It can keep people in bed for days or even a couple of weeks. Some people are more

at risk for serious complications from the flu, including seniors, young children, and people with long-term lung diseases like asthma and chronic obstructive pulmonary disease (COPD). Flu can make asthma symptoms worse and cause COPD flare-ups.

- **Human Metapneumovirus (hMPV)** is a respiratory virus that causes an upper respiratory infection (a cold). It usually occurs in the winter and early spring, along with the "flu" season.
- **Pertussis,** also known as whooping cough, is a contagious infection of the respiratory tract (breathing tubes). It causes severe coughing that can last for weeks. People with pertussis often make a loud "whooping sound" when they inhale after coughing. Most cases of pertussis can be prevented by a vaccination (shot). Anyone can get pertussis. It adversely affects infants younger than 6 months old before they're fully protected by immunizations, and youth 11 to 18 years old whose immunity has started to fade. The disease can be very serious in very young children and infants. Pregnant women in their third trimester and adults over the age of 60 also have higher risk for complications. With good care, most people recover from pertussis with no problems.
- **Asthma:** Asthma is a chronic disease that makes the lungs very sensitive and hard to breathe. Asthma can't be cured, but with proper treatment, people with asthma can lead normal, active lives. Certain aggravations can make the airways become:
  - Swollen and filled with mucus – the swelling and mucus makes the airways narrower, so it is hard for air to pass through.
  - Small and tight – the airways might also become twitchy and squeeze together and tighten. This makes the airways narrower and hard for air to pass through.
- **Chronic Obstructive Pulmonary Disease (COPD)** COPD is a lung disease that includes chronic bronchitis and emphysema. In 80-90% of cases, it is caused by smoking. COPD develops over time. In most cases, COPD is diagnosed in people over 40 years of age. Someone with COPD may not realize that they are becoming more short of breath until it becomes very hard to do simple tasks like walking up stairs. When one has COPD, the lungs are obstructed or blocked, making it hard to breathe. In chronic bronchitis, the airways become swollen and can be filled with mucus, which can make it hard to breathe. In emphysema, the air sacs (alveoli) in the lungs are damaged which can make it hard to breathe. Other causes of COPD can include:
  - Genetic reasons (alpha-1 antitrypsin deficiency)
  - Occupational dusts and chemicals
  - Second hand smoke
  - Frequent lung infections as a child
  - Wood smoke and other biomass (animal dung, crop residues) fuel used for cooking
- **Bronchitis** is an inflammation of the bronchi. This inflammation means the walls of the bronchi are swollen and filled with extra sticky mucus. Airflow into and out of the lungs is partly blocked because of the swelling and extra mucus in the bronchi. This makes one cough. There are two kinds of bronchitis:

- Acute bronchitis is a sudden infection of the airways, usually by a virus. It makes one sick for a while but gets better after two to three weeks.
- Chronic bronchitis doesn't go away. With chronic bronchitis, one has a cough with mucus most days for three months of the year.

- **Bronchiectasis** is a chronic condition where the walls of the bronchi are thickened from inflammation and infection. People with bronchiectasis have periodic flare-ups of breathing difficulties, called exacerbations.
- **Bronchiolitis** is a common lung infection in young children and infants. It causes inflammation and congestion in the small airways (bronchioles) of the lung. Bronchiolitis is almost always caused by a virus. Typically, the peak time for bronchiolitis is during the winter months. Bronchiolitis starts out with symptoms similar to those of a common cold but then progresses to coughing, wheezing and sometimes difficulty breathing. Symptoms of bronchiolitis can last for several days to weeks, even a month. Most children get better with care at home. A very small percentage of children requires hospitalization.
- **Cryptogenic Organizing Pneumonia (COP)** is a rare lung condition affecting the small airways (bronchioles) and alveoli (tiny air sacs). It was previously known as idiopathic bronchiolitis obliterans with organizing pneumonia (BOOP).
- **Bronchiolitis Obliterans with Organizing Pneumonia (BOOP)** is a lung disease that causes inflammation in the small air tubes (bronchioles) and air sacs (alveoli). BOOP typically develops in individuals between 40-60 years old; however, the disorder may affect individuals of any age. The signs and symptoms of BOOP vary but often include shortness of breath, a dry cough, and fever. BOOP can be caused by viral infections, various drugs, and other medical conditions. If the cause is known, the condition is called secondary BOOP. In many cases, the underlying cause of BOOP is unknown. These cases are called idiopathic BOOP or cryptogenic organizing pneumonia. Treatment often includes corticosteroid medications.
- **Bronchopulmonary dysplasia (BPD)** is a form of chronic lung disease that affects newborns (mostly premature) and infants. It results from damage to the lungs caused by mechanical ventilation (respirator) and long-term use of oxygen. Most infants recover from BPD, but some may have long-term breathing difficulty.
- **Croup** is a viral infection that causes swelling in the throat and vocal cords (larynx). Croup commonly affects children under five because their airways are smaller and more prone to swelling. One of the tell-tale signs of croup is a loud, "barky" cough that is worse at night.
- **Cystic Fibrosis (CF)** is a genetic condition causing poor clearance of mucus from the bronchi. The accumulated mucus results in repeated lung infections. CF mainly affects the lungs and digestion. Those with CF have an unusually thick, sticky mucus that clogs their lungs, makes it hard to breathe, and can lead to life-threatening lung infections. CF also affects the pancreas: thick secretions there stop the release of the digestive enzymes that normally help break down food, making it hard for one to digest and absorb nutrients. The mucus can also block the bile duct in the liver, which eventually causes permanent liver damage in some people with CF.

Respiratory Diseases Affecting the Air Sacs (Alveoli)

The airways eventually branch into tiny tubes (bronchioles) that dead-end into clusters of air sacs called alveoli. These air sacs make up most of the lung tissue. Lung diseases affecting the alveoli include:

- **Emphysema** is one of the diseases that comprises COPD (chronic obstructive pulmonary disease). Emphysema involves gradual damage of lung tissue, specifically thinning and destruction of the alveoli or air sacs.
- **Pneumonia** is inflammation of one or both lungs that is usually caused by an infection. Many different germs can cause pneumonia, including bacteria, viruses, and fungi. When one breathes in these germs, they can settle in the air sacs (alveoli) of the lungs. Deep in the lungs, the germs may grow and overcome the body's normal defenses. After the lungs become infected, the air sacs (alveoli) in the lungs fill with pus and mucus. This inflammation of the air sacs makes them less stretchy and keeps oxygen from properly reaching the blood stream. As one works harder to breathe and give the body oxygen, one can feel short of breath. The swelling also causes many of the other symptoms of pneumonia like cough, fever, and chest pain. Pneumonia can be life-threatening. It's a leading cause of death and hospitalization in seniors and in people with long-term chronic diseases.
- **Coccidioidomycosis** is often misdiagnosed and treated as bacterial pneumonia, which is more common. The symptoms and initial testing are often not enough to distinguish it from other causes of infection. Symptoms include cough, chest pain, shortness of breath, fever, joint aches, fatigue, rash. This disease lasts for weeks rather than days.
- **Tuberculosis (TB)** is a serious disease caused by breathing in a bacterium called Mycobacterium tuberculosis. TB usually infects the lungs. TB can also infect other parts of the body, including the kidneys, spine and brain. It is possible that one can have TB and not be sick, this is called latent TB. Latent TB is when one has the TB bacteria in the body, but it is not growing. The latent TB can become active TB at any time and make one very sick. If one has an inactive TB infection he/she needs to get treatment to cure the TB infection. TB is contagious. TB disease spreads through the air. It's important for those with TB to get treatment right away. TB treatments can cure TB and prevent it from spreading to others.
- **Acute Respiratory Distress Syndrome (ARDS)**
  ARDS is a buildup of fluid in the alveoli. This means less oxygen can get to the organs, which is very dangerous. ARDS occurs when there is significant trauma that either affects the lungs directly or indirectly. Some examples of trauma include sepsis (a blood infection), breathing in smoke from a house fire, near-drowning, severe pneumonia, major trauma, and shock from any cause. The body responds to this trauma with an inflammatory reaction that releases numerous natural molecules into the bloodstream. Normally, this inflammatory reaction would be protective and help one fight infection or heal from an injury. However, in some people, these inflammatory molecules lead the smallest blood vessels in the lungs to leak fluid. Fluid leaves

these small vessels and goes into the alveoli. The alveoli fill with this fluid making it difficult for oxygen to get into the bloodstream.

- **Pulmonary hemorrhage**, inflammation and damage to capillaries in the lung resulting in blood leaking into the alveoli. This may cause blood to be coughed up. Pulmonary hemorrhage can be due to auto-immune disorders such as granulomatosis with polyangiitis and Goodpasture's syndrome.
- **Pneumoconiosis** is a category of conditions caused by the inhalation of a substance that injures the lungs**.** The most common symptoms of pneumoconiosis are cough and shortness of breath. The risk is generally higher when people have been exposed to mineral dusts in high concentrations and/or for long periods of time. Inadequate or inconsistent use of personal protective equipment (PPE) such as respirators (specially fitted protective masks) is another risk factor since preventing dusts from being inhaled will also prevent pneumoconiosis. Pneumoconiosis does not generally occur from environmental (non-workplace) exposures since dust levels in the environment are much lower.
- **Byssinosis** a lung disease caused by prolonged inhalation of textile fiber dust.
- **Silicosis** lung fibrosis caused by the inhalation of dust containing silica.
- **Lung Cancer** has many forms and may develop in any part of the lungs. Most often this is in the main part of the lung, in or near the alveoli. Cancer is a disease where cancer cells grow out of control, taking over normal cells and organs in the body. There are two major types of lung cancer, non-small cell lung cancer and small cell lung cancer. Each type of lung cancer grows and spreads in different ways. Each type may be treated differently.
    - Non-small cell lung cancer: This is the most common type of lung cancer. It usually spreads more slowly than other lung cancers. There are three major types of non-small cell lung cancer:
        - Squamous cell carcinoma
        - Adenocarcinoma
        - Large cell carcinoma
    - Small cell lung cancer: This is a less common type of lung cancer and it spreads faster than non-small-cell lung cancer. Small cell lung cancer is named for the size of cancer cells, which can only be seen under a microscope. There are three major types of small cell lung cancer:
        - Small cell carcinoma
        - Mixed small cell/large cell
        - Combined small cell carcinoma
- There are also other types of lung cancer Lymphangioleiomyomatosis (LAM), Mesothelioma, Middle Eastern Respiratory Syndrome (MERS), and Nontuberculosis Mycobacteria (NTM).

Respiratory Diseases Affecting the Interstitium

The interstitium is the microscopically thin, delicate lining between the lungs' air sacs (alveoli). Tiny blood vessels run through the interstitium and allow gas exchange between the alveoli and the blood. Various lung diseases affect the interstitium:

- **Pulmonary Fibrosis (PF)** is a disease where there is scarring of the lungs, which makes it difficult to breathe. Pulmonary fibrosis is one form of interstitial lung disease.
- **Interstitial Lung Disease (ILD)** is an umbrella term for a large group of disorders that cause scarring (fibrosis) of the lungs. The scarring causes stiffness in the lungs which makes it difficult to breathe. ILDs can be caused by exposure to hazardous chemicals, certain medications and medical treatments. In most cases, the causes are unknown. Lung damage from many ILDs is irreversible and progressive, meaning it gets worse over time. In some cases, it can be slowed by certain medications. Occasionally, people with ILDs will be recommended for lung transplants. Some example of ILDs include Idiopathic Pulmonary Fibrosis, Hypersensitivity Pneumonitis, Sarcoidosis, and Asbestosis.
    - **Idiopathic Pulmonary Fibrosis (IPF)** is a type of lung disease that results in scarring (fibrosis) of the lungs for an unknown reason. Over time, the scarring gets worse and it becomes hard to take in a deep breath and the lungs cannot take in enough oxygen. IPF is a form of interstitial lung disease, primarily involving the interstitium (the tissue and space around the air sacs of the lungs), and not directly affecting the airways or blood vessels. There are many other kinds of interstitial lung disease that can also cause inflammation and/or fibrosis, and these are treated differently
    - **Hypersensitivity Pneumonitis** is a disease of the lungs in which your lungs become inflamed as an allergic reaction to inhaled dust, fungus, molds or chemicals.
    - **Sarcoidosis** is a disease that causes swelling in the cells in different organs of the body. It usually affects the lungs. It can also affect other organs, like the skin, eyes, lymph nodes and brain. With sarcoidosis, some of the blood cells bunch together to form tiny lumps called granulomas. The granulomas can form in different parts of the body. If they build up in the lungs, they can stop the lungs from working properly.
    - **Asbestosis** is a chronic (long-term) lung disease caused by breathing in asbestos fibers. Asbestos is a heat-resistant mineral that used to be common in insulation, vinyl floor tiles, cement, brake linings and other products. If one breathes a lot of asbestos fibers over a long time it can cause scarring in the lungs and shortness of breath.

Respiratory Diseases and Disorders Affecting Blood Vessels

The right side of the heart receives low-oxygen blood from the veins. It pumps blood into the lungs through the pulmonary arteries. These blood vessels can suffer from disease, as well.

- **Pulmonary Embolism** happens when one or more of the arteries in the lungs gets blocked by a blood clot, fat, or tumor. The most common type of pulmonary embolism is caused by a blood clot that moves through the blood stream, goes through the heart and blocks off an artery in the lung. Most pulmonary embolisms are caused from clots originating in the lower extremities (deep vein thrombosis), and many resolves on their own. However, in some cases, pulmonary embolism can cause sudden death. Pulmonary embolism can be caused by clots from the venous circulation from the right side of the heart or tumors that have invaded the circulatory system. Other sources can include amniotic fluid, air, fat, bone marrow, and any foreign substances.
- **Pulmonary Arterial Hypertension (PAH)** is a disease where one has abnormally high blood pressure in the blood vessels of the lungs (pulmonary arteries). In PAH, the pulmonary arteries become narrowed, and can be scarred to the point of being closed. PAH is a serious illness and can be life-threatening. PAH is due to disease in the pulmonary arteries. There are many new medications for patients with PAH.
- **Chronic thromboembolic pulmonary hypertension (CTEPH) is** a form of pulmonary hypertension, or high blood pressure, affecting the lungs. It is caused by blood clots.
- **Deep Vein Thrombosis (DVT) / Blood Clots:** Blood clots are a normal reaction to blood vessel injury and bleeding. Sometimes a blood clot can form in a vein deep in the body, which is called DVT. A serious and potentially life-threatening complication of these blood clots is when a deep vein clot breaks loose and travels through the blood stream, lodging in the arteries in the lungs and blocking blood flow to the lungs.

Respiratory Diseases and Disorders Affecting the Pleura

The pleura is a thin lining that surrounds the lung and lines the inside of the chest wall. A tiny layer of fluid allows the pleura on the lung's surface to slide along the chest wall with each breath.

- **Pleurisy** is an inflammation of the pleura. The pleura is a two layered membrane that both encloses the lung and lines the chest cavity. People have two pleurae, one around each lung. The pleurae act as a protective wrapping, fitting snugly over your lungs. Pleurae are made up of two layers. Normally, there is nothing but a thin layer of a lubricating fluid between the inner pleural lining and the outer pleural lining. The smooth pleura linings and lubricating fluid allow your lungs to move freely in your chest, as they do in normal breathing. Those with pleurisy, the two layers of pleura get inflamed (red and swollen). This can create a space between the layers called the pleural cavity. In wet pleurisy, this space can fill up with fluid that can get infected.
- **Pleural Effusion:** Fluid collects in the normally tiny pleura space between the lung and the chest wall. Pneumonia or heart failure is usually responsible. If large, pleural effusions can

impair breathing, and should be drained.

- **Pneumothorax:** Air may enter the space between the chest wall and the lung, collapsing the lung. To remove the air, a tube is typically inserted through the chest wall.
- **Mesothelioma:** A rare form of cancer that forms on the pleura. Mesothelioma tends to emerge several decades after asbestos exposure.

Respiratory Diseases and Disorders Affecting the Chest Wall

The chest wall also plays an important role in breathing. Muscles connect the ribs to each other, helping the chest to expand. The diaphragm descends with each breath in, also causing chest expansion.

- **Obesity Hypoventilation Syndrome:** Extra weight on the chest and abdomen makes it difficult for the chest to expand. Serious breathing problems can result.
- **Neuromuscular Disorders:** Poor function in the nerves controlling the respiratory muscles causes difficulty breathing. Amyotrophic lateral sclerosis and myasthenia gravis are examples of neuromuscular lung disease.

Other Respiratory Diseases and Disorders

- **Alpha-1 Antitrypsin Deficiency** is a genetic disorder that may result in lung disease or liver disease. Onset of lung problems is typically between 20 and 50 years old. This may result in shortness of breath, wheezing, or an increased risk of lung infections.
- **Hantavirus Pulmonary Syndrome (HPS)** Hantavirus Pulmonary Syndrome is a rare but serious lung disease spread by deer, mice and other wild rodents. Hantavirus is found in the saliva, urine and droppings of infected rodents. People can get Hantavirus when they breathe in tiny particles of fresh saliva, urine, droppings or nesting materials that are infected with the virus. Hantavirus Pulmonary Syndrome is not spread from person to person.
- **Histoplasmosis** an infection caused by the fungus Histoplasma capsulatum. Histoplasmosis is the most common of the three major endemic (limited to a specific geographical area) fungal infections of North America.
- **Respiratory Syncytial Virus (RSV)** is a virus that infects the lungs and airways (breathing passages). RSV can affect anyone of any age, but it's most common in infants and young children. It's so common that almost all children have been infected with RSV by the age of three. RSV is usually a mild disease that goes away on its own. In very young children RSV can sometimes lead to serious infections like pneumonia or bronchiolitis.
- **Severe Acute Respiratory Syndrome (SARS)** is an infectious condition that can cause serious respiratory illness or death. An outbreak of SARS occurred in 2003 and started in China but progressed worldwide before it was contained. There have been no cases of SARS anywhere in the world since 2004.

- **Shortness of Breath:** Some people with respiratory problems can feel breathless just by doing normal activities like getting out of a chair or walking to another room. One should seek medical advice if the shortness of breath is accompanied by:
    - Swelling in feet and ankles
    - Trouble breathing when lying flat
    - High fever, chills, and cough
    - Lips or fingertips turning blue
    - Wheezing
    - Worsening of pre-existing shortness of breath after using inhaler
    - Breathlessness that does not go away after 30 minutes of rest
- **Sleep Apnea (OSA)** Obstructive sleep apnea is a serious breathing problem that interrupts sleep. Obstructive sleep apnea (also called OSA or obstructive sleep apnea-hypopnea syndrome) means one has short pauses in breathing when he/she sleeps. These breathing pauses – called apneas or apnea events – last for 10 to 30 seconds, maybe longer. People with obstructive sleep apnea can stop breathing dozens or hundreds of times each night leading to sleep disruption and low levels of oxygen. Obstructive sleep apnea stops one from having the restful sleep that is needed to stay healthy. If it's not treated, sleep apnea can lead to daytime sleepiness, and reduced cognitive function. People with untreated obstructive sleep apnea have an increased risk of motor vehicle crashes, cardiovascular disease, hypertension, and early death.
- **Sudden Infant Death Syndrome (SIDS)** is the sudden and unexplained death of an infant who is younger than one year old. SIDS seems to strike without warning, usually in babies who seem perfectly healthy. Even though the number of SIDS cases has dropped in the last 10 years, it's still the leading cause of death in infants between one month and one year.

Module I Lesson 4 Study #1

Development of an educational intervention to reduce the burden of adult chronic lung disease in rural India: Inputs from a qualitative study

Paul B, Isaac R, R. H, Jebaraj P, S. M, Das D, et al. (2021) Development of an educational intervention to reduce the burden of adult chronic lung disease in rural India: Inputs from a qualitative study. PLoS ONE 16(7): e0254534. https://doi.org/10.1371/journal.pone.0254534
Read entire article here.

Background
Chronic respiratory diseases (CRDs) are major causes of mortality and morbidity worldwide with a substantial burden of the disease being borne by the low and middle income countries (LMICs). Interventions to change health behaviour which aim to improve the quality of life and reduce disease burden due to CRD require knowledge of the problem and factors influencing such behaviour. Our study sought to appreciate the lived experiences of people with CRD, their understanding of the disease and its risk factors, and usual practice of health behaviour in a rural low-literate community in southern India.

Methods
Qualitative data were collected between September and December 2018 through eight focus group discussions (FGDs), five in-depth interviews and four key-informant interviews from patients and community members. Community engagement was undertaken prior to the study and all interviews and discussions were recorded with permission. Inductive coding was used to thematically analyse the results.

Results
Major themes included understanding of chronic lung disease, health behaviours, lived experiences with the disease and social norms, attitudes and other factors influencing health behaviour.

Discussion
Poor understanding of CRDs and their risk factors affect health seeking behaviour and/or health practices. Stigma associated with the disease and related health behaviours (e.g. inhaler use) creates emotional challenges and mental health problems, besides influencing health behaviour. However barriers can be circumvented by increasing community awareness; communication and connection with the community through community based health care providers can turn challenges into opportunities for better health care.

Module I Lesson 4 Study #2

Observational studies assessing the pharmacological treatment of obstructive lung disease: strengths, challenges, and considerations for study design.

Jørgen Vestbo, Christer Janson, Javier Nuevo, David Price

ERJ Open Research Oct 2020, 6 (4) 00044-2020. Read entire article here.

Background

Randomized controlled trials (RCTs) are the gold standard for evaluating treatment efficacy in patients with obstructive lung disease. However, due to strict inclusion criteria and the conditions required for ascertaining statistical significance, the patients included typically represent as little as 5% of the general obstructive lung disease population. Thus, studies in broader patient populations are becoming increasingly important. These can be randomized effectiveness trials or observational studies providing data on real-world treatment effectiveness and safety data that complement efficacy RCTs.

Methods

In this review we describe the features associated with the diagnosis of asthma and chronic obstructive pulmonary disease (COPD) in the real-world clinical practice setting. We also discuss how RCTs and observational studies have reported opposing outcomes with several treatments and inhaler devices due to differences in study design and the variations in patients recruited by different study types. Whilst observational studies are not without weaknesses, we outline recently developed tools for defining markers of quality of observational studies. We also examine how observational studies are capable of providing valuable insights into disease mechanisms and management and how they are a vital component of research into obstructive lung disease.

Conclusion

Real-world evidence can provide valuable insights into disease mechanisms and management; however, due to the potential for producing large amounts of data and analyses compared with RCTs, it is vital that they are designed with clear research questions in mind. These research questions may demand different methodologies and, as such, will guide the type of study that is required. This will help to challenge perceptions that real-world evidence is solely for the evaluation of safety/epidemiology and will demonstrate that they can also inform on patient outcomes if designed with clear research questions. Furthermore, due to the inclusion of a broader range of patients than RCTs, real-world studies require a much greater understanding of confounders and modifiers of effects compared with RCTs to aid interpretation of their findings.

Observational real-world studies are a vital component of research into obstructive lung disease, and well-designed observational studies can support pivotal RCTs and provide evidence that has the potential to influence clinical practice. Although observational studies are subject to specific challenges, with the aid of recently developed quality standard tools, these challenges can be factored into study design to produce high-quality results. In future, well-designed, real-world studies that include a broad range of patients (in terms of geographical location, care setting and severity level) across both asthma and COPD diagnoses will be instrumental in supporting a more personalized, endotype-driven approach to the assessment and management of patients with obstructive lung disease.

As we move into an era of personalized medicine, recent observational studies, such as the NOVEL observational longiTudinal studY (NOVELTY), have the capacity to provide a greater understanding of the value of a personalized healthcare approach in patients in clinical practice by focusing on standardized outcome measures of patient-reported outcomes, physician assessments, airway physiology, and blood and airway biomarkers across both primary and specialist care.

Take Module I Lesson 4 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. What are the three main categories of respiratory diseases?
2. Define Upper Respiratory Infection and in what category of RD does it fall?
3. Define Lower Respiratory Infection and in what category of RD does it fall?
4. Define Chronic Respiratory Disease and what are some of its characteristics?
5. Are CRDs curable?
6. What is restrictive lung disease?
7. What are the most common CRDs?
8. List three types of RD cancers.
9. What is responsible for 30% of all cancer deaths?
10. Why is it a concern for the lungs if one has a completely different type of cancer, like breast cancer?
11. Describe the difference between Obstructive and Restrictive Respiratory Diseases.
12. List and define five respiratory diseases that affect the airways.
13. List and define five respiratory diseases that affect the air sacs (alveoli).
14. List and define two respiratory diseases that affect the interstitium.
15. List and define two respiratory diseases that affect the blood vessels.
16. List and define two respiratory diseases that affect the pleura.
17. List and define two respiratory diseases that affect the chest wall.
18. What is Shortness of Breath?
19. What is Sleep Apnea (OSA)?
20. What is Sudden Death Syndrome (SIDS)?

Lesson Five

Covid-19 Implications

In March 2020, the world was shut down due to the pandemic of Covid-19. Since then, much research has been conducted. Because the implications of Covid-19 were devasting and research was happening in real time at warp speed, information regarding the virus is ever changing and evolving. In this course, we are providing some interesting findings from several peer reviewed literature to better understand Covid-19 and how it can be helpful to the fitness specialist when working with one who is recovering from the virus.

COVID-19

- Covid-19 Definition: Comes from a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). COVID-19 identified as the cause of a disease outbreak that originated in China.
- The virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and causes COVID-19.
- In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
- COVID-19 research is occurring in real time and is under the world's microscope. It is evolving every day.

Symptoms of COVID-19

- According to the CDC, although most people recover within weeks or months of contracting Covid-19, some do not.
- Experts use the term Long COVID to describe a range of symptoms that can last weeks or months after first being infected. These symptoms can even appear weeks after infection.
- Multiorgan Effects
    - Including conditions like multisystem inflammatory syndrome (MIS) where different body parts are swollen
    - Autoimmune conditions where the body attacks healthy cells in the body by mistake
- Tiredness/fatigue
- Difficulty thinking or concentrating ("brain fog")
- Headache
- Loss of smell or taste
- Dizziness on standing
- Heart palpitations
- Chest pain
- Difficulty breathing or shortness of breath
- Cough
- Joint/muscle pain
- Depression/anxiety
- Fever
- Symptoms worsen after physical or mental activities

The Role of the Respiratory Disease Fitness Specialist

- There is a need for a health/fitness specialist who understands COVID-19 and can provide specialized training beyond the basic fitness professional.
- The RDFS Focuses on Special Conditions: What quickly became unique about COVID-19 is that the virus not only attacks one part of the body but many parts of the body. Being an RDFS provides solutions for many people who suffer from post-COVID symptoms and want to become stronger and healthier. Providing those health/fitness solutions requires a specific type of education and training that applies to the post-COVID client--far beyond the education of a primary health and fitness professional.
- The RDFS's Role in Prevention of COVID-19: The RDFS plays a crucial role in preventing many diseases that increased the risk for those who contracted COVID-19. Those who were at greater risk for COVID-19 had preexisting conditions such as obesity, diabetes, chronic respiratory disease, and a lower immune system.
- The RDFS as an Educator
- The RDFS as a Relationship Builder
- Local Medical Community
- Specialized Support/Social Media Groups
- See the Business Module of the Manual

The Center for Disease Control and Prevention (CDC) Guidelines for COVID-19 and People with Certain Medical Conditions

Updated February 25, 2022 (Guidelines are fluid and should be checked on a regular basis here.)

What You Need To Know

- A person with any of the medical conditions listed below is more likely to get very sick with COVID-19. If you have one of these conditions, talk with your healthcare provider about how best to protect yourself from severe illness from COVID-19.
- The list below does not include all possible conditions that put you at higher risk of severe illness from COVID-19. If you have questions about a condition not included on this list, talk to your healthcare provider about how best to manage your condition and protect yourself from COVID-19.
- Staying up to date with COVID-19 vaccines (getting primary series and booster) and following preventive measures for COVID-19 are important. This is especially important if you are older or have severe health conditions or more than one health condition, including those on the list below.
- Approved and authorized COVID-19 vaccines (primary series and booster) are safe and effective.
- Some people who are immunocompromised, or people with weakened immune systems, may be eligible for an additional primary dose of COVID-19 vaccine.

Overview
Based on the current evidence, a person with any of the conditions listed below is more likely to get very sick from COVID-19. This means that a person with one or more of these conditions who gets very sick from COVID-19 (has severe illness from COVID-19) is more likely to:

- Be hospitalized
- Need intensive care
- Require a ventilator to help them breathe
- Die

In addition:

- Older adults are at highest risk of getting very sick from COVID-19. More than 81% of COVID-19 deaths occur in people over age 65. The number of deaths among people over age 65 is 97 times higher than the number of deaths among people ages 18-29 years.
- A person's risk of severe illness from COVID-19 increases as the number of underlying medical conditions they have increases.
- Some people are at increased risk of getting very sick or dying from COVID-19 because of where they live or work, or because they can't get health care. This includes many people from racial and ethnic minority groups and people with disabilities.
    - Studies have shown people from racial and ethnic minority groups are also dying from COVID-19 at younger ages. People in racial and ethnic minority groups are often younger when they develop chronic medical conditions and may be more likely to have more than one medical condition.
    - People with disabilities are more likely than those without disabilities to have chronic health conditions, live in shared group (also called "congregate") settings, and face more barriers in accessing health care. Studies have shown that some people with certain disabilities are more likely to get COVID-19 and have worse outcomes.

Staying up to date with COVID-19 vaccines (getting primary series and booster) and following preventive measures for COVID-19 are important. This is especially important if you are older or have severe health conditions or more than one health condition, including those on this list. Learn more about how CDC develops COVID-19 vaccination recommendations.

Medical Conditions

- The conditions on this list are in alphabetical order. They are **not in order of risk.**
- CDC completed a review for each medical condition on this list. This was done to ensure that these conditions met criteria for inclusion on this list. CDC conducts ongoing reviews of additional underlying conditions. If other medical conditions have enough evidence, they might be added to the list.
- Because we are learning more about COVID-19 every day, this list **does not** include all medical conditions that place a person at higher risk of severe illness from COVID-19. Rare medical conditions, including many conditions that mostly affect children, may not be included on the list below. We will update the list as we learn more.
- A person with a condition that is not listed may still be at greater risk of getting very sick from COVID-19 than other people who do not have the condition. It is important that you talk with your healthcare professional about your risk.

1. Cancer: Having cancer can make you more likely to get very sick from COVID-19. Treatments for many types of cancer can weaken your body's ability to fight off disease. At this time, based on available studies, having a history of cancer may increase your risk.
2. Chronic kidney disease: Having chronic kidney disease of any stage can make you more likely to get very sick from COVID-19.
3. Chronic liver disease: Having chronic liver disease can make you more likely to get very sick from COVID-19. Chronic liver disease can include alcohol-related liver disease, non-alcoholic fatty liver disease, autoimmune hepatitis, and cirrhosis (or scarring of the liver).
4. Chronic lung diseases: Having a chronic lung disease can make you more likely to get very sick from COVID-19. Chronic lung diseases can include:

   - Asthma, if it's moderate to severe
   - Bronchiectasis (thickening of the lungs' airways)
   - Bronchopulmonary dysplasia (chronic lung disease affecting newborns)
   - Chronic obstructive pulmonary disease (COPD), including emphysema and chronic bronchitis
   - Having damaged or scarred lung tissue known as interstitial lung disease (including idiopathic pulmonary fibrosis)
   - Pulmonary embolism (blood clot in the lungs)
   - Pulmonary hypertension (high blood pressure in the lungs)

5. Cystic Fibrosis: Having cystic fibrosis, with or without lung or other solid organ transplant (like kidney, liver, intestines, heart, and pancreas) can make you more likely to get very sick from COVID-19.
6. Dementia or other neurological conditions: Having neurological conditions, such as dementia, can make you more likely to get very sick from COVID-19.
7. Diabetes (type 1 or type 2): Having either type 1 or type 2 diabetes can make you more likely to get very sick from COVID-19.
8. Disabilities: People with some types of disabilities may be more likely to get very sick from COVID-19 because of underlying medical conditions, living in congregate settings, or systemic health and social inequities.
9. People with any type of disability that makes it more difficult to do certain activities or interact with the world around them, including people who need help with self-care or daily activities.
   - People with attention-deficit/hyperactivity disorder (ADHD)
   - People with cerebral palsy
   - People with birth defects
   - People with intellectual and developmental disabilities
   - People with learning disabilities
   - People with spinal cord injuries
   - People with Down Syndrome

10. Heart conditions: Having heart conditions such as heart failure, coronary artery disease, cardiomyopathies, and possibly high blood pressure (hypertension) can make you more likely to get very sick from COVID-19.

11. HIV infection: Having HIV (Human Immunodeficiency Virus) can make you more likely to get very sick from COVID-19.

12. Immunocompromised state (weakened immune system):

    - Some people are immunocompromised or have a weakened immune system. For example, people on chemotherapy or who have had a solid organ transplant, like a kidney transplant or heart transplant. Being immunocompromised can make you more likely to get very sick from COVID-19. Many conditions and treatments can cause a person to be immunocompromised or have a weakened immune system. For example, some people inherit problems with their immune system. One example is called Primary immunodeficiency. Other people have to use certain types of medicines for a long time, like corticosteroids, that weaken their immune system. Such long-term uses can lead to secondary or acquired immunodeficiency.

    - People who are immunocompromised or are taking medicines that weaken their immune system may not be protected even if they are up to date on their vaccines. They should continue to take all precautions recommended for people who are not vaccinated people, including wearing a well-fitting mask, until advised otherwise by their healthcare professionals.

    - After completing the primary series, some people who are moderately or severely immunocompromised should get an additional primary dose. Because the immune response following COVID-19 vaccination may differ in people who are moderately or severely immunocompromised, specific guidance has been developed.

13. Everyone 12 years and older, including people who are immunocompromised, should get a booster shot. If you are eligible for an additional primary dose, you should get this dose first before you get a booster shot.

14. Mental health conditions: Having mood disorders, including depression, and schizophrenia spectrum disorders can make you more likely to get very sick from COVID-19.

15. Overweight and obesity: Overweight (defined as a body mass index (BMI) is 25 kg/m2 or higher, but under 30 kg/m2), obesity (BMI is 30 kg/m2 or higher, but under 40 kg/m2), or severe obesity (BMI is 40 kg/m2 or higher), can make you more likely to get very sick from COVID-19. The risk of severe illness from COVID-19 increases sharply with higher BMI.

16. Physical inactivity: People who do little or no physical activity, or exercise, are more likely to get very sick from COVID-19 than those who are physically active. Being physically active (or exercising regularly) is important to being healthy.

17. Pregnancy: Pregnant and recently pregnant people (for at least 42 days following end of pregnancy) are more likely to get very sick from COVID-19 compared with non-pregnant people.

18. Sickle cell disease or thalassemia: Having hemoglobin blood disorders like sickle cell disease or thalassemia (inherited red blood cell disorders) can make you more likely to get very sick from COVID-19.

19. Smoking, current or former: Being a current or former cigarette smoker can make you more likely to get very sick from COVID-19. If you currently smoke, quit. If you used to smoke, don't start again. If you've never smoked, don't start.

20. Solid organ or blood stem cell transplant: Having had a solid organ or blood stem cell transplant, which includes bone marrow transplants, can make you more likely to get very sick from COVID-19.

21. Stroke or cerebrovascular disease: Having cerebrovascular disease, such as having a stroke which affects blood flow to the brain, can make you more likely to get very sick from COVID-19.

22. Substance use disorders: Having a substance use disorder (such as alcohol, opioid, or cocaine use disorder) can make you more likely to get very sick from COVID-19.

23. Tuberculosis: Having tuberculosis (TB) can make you more likely to get very sick from COVID-19.

24. Additional Information on Children and Teens:

    - People of all ages, including children, can get very sick from COVID-19. Children with underlying medical conditions are at increased risk for getting very sick compared to children without underlying medical conditions.

    - Current evidence suggests that children with medical complexity, with genetic, neurologic, or metabolic conditions, or with congenital heart disease can be at increased risk for getting very sick from COVID-19. Like adults, children with obesity, diabetes, asthma or chronic lung disease, sickle cell disease, or who are immunocompromised can also be at increased risk for getting very sick from COVID-19.

Actions One Can Take
It is important to protect yourself and others by taking preventive measures against COVID-19:

- Stay up to date with your COVID-19 vaccines
- Wear a well-fitting mask
- Avoid crowds and poorly ventilated spaces
- Test to prevent the spread to others
- Wash your hands often
- Cover coughs and sneezes
- Monitor your health daily

Seek care when needed

1. Call your healthcare professional if you have any concerns about your medical conditions or if you get sick and think that you may have COVID-19. Discuss steps you can take to manage your health and risks. **If you need emergency help, call 911 right away.**
2. Do not delay getting care for your medical condition because of COVID-19. Emergency departments, urgent care, clinics, and your healthcare professional have infection prevention plans to help protect you from getting COVID-19 if you need care.

Continue medications and preventive care

- Continue your medicines and do not change your treatment plan without talking to your healthcare professional.
- Have at least a 30-day supply of prescription and non-prescription medicines. Talk to a healthcare professional, insurer, or pharmacist about getting an extra supply (i.e., more than 30 days) of prescription medicines, if possible, to reduce your trips to the pharmacy.
- Follow your current treatment plan (e.g., Asthma Action Plan, dialysis schedule, blood sugar testing, nutrition, and exercise recommendations) to keep your medical condition(s) under control.
- When possible, keep your appointments (e.g., vaccinations and blood pressure checks) with your healthcare professional. Check with your healthcare professional about safety precautions for office visits and ask about telemedicine or virtual healthcare appointment options.
- Learn about stress and coping. You may feel increased stress during this pandemic. Fear and anxiety can be overwhelming and cause strong emotions. It can be helpful to talk with a professional like a counselor, therapist, psychologist, or psychiatrist. Ask your primary care provider if you would like to speak with a professional. Getting regular exercise and being physically active is also a great way to reduce stress.

Accommodate dietary needs and avoid triggers

- Have non-perishable food choices such as canned goods available that meet your needs based on your medical condition (e.g., kidney diet and KCER 3-Day Emergency Diet Plan, external icon, diabetic diet).
- Know the triggers for your condition and avoid when possible (e.g., avoid asthma triggers by having another member of your household clean and disinfect your house for you or avoid possible sickle cell disease triggers to prevent pain crises).

Continued Research on COVID-19 is Needed

Covid-19	
WHAT WE KNOW	**WHAT WE STILL DON'T KNOW**
The virus affects people differently.	Where exactly did the virus come from? (Controversial)
The virus can damage organs.	Why are children less vulnerable than adults in some variants?
The virus spreads exponentially.	What is the herd immunity threshold for Covid-19?
Herd immunity usually happens via vaccines.	How long immunity lasts after vaccination, and will it become a yearly vaccine?
Most vaccines probably won't prevent transmission but reduce the symptoms when one becomes ill because of COVID-19.	After vaccination, can a person still spread Covid-19?
Indoor ventilation matters.	What are the long-term health implications?
Social distancing, handwashing, and wearing masks are still recommended to reduce the spread of the virus.	What will the next pandemic look like?

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Module I Lesson 5 Study #1

Association between pre-existing respiratory disease and its treatment, and severe COVID-19: a population cohort study

Prof Paul Aveyard, FRCGP, Min Gao, MSc, Nicola Lindson, PhD, Jamie Hartmann-Boyce, DPhil, Peter Watkinson, MD, Prof Duncan Young, DM, et al. Association between pre-existing respiratory disease and its treatment, and severe COVID-19: a population cohort study. The Lancet Respiratory Medicine. VOLUME 9, ISSUE 8, P909-923, AUGUST 01, 2021

Read entire article here.

Background
Previous studies suggested that the prevalence of chronic respiratory disease in patients hospitalized with COVID-19 was lower than its prevalence in the general population. The aim of this study was to assess whether chronic lung disease or use of inhaled corticosteroids (ICS) affects the risk of contracting severe COVID-19.

Methods
In this population cohort study, records from 1205 general practices in England that contribute to the QResearch database were linked to Public Health England's database of SARS-CoV-2 testing and English hospital admissions, intensive care unit (ICU) admissions, and deaths for COVID-19. All patients aged 20 years and older who were registered with one of the 1205 general practices on Jan 24, 2020, were included in this study. With Cox regression, we examined the risks of COVID-19-related hospitalisation, admission to ICU, and death in relation to respiratory disease and use of ICS, adjusting for demographic and socioeconomic status and comorbidities associated with severe COVID-19.

Results
Between Jan 24 and April 30, 2020, 8 256 161 people were included in the cohort and observed, of whom 14 479 (0·2%) were admitted to hospital with COVID-19, 1542 (<0·1%) were admitted to ICU, and 5956 (0·1%) died. People with some respiratory diseases were at an increased risk of hospitalization (chronic obstructive pulmonary disease [COPD] hazard ratio [HR] 1·54 [95% CI 1·45–1·63], asthma 1·18 [1·13–1·24], severe asthma 1·29 [1·22–1·37; people on three or more current asthma medications], bronchiectasis 1·34 [1·20–1·50], sarcoidosis 1·36 [1·10–1·68], extrinsic allergic alveolitis 1·35 [0·82–2·21], idiopathic pulmonary fibrosis 1·59 [1·30–1·95], other interstitial lung disease 1·66 [1·30–2·12], and lung cancer 2·24 [1·89–2·65]) and death (COPD 1·54 [1·42–1·67], asthma 0·99 [0·91–1·07], severe asthma 1·08 [0·98–1·19], bronchiectasis 1·12 [0·94–1·33], sarcoidosis 1·41 [0·99–1·99), extrinsic allergic alveolitis 1·56 [0·78–3·13], idiopathic pulmonary fibrosis 1·47 [1·12–1·92], other interstitial lung disease 2·05 [1·49–2·81], and lung cancer 1·77 [1·37–2·29]) due to COVID-19 compared with those without these diseases. Admission to ICU was rare, but the HR for people with asthma was 1·08 (0·93–1·25) and severe asthma was 1·30 (1·08–1·58). In a post-hoc analysis, relative risks of severe COVID-19 in people with respiratory disease were similar before and after shielding was introduced on March 23, 2020. In another post-hoc analysis, people with two or more prescriptions for ICS in the 150 days before study start were at a slightly higher risk of severe COVID-19 compared with all other individuals (i.e., no or one ICS prescription): HR 1·13 (1·03–1·23) for hospitalization, 1·63 (1·18–2·24) for ICU admission, and 1·15 (1·01–1·31) for death.

Conclusion

The risk of severe COVID-19 in people with asthma is relatively small. People with COPD and interstitial lung disease appear to have a modestly increased risk of severe disease, but their risk of death from COVID-19 at the height of the epidemic was mostly far lower than the ordinary risk of death from any cause. Use of inhaled steroids might be associated with a modestly increased risk of severe COVID-19.

Module I Lesson 5 Study #2

Associations between COVID-19 infection, tobacco smoking and nicotine use, common respiratory conditions and inhaled corticosteroids: a prospective QResearch-Case Mix Program data linkage study January-May 2020

Nicola Lindson, Min Gao, Jamie Hartmann-Boyce, Margaret Smith, Paul Aveyard, Duncan Young, Carol Coupland, Pui San Tan, Ashley K. Clift, David Harrison, Doug Gould, Ian D Pavord, Peter Watkinson, Julia Hippisley-Cox. medRxiv 2020.06.05.20116624; doi: https://doi.org/10.1101/2020.06.05.20116624

This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.

Read entire article here.

Background

Epidemiological and laboratory research seems to suggest that smoking and perhaps nicotine alone could reduce the severity of COVID-19. Likewise, there is some evidence that inhaled corticosteroids could also reduce its severity, opening the possibility that nicotine and inhaled steroids could be used as treatments.

Methods

In this prospective cohort study, we will link English general practice records from the QResearch database to Public Health England's database of SARS-CoV-2 positive tests, Hospital Episode Statistics, admission to intensive care units, and death from COVID-19 to identify our outcomes: hospitalization, ICU admission, and death due to COVID. Using Cox regression, we will perform sequential adjustment for potential confounders identified by separate directed acyclic graphs to:

- Assess the association between smoking and COVID-19 disease severity, and how that changes on adjustment for smoking-related comorbidity.
- More closely characterize the association between smoking and severe COVID-19 disease by assessing whether the association is modified by age (as a proxy of length of smoking), gender, ethnic group, and whether people have asthma or COPD.
- Assess for evidence of a dose-response relation between smoking intensity and disease severity, which would help create a case for causality.
- Examine the association between former smokers who are using NRT or are vaping and disease severity.
- Examine whether pre-existing respiratory disease is associated with severe COVID-19 infection.

- Assess whether the association between chronic obstructive pulmonary disease (COPD) and asthma and COVID-19 disease severity is modified by age, gender, ethnicity, and smoking status.

- Assess whether the use of inhaled corticosteroids is associated with severity of COVID-19 disease.

- To assess whether the association between use of inhaled corticosteroids and severity of COVID-19 disease is modified by the number of other airways medications used (as a proxy for severity of condition) and whether people have asthma or COPD.

Conclusion

This representative population sample will, to our knowledge, present the first comprehensive examination of the association between smoking, nicotine use without smoking, respiratory disease, and severity of COVID-19. We will undertake several sensitivity analyses to examine the potential for bias in these associations.

Module I Lesson 5 Study #3

Asthma and COVID-19: review of evidence on risks and management considerations

Hartmann-Boyce J, Gunnell J, Drake J, et al. Asthma and COVID-19: review of evidence on risks and management considerations. BMJ Evidence-Based Medicine 2021;26:195.

Read entire article here.

Background
Respiratory illnesses typically present increased risks to people with asthma (PWA). However, data on the risks of COVID-19 to PWA have presented contradictory findings, with implications for asthma management. The objective is to assess the risks and management considerations of COVID-19 in people with asthma (PWA).

Methods
We conducted a rapid literature review. We searched PubMed, medRxiv, LitCovid, TRIP, Google and Google Scholar for terms relating to asthma and COVID-19, and for systematic reviews related to specific management questions within our review, in April 2020. References were screened and data were extracted by one reviewer.

Results
We extracted data from 139 references. The evidence available is limited, with some sources suggesting an under-representation of PWA in hospitalized cases and others showing an increased risk of worse outcomes in PWA, which may be associated with disease severity. Consensus broadly holds that asthma medications should be continued as usual. Almost all aspects of asthma care will be disrupted during the pandemic due not only to limits in face-to-face care but also to the fact that many of the diagnostic tools used in asthma are considered aerosol-generating procedures. Self-management and remote interventions may be of benefit for asthma care during this time but have not been tested in this context.

Conclusion
Evidence on COVID-19 and asthma is limited and continuing to emerge. More research is needed on the possible associations between asthma and COVID-19 infection and severity, as well as on interventions to support asthma care in light of constraints and disruptions to healthcare systems. We found no evidence regarding health inequalities, and this urgently needs to be addressed in the literature as the burdens of asthma and of COVID-19 are not equally distributed across the population.

Module I Lesson 5 Study #4

Outcome of Hospitalization for COVID-19 in Patients with Interstitial Lung Disease. An International Multicenter Study

Drake TM, Docherty AB, Harrison EM, Quint JK, Adamali H, Agnew S, Babu S, Barber CM, Barratt S, Bendstrup E, Bianchi S, Villegas DC, Chaudhuri N, Chua F, Coker R, Chang W, Crawshaw A, Crowley LE, Dosanjh D, Fiddler CA, Forrest IA, George PM, Gibbons MA, Groom K, Haney S, Hart SP, Heiden E, Henry M, Ho LP, Hoyles RK, Hutchinson J, Hurley K, Jones M, Jones S, Kokosi M, Kreuter M, MacKay LS, Mahendran S, Margaritopoulos G, Molina-Molina M, Molyneaux PL, O'Brien A, O'Reilly K, Packham A, Parfrey H, Poletti V, Porter JC, Renzoni E, Rivera-Ortega P, Russell AM, Saini G, Spencer LG, Stella GM, Stone H, Sturney S, Thickett D, Thillai M, Wallis T, Ward K, Wells AU, West A, Wickremasinghe M, Woodhead F, Hearson G, Howard L, Baillie JK, Openshaw PJM, Semple MG, Stewart I, Jenkins RG; ISARIC4C Investigators. Outcome of Hospitalization for COVID-19 in Patients with Interstitial Lung Disease. An International Multicenter Study. Am J Respir Crit Care Med. 2020 Dec 15;202(12):1656-1665. doi: 10.1164/rccm.202007-2794OC. PMID: 33007173; PMCID: PMC7737581.

Read entire article here.

Background

The impact of coronavirus disease (COVID-19) on patients with interstitial lung disease (ILD) has not been established. The objective is to assess outcomes in patients with ILD hospitalized for COVID-19 versus those without ILD in a contemporaneous age-, sex-, and comorbidity-matched population.

Methods

An international multicenter audit of patients with a prior diagnosis of ILD admitted to the hospital with COVID-19 between March 1 and May 1, 2020, was undertaken and compared with patients without ILD, obtained from the ISARIC4C (International Severe Acute Respiratory and Emerging Infection Consortium Coronavirus Clinical Characterization Consortium) cohort, admitted with COVID-19 over the same period. The primary outcome was survival. Secondary analysis distinguished idiopathic pulmonary fibrosis from non-idiopathic pulmonary fibrosis ILD and used lung function to determine the greatest risks of death.

Measurements and Main Results

Data from 349 patients with ILD across Europe were included, of whom 161 were admitted to the hospital with laboratory or clinical evidence of COVID-19 and eligible for propensity score matching. Overall mortality was 49% (79/161) in patients with ILD with COVID-19. After matching, patients with ILD with COVID-19 had significantly poorer survival (hazard ratio [HR], 1.60; confidence interval, 1.17-2.18; P = 0.003) than age-, sex-, and comorbidity-matched controls without ILD. Patients with an FVC of <80% had an increased risk of death versus patients with FVC ≥80% (HR, 1.72; 1.05-2.83). Furthermore, obese patients with ILD had an elevated risk of death (HR, 2.27; 1.39-3.71).

Conclusion

Patients with ILD are at increased risk of death from COVID-19, particularly those with poor lung function and obesity. Stringent precautions should be taken to avoid COVID-19 in patients with ILD.

Module I Lesson 5 Study #5

Use of "normal" risk to improve understanding of dangers of covid-19

Spiegelhalter D. Use of "normal" risk to improve understanding of dangers of covid-19 BMJ 2020; 370 :m3259 doi:10.1136/bmj.m325

Read entire article here.

Background

Accumulating data on deaths from covid-19 show an association with age that closely matches the "normal" risk we all face. Explaining risk in this way could help people understand and manage their response. As covid-19 turns from a societal threat into a matter of risk management, it is vital that the associated risks are understood and clearly communicated. But these risks vary hugely between people, and so finding appropriate analogues is a challenge. Although covid-19 is a complex multisystem disease that can cause prolonged illness, here the focus is solely on the risks of dying from covid-19 and the exploration of the use of "normal" risk—the risk of death from all causes each year—as an aid to transparent communication.

Conclusion

- It is difficult to communicate the huge range of individual mortality risks from covid-19 experienced by people of different ages.
- For the general population, the risk of catching and then dying from covid-19 during 16 weeks of the pandemic was equivalent to experiencing around 5 weeks extra "normal" risk for those over 55, decreasing steadily with age, to just 2 extra days for schoolchildren
- For those over 55 who are infected with covid-19, the additional risk of dying is slightly more than the "normal" risk of death from all other causes over one year, and less for under 55s.
- Analogy with normal risk seems an appropriate and useful tool for risk communication of lethal risk, although it does not deal with longer term harm to survivors.

Take Module I Lesson 5 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. Define COVID-19.
2. List 5 medical conditions that will put one into a category of people who will more likely to get very sick from COVID-19.
3. List 5 things we know about COVID-19.
4. List 3 things that we still don’t know about COVID-19.

Lesson Six

The Most Common Respiratory Diseases: Signs, Symptoms, Treatments, and Prevention

Respiratory illness is a common problem in the United States. Many times, people are genetically more likely to get respiratory conditions, but the workplace or environmental exposures could also play a big role. Smoking is the most common cause of respiratory disease. In the United States, tobacco smoke is a key factor in the development and progression chronic respiratory diseases, including COPD, although exposure to air pollutants in the home and workplace, genetic factors, and respiratory infections also play a role. Respiratory diseases can be prevented by avoiding exposure to tobacco smoke, home and workplace air pollutants, and respiratory infections. Smoking cessation is the most important part of treatment for smokers diagnosed with chronic respiratory disease. Washing hands regularly with soap and water can prevent respiratory infections. It is estimated that hands spread 80 percent of common infectious respiratory diseases like colds and flu. Early detection of respiratory diseases might change disease course and progress.

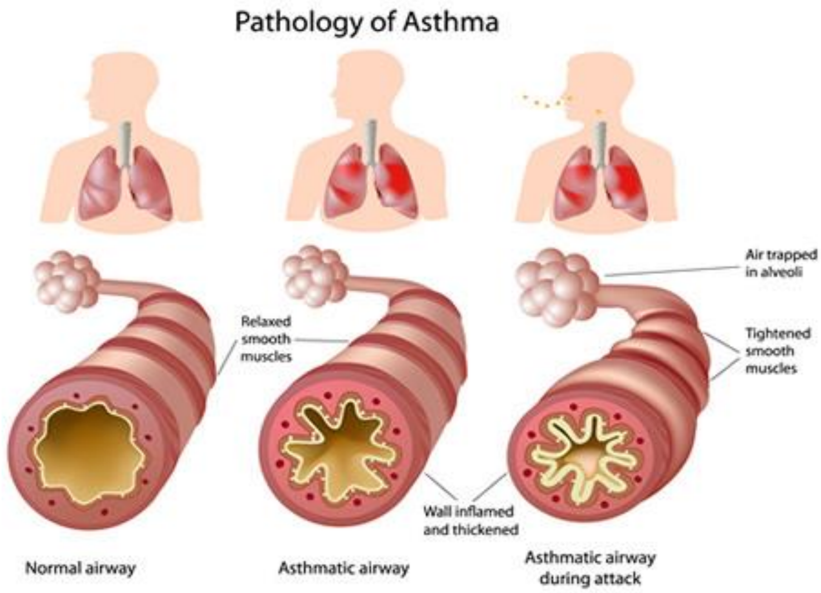
According to The Center for Disease Control and Prevention (CDC), tobacco use is the leading cause of preventable illness and death and produces 480,000 deaths a year (including deaths from secondhand smoke). Maintaining a healthy weight, getting adequate sleep, decreasing stress, adding plenty of activity, and eating a balanced diet are also great prevention tactics.
Respiratory diseases may be investigated and diagnosed by performing one or more of the following tests: biopsy of the lung or pleura, blood test, bronchoscopy, chest x-ray, computed tomography scan, culture of microorganisms from secretions such as sputum, ultrasound scanning, pulmonary function test, and ventilation-perfusion scan. One common and simple test is called spirometry and can be used to measure pulmonary or lung function. A deeper look into the most common performance tests for those with a respiratory disease will be covered in chapter eight.

The following is a break-down of some of the most common chronic respiratory diseases: asthma, chronic obstructive pulmonary disease, occupational lung diseases, and pulmonary hypertension.

ASTHMA

Asthma is defined as a common, chronic respiratory condition that causes difficulty breathing due to inflammation of the airways. Asthma is characterized by inflammation of the bronchial tubes with increased production of sticky secretions inside the tubes. (See Figure 5.1)

Epidemiology: The prevalence of asthma has increased since 1980; however, deaths from asthma have decreased since the mid-1990s (NHLBI, 2007). Usually, asthma starts in childhood years and progresses into adulthood. However, some people in their 60s, 70s and 80s can get adult-onset asthma. Asthma affects people of every race, sex, and age. However, significant disparities in asthma morbidity and mortality exist, particularly for low-income and minority populations. Populations with higher rates of asthma include children, women (among adults) and boys (among children), African Americans, Puerto Ricans, people living in the northeastern United States, people living below the federal poverty level, and employees with certain exposures in the workplace.



Symptoms: Asthma symptoms vary from person to person. One may have infrequent asthma attacks or have symptoms only at certain times - such as when exercising - or have symptoms all the time. Symptoms include: dry cough, wheezing, chest tightness, trouble sleeping, and shortness of breath. Signs that your asthma is probably worsening include: asthma signs and symptoms that are more frequent and bothersome, increasing difficulty breathing (measurable with a peak flow meter), and the need to use a quick-relief inhaler more often.

Causes: The causes of asthma are an active area of research and involve both genetic and environmental factors. For some people, asthma signs and symptoms flare up in certain situations:

- Exercise-induced asthma, which may be worse when the air is cold and dry
- Occupational asthma, triggered by workplace irritants such as chemical fumes, gases or dust
- Allergy-induced asthma, triggered by airborne substances, such as pollen, mold spores, cockroach waste or particles of skin and dried saliva shed by pets (pet dander)

Risk Factors: Risk factors for asthma currently being investigated include:

- Having a blood relative (such as a parent or sibling) with asthma
- Having another allergic condition, such as atopic dermatitis or allergic rhinitis (hay fever)
- Being overweight
- Being a smoker
- Exposure to secondhand smoke
- Exposure to exhaust fumes or other types of pollution
- Exposure to occupational triggers, such as chemicals used in farming, hairdressing and manufacturing

Treatment: While there is currently no cure for asthma, there are diagnoses and treatment guidelines that are aimed at ensuring that all people with asthma live full and active lives.

Prevention: While there's no way to prevent asthma, one should work with his/her doctor to design a step-by-step plan for living with the asthma condition and preventing asthma attacks.

- **Follow the asthma action plan.** With a doctor and health care team, write a detailed plan for taking medications and managing an asthma attack. Then be sure to follow the plan. Asthma is an ongoing condition that needs regular monitoring and treatment. Taking control of the treatment can make one feel more in control of his/her life in general.
- **Get vaccinated for influenza and pneumonia.** Staying current with vaccinations can prevent flu and pneumonia from triggering asthma flare-ups.
- **Identify and avoid asthma triggers.** Several outdoor allergens and irritants — ranging from pollen and mold to cold air and air pollution — can trigger asthma attacks. One should determine what causes or worsens the asthma and take steps to avoid those triggers.
- **Monitor breathing.** One may learn to recognize warning signs of an impending attack, such as slight coughing, wheezing or shortness of breath. But because lung function may decrease before one notices any signs or symptoms, one should regularly measure and record peak airflow with a home peak flow meter.
- **Identify and treat attacks early.** If one acts quickly, he/she is less likely to have a severe attack and will not need as much medication to control the symptoms. When peak flow measurements decrease and alerts one to an oncoming attack, he/she should take the medication as instructed and immediately stop any activity that may have triggered the attack. If the symptoms don't improve, one should get medical help as directed in the action plan.
- **Take medication as prescribed.** Just because one’s asthma seems to be improving, one should not change anything without first talking to his/her doctor.
- **Pay attention to increasing quick-relief inhaler use.** If one relies more and more on the quick-relief inhaler, he/she should visit doctor to adjust treatment.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

Chronic Obstructive Pulmonary Disease, or COPD, refers to a group of diseases that cause airflow blockage and breathing-related problems. It includes emphysema, chronic bronchitis, and in some cases asthma. (See Figure 5.2)

Epidemiology: According to the American Lung Association, COPD is the 3rd leading cause of death in the United States. COPD is one of the most serious and dangerous respiratory illnesses, and COPD is the number one problem seen in most pulmonology offices. Approximately fifteen million Americans have been diagnosed with COPD. In 2014, approximately 142,000 individuals died from COPD (Rabe, K.F. et al., 2007). It is suggested by some studies that many U.S. adults have low lung function but no reported obstructive lung disease diagnosis, which may indicate the presence of undiagnosed COPD (Mannino, D.M., Gagnon, R.C., Petty, T.L., and Lydick, E., 2000). In nearly 8 out of 10 cases, COPD is caused by exposure to cigarette smoke. Other environmental exposures (such as those in the workplace) may also cause COPD. Genetic factors strongly influence the development of the disease. For example, not all smokers develop COPD. Quitting smoking may slow the progression of the disease. Women and men are affected equally, yet more women than men have died of COPD since 2000.

Symptoms: Many people don't recognize the symptoms of COPD until later stages of the disease. Sometimes people think they are short of breath or less able to go about their normal activities because they are "just getting older." Symptoms of COPD include:

- Chronic cough
- Shortness of breath while doing everyday activities (dyspnea)
- Frequent respiratory infections
- Blueness of the lips or fingernail beds (cyanosis)
- Fatigue
- Producing a lot of mucus (also called phlegm or sputum)
- Wheezing

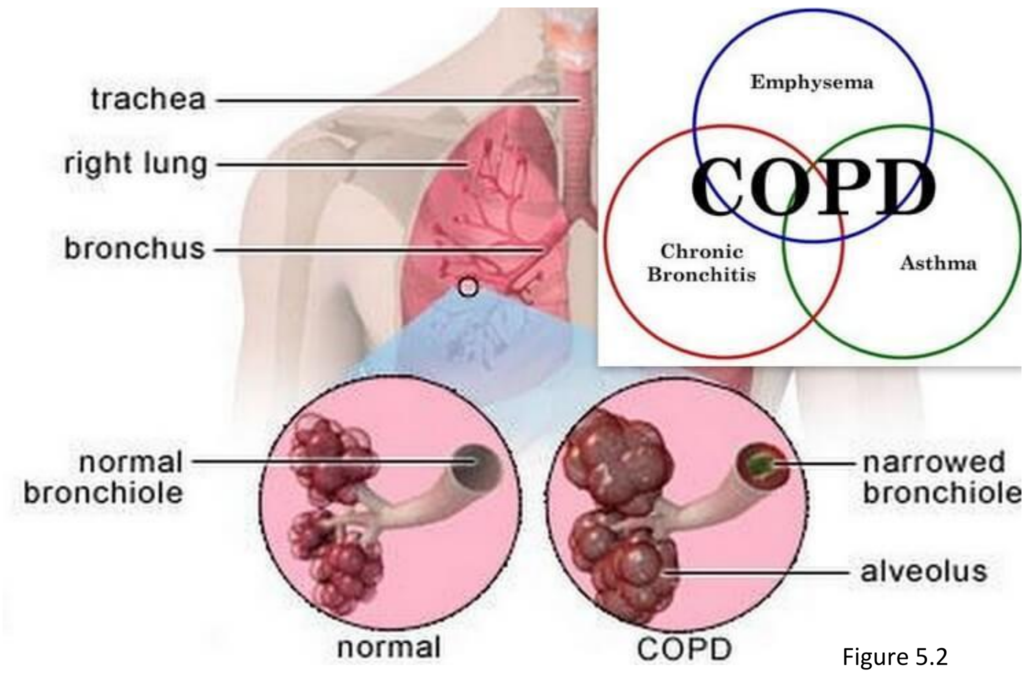


Figure 5.2

Causes: The main cause of COPD in the U.S. is tobacco smoking. Only about 20 to 30 percent of chronic smokers may develop clinically apparent COPD, although many smokers with long smoking histories may develop reduced lung function. Some smokers develop less common lung conditions. They may be misdiagnosed as having COPD until a more thorough evaluation is performed.

- **Emphysema:** This lung disease causes destruction of the fragile walls and elastic fibers of the alveoli. Small airways collapse when you exhale, impairing airflow out of the lungs.
- **Chronic bronchitis:** In this condition, the bronchial tubes become inflamed and narrowed and the lungs produce more mucus, which can further block the narrowed tubes. Ones develops a chronic cough trying to clear the airways.
- **Cigarette smoke and other irritants:** In the vast majority of cases, the lung damage that leads to COPD is caused by long-term cigarette smoking. But there are likely other factors at play in the development of COPD, such as a genetic susceptibility to the disease, because only about 20 to 30 percent of smokers may develop COPD. Other irritants can cause COPD,

including cigar smoke, secondhand smoke, pipe smoke, air pollution and workplace exposure to dust, smoke or fumes.

- **Alpha-1-antitrypsin deficiency:** In about 1 percent of people with COPD, the disease results from a genetic disorder that causes low levels of a protein called alpha-1-antitrypsin. Alpha-1-antitrypsin (AAt) is made in the liver and secreted into the bloodstream to help protect the lungs. Alpha-1-antitrypsin deficiency can affect the liver as well as the lungs. Damage to the lung can occur in infants and children, not only adults with long smoking histories. For adults with COPD related to AAt deficiency, treatment options include those used for people with more-common types of COPD. In addition, some people can be treated by replacing the missing AAt protein, which may prevent further damage to the lungs.

Risk Factors:

- **Exposure to tobacco smoke.** The most significant risk factor for COPD is long-term cigarette smoking. The more years one smokes and the more packs one smokes, the greater the risk. Pipe smokers, cigar smokers and marijuana smokers also may be at risk, as well as people exposed to large amounts of secondhand smoke.
- **People with asthma who smoke.** The combination of asthma, a chronic inflammatory airway disease, and smoking increases the risk of COPD even more.
- **Occupational exposure to dusts and chemicals.** Long-term exposure to chemical fumes, vapors and dusts in the workplace can irritate and inflame the lungs.
- **Exposure to fumes from burning fuel.** In the developing world, people exposed to fumes from burning fuel for cooking and heating in poorly ventilated homes are at higher risk of developing COPD.
- **Age.** COPD develops slowly over years, so most people are at least 40 years old when symptoms begin.
- **Genetics.** The uncommon genetic disorder alpha-1-antitrypsin deficiency is the cause of some cases of COPD. Other genetic factors likely make certain smokers more susceptible to the disease.

Treatment: Treatment includes smoking cessation, bronchodilator therapy (medication that opens the airways) and pulmonary rehabilitation, which is a supervised exercise program for people with COPD. Unlike asthma, COPD is not reversible.

Prevention: Unlike some diseases, COPD has a clear cause and a clear path of prevention. Most cases are directly related to cigarette smoking, and the best way to prevent COPD is to never smoke or to stop smoking immediately. It's the best chance for preventing damage to the lungs. Occupational exposure to chemical fumes and dust is another risk factor for COPD. If one works with this type of lung irritant, he/she should use respiratory protective equipment.

OCCUPATIONAL LUNG DISEASES

Occupational lung diseases are lung problems that are made worse in certain work environments. They are caused by long-term exposure to certain irritants that are breathed into the lungs. These lung diseases may have lasting effects, even after the exposure ends. Particles in the air from many sources, such as factories, smokestacks, exhaust, fires, mining, construction, and agriculture, cause these lung problems. The smaller the particles are, the more damage they can do to the lungs. Smaller particles are easily inhaled deep into the lungs. There, they are absorbed into the body instead of being coughed out.

Types

- Asbestosis. This condition is caused when a person breathes in tiny asbestos fibers. Over time, this leads to scarring of the lungs and stiff lung tissue. It’s often linked with construction work. (See Figure 5.3)
- Coal worker's pneumoconiosis or black lung disease. This disease is caused by inhaling coal dust. It causes inflammation and scarring of the lungs. This can cause permanent lung damage and shortness of breath.
- Silicosis. This condition is caused by breathing in airborne crystalline silica. This is a dust found in the air of mines; foundries; blasting operations; and stone, clay, and glass manufacturing facilities. It causes scarring of the lungs. It can also increase the risk for other lung diseases.
- Byssinosis. This is caused by breathing in dust from hemp, flax, and cotton processing. It is also known as Brown Lung Disease. The condition is chronic and causes chest tightness and shortness of breath. It affects textile workers, especially those who work with unprocessed cotton.
- Hypersensitivity pneumonitis. This is an allergic lung disease caused by a lung inflammation that happens from breathing in many different substances including fungus spores, bacteria, animal or plant protein, or specific chemicals. They can come from moldy hay, bird droppings, and other organic dusts. The disease causes inflamed air sacs in the lungs and leads to fibrous scar tissue in the lungs and trouble breathing. There are variations of this disease depending on the job. They include cork worker's lung, farmer's lung, and mushroom worker's lung.

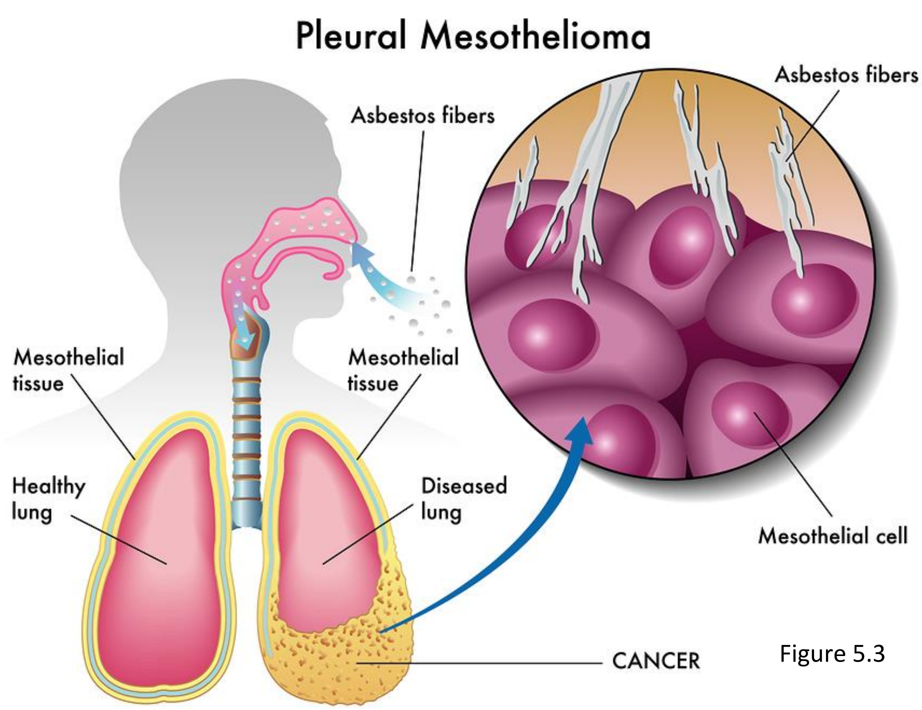


Figure 5.3

- Occupational asthma. Occupational asthma is caused by breathing in dusts, gases, fumes, and vapors. It causes asthma symptoms such as a chronic cough and wheezing. This condition can be reversed if found early. If one works in manufacturing and processing operations, farming, animal care, food processing, cotton and textile industries, and refining operations, one is at higher risk for getting this illness.

Risk Factors Certain types of work put you at greater risk for occupational lung diseases than others. For instance, working in a car garage or textile factory can expose you to unsafe chemicals, dusts, and fibers.

Treatment There is no cure for most occupational lung diseases. Treatments are aimed at:

- Preventing further exposure
- Preventing more lung scarring
- Managing symptoms
- Helping one stay active and healthy
- Treatment depends on the type of lung disease. There is no way to fix lung scarring that has already happened.

Prevention Occupational lung diseases are preventable. The best prevention is to avoid the inhaled substances that cause lung problems. Other preventive measures include:

- Do not smoke. Smoking can increase the risk for occupational lung disease.
- Wear proper protective devices, such as facemasks or respirators, if needed when around airborne irritants and dusts.
- Evaluate lung function with spirometry as often as advised by a Figure 5.3 s one get familiar with lung function and watch for changes.
- Understand the risks of lung disease at work and use protection to reduce risk.
- Hire an occupational health expert to investigate work environment for risks for occupational lung diseases.

PULMONARY HYPERTENSION

Pulmonary hypertension is a type of high blood pressure that affects the arteries in the lungs and the right side of the heart. In one form of pulmonary hypertension, tiny arteries in the lungs, called pulmonary arterioles, and capillaries become narrowed, blocked or destroyed. This makes it harder for blood to flow through the lungs and raises pressure within the lungs' arteries. As the pressure builds, the heart's lower right chamber (right ventricle) must work harder to pump blood through the lungs, eventually causing the heart muscle to weaken and fail. (See Figure 5.4) Some forms of pulmonary hypertension are serious conditions that become progressively worse and are sometimes fatal. Although some forms of pulmonary hypertension aren't curable, treatment can help lessen symptoms and improve quality of life.

Epidemiology Pulmonary hypertension can occur in association with many other diseases such as lung disease and heart disease. Some common underlying causes include pulmonary arterial hypertension from some types of congenital heart disease, connective tissue disease, coronary artery disease, high blood pressure, liver disease (cirrhosis), blood clots to the lungs, and chronic lung diseases like emphysema. Genetics also play a role in pulmonary hypertension. Pulmonary hypertension occurs at all ages, and the incidence of it increases with age. Pulmonary hypertension is more common among women, non-Hispanic blacks, and among people aged 75 or older. Heart failure is common in pulmonary hypertension.

Symptoms: The signs and symptoms of pulmonary hypertension in its early stages might not be noticeable for months or even years. As the disease progresses, symptoms become worse. Pulmonary hypertension symptoms include:

- Shortness of breath (dyspnea), initially while exercising and eventually while at rest
- Fatigue
- Dizziness or fainting spells (syncope)
- Chest pressure or pain
- Swelling (edema) in your ankles, legs and eventually in your abdomen (ascites)
- Bluish color to your lips and skin (cyanosis)
- Racing pulse or heart palpitations

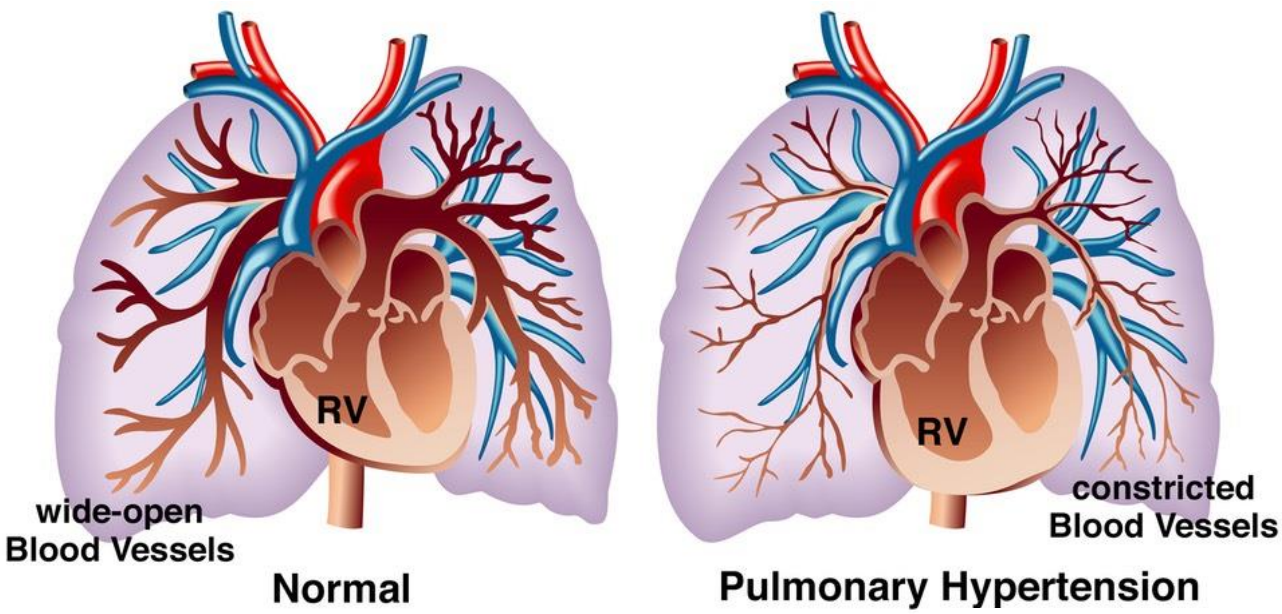


Figure 5.4

Causes: Pulmonary hypertension is classified into five groups, depending on the cause.

- Group 1: Pulmonary arterial hypertension
    - Cause unknown, known as idiopathic pulmonary arterial hypertension
    - A specific gene mutation that can cause pulmonary hypertension to develop in families, also called heritable pulmonary arterial hypertension
    - Certain drugs — such as certain prescription diet drugs or illegal drugs such as methamphetamines — or certain toxins
    - Heart abnormalities present at birth (congenital heart disease)
    - Other conditions, such as connective tissue disorders (scleroderma, lupus, others), HIV infection or chronic liver disease (cirrhosis)

- Group 2: Pulmonary hypertension caused by left-sided heart disease
    - Left-sided valvular heart disease, such as mitral valve or aortic valve disease
    - Failure of the lower left heart chamber (left ventricle)
- Group 3: Pulmonary hypertension caused by lung disease
    - Chronic obstructive pulmonary disease, such as emphysema
    - Lung disease such as pulmonary fibrosis, a condition that causes scarring in the tissue between the lungs' air sacs (interstitium)
    - Sleep apnea and other sleep disorders
    - Long-term exposure to high altitudes in people who may be at higher risk of pulmonary hypertension
- Group 4: Pulmonary hypertension caused by chronic blood clots
    - Chronic blood clots in the lungs (pulmonary emboli)
- Group 5: Pulmonary hypertension associated with other conditions that have unclear reasons why the pulmonary hypertension occurs
    - Blood disorders
    - Disorders that affect several organs in the body, such as sarcoidosis
    - Metabolic disorders, such as glycogen storage disease
    - Tumors pressing against pulmonary arteries

Risk Factors One's risk of developing pulmonary hypertension increases if one:

- Is a young adult. An idiopathic pulmonary arterial hypertension is more common in younger adults
- Is overweight
- Has a family history of the disease
- Has one of various conditions that can increase the risk of developing pulmonary hypertension
- Uses illegal drugs, such as cocaine
- Takes certain appetite-suppressant medications
- Has an existing risk of developing pulmonary hypertension, such as a family history of the condition, and lives at a high altitude

Treatment Pulmonary hypertension can't be cured, but doctors can help one manage the condition. Treatment may help improve symptoms and slow the progress of pulmonary hypertension.

- Medications
    - Blood vessel dilators (vasodilators). Vasodilators open narrowed blood vessels
    - Endothelin receptor antagonists. These medications reverse the effect of endothelin, a substance in the walls of blood vessels that causes them to narrow.
    - Sildenafil and tadalafil. Sildenafil (Revatio, Viagra) and tadalafil (Cialis, Adcirca) are sometimes used to treat pulmonary hypertension. These drugs work by opening the blood vessels in the lungs to allow blood to flow through more easily.
    - High-dose calcium channel blockers. These drugs help relax the muscles in the walls of the blood vessels.
    - Soluble guanylate cyclase (SGC) stimulator. SGC stimulators (Adempas) interact with nitric oxide and help relax the pulmonary arteries and lower the pressure within the arteries.
    - Anticoagulants. This medication helps prevent the formation of blood clots within the

small pulmonary arteries.
    - Digoxin. Digoxin (Lanoxin) can help the heart beat stronger and pump more blood. It can help control the heart rate if one experiences arrhythmias.
    - Diuretics. Commonly known as water pills, these medications help eliminate excess fluid from the body. This reduces the amount of work the heart must perform. They may also be used to limit fluid buildup in your lungs.
    - Oxygen. Breathing pure oxygen, a treatment known as oxygen therapy, is a method to help treat pulmonary hypertension, especially if one lives at a high altitude or has sleep apnea. Some people who have pulmonary hypertension eventually require continuous oxygen therapy.
- Surgeries
    - Atrial septostomy. If medications don't control pulmonary hypertension, this open-heart surgery might be an option. In an atrial septostomy, a surgeon will create an opening between the upper left and right chambers of the heart (atria) to relieve the pressure on the right side of your heart.
    - Transplantation. In some cases, a lung or heart-lung transplant might be an option, especially for younger people who have idiopathic pulmonary arterial hypertension.

Prevention: While not all pulmonary hypertension can be prevented, efforts to prevent high blood pressure, coronary heart disease, chronic liver disease, and chronic lung disease from tobacco use can help prevent pulmonary hypertension in some patients. In general, making healthy lifestyle changes, such as quitting smoking, cutting down on salt, eating healthy foods and regular exercise stand as the best preventive measures to avoid forms of this disorder.

Take Module I Lesson 6 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. List four factors that play a role in causing respiratory diseases.
2. In the U.S., what is the leading common cause of chronic respiratory disease?
3. What is a simple task that one can do to prevent common infectious respiratory diseases?
4. Unsanitized hands cause what percentage of common infectious respiratory diseases like colds and flu?
5. According to The Center for Disease Control and Prevention (CDC), tobacco use is the leading cause of preventable illness and death and produces how many deaths a year (including deaths from secondhand smoke).
6. What are the four most common chronic respiratory diseases?
7. What are the symptoms, causes, and risk factors for asthma?
8. List two actions one can take to prevent asthma.
9. What are the three diseases that cause airflow blockage and breathing-related problems resulting in COPD?
10. According to the American Lung Association, what is the third leading death in the U.S.?
11. What are the symptoms, causes, and risk factors for COPD?
12. What can one do to prevent COPD?
13. What is occupational lung disease?
14. Name three types of occupational lung disease.
15. List two actions one can take to prevent occupational lung disease.
16. What is pulmonary hypertension?
17. What are the symptoms of and risk factors for pulmonary hypertension?
18. Name and describe the five cause groups for pulmonary hypertension.
19. List three treatments for pulmonary hypertension.

Module II: Application

Lesson One: Exercise and Chronic Respiratory Disease

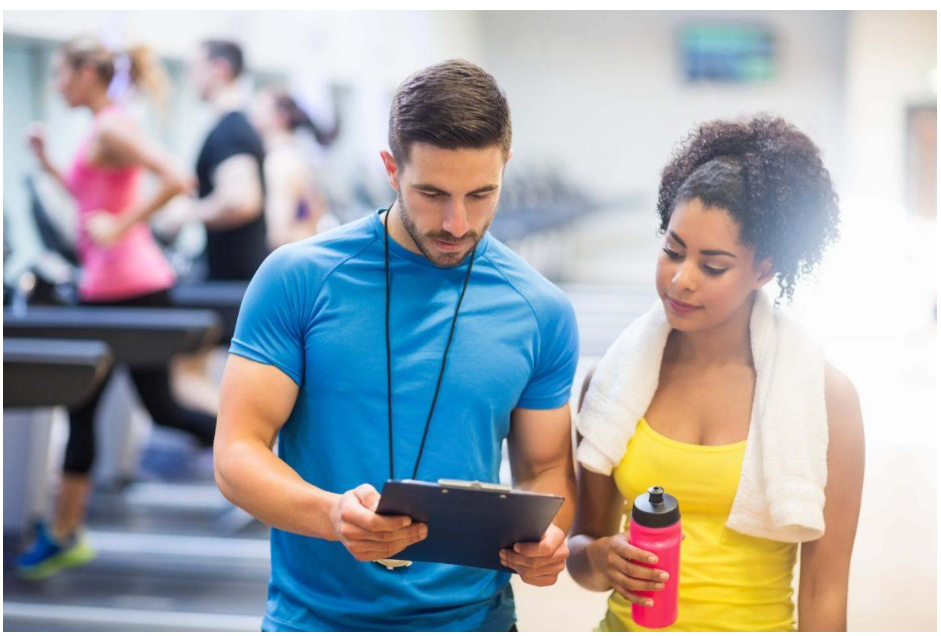
Lesson Two: The Science of Healthy Breathing

Lesson Three: Scope and Practice for the Health/Fitness Professional

Lesson Four: Screening and Assessments

Lesson Five: Goals and Program Design

Lesson Six: Nutrition and Healthy Weight Management



Lesson One

Exercise and Chronic Respiratory Disease

If you are a health and fitness professional, some of your clients may be suffering from a chronic respiratory disease and you may be an important source for relief. Moderate exercise is known to improve use of oxygen, energy levels, anxiety, stress and depression, sleep, self-esteem, cardiovascular fitness, muscle strength, and shortness of breath (Storer, T.W., 2001). While it might seem odd that exercise improves breathing when one is short of breath, exercising really does help one with respiratory disease. Exercise helps the blood circulate and helps the heart send oxygen to the rest of the body. Exercise also strengthens the respiratory muscles which can make it easier to breathe.

Benefits of Exercise

Respiratory or pulmonary rehabilitation is increasingly recognized as an important part of the management of patients with CRD. The widespread application of such programs should be preceded by evidence of directly attributable improvements in function. The effects of respiratory or pulmonary rehabilitation on exercise capacity and health related quality of life in individuals with CRD is well documented. Exercising helps to increase fitness and strengthen muscles to reduce breathlessness during everyday tasks. Exercising regularly will make muscles stronger, including the breathing muscles, so they need less oxygen to do the same amount of work. Weaker muscles require more

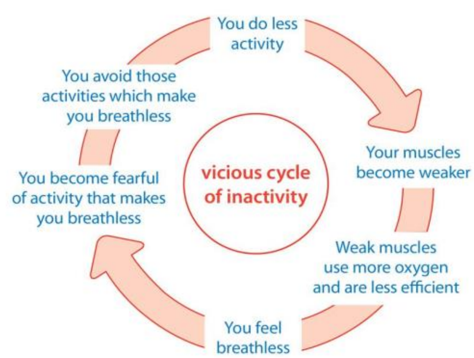


Figure 6.1

oxygen to work. If one with CRD avoids physical activity that makes him/her breathless, the muscles will become weaker and one will become more breathless. (See Figure 6.1) Regular exercise will help one to manage feeling out of breath and break the vicious cycle of inactivity.

As well as increasing overall fitness, strengthening the muscles, and helping one cope with breathlessness, regular exercise improves:

- The ability to resist infections
- The ability to do daily activities
- The strength of the bones
- The strength of the muscles that one breathes with
- The strength of the heart muscles and circulation

- Energy levels
- Well-being and confidence

In addition, exercise reduces:

- Feelings of anxiety or depression
- Blood pressure
- Risk of falling (by improving balance)
- Risk of diabetes
- Risk of arthritis
- Risk of heart disease and stroke
- Stress levels

Timing of Exercise Initiation

Pulmonary rehabilitation initiated shortly after a hospitalization for a COPD or CRD exacerbation is clinically effective, safe, and associated with a reduction in subsequent hospital admissions. In addition, exercise rehabilitation commenced during acute or critical illness reduces the extent of functional decline and hastens recovery. Appropriately resourced home-based exercise training has proven effective in reducing dyspnea and increasing exercise performance in individuals with COPD and other chronic respiratory diseases.

Exercise Limitations for Individuals with CRD

Exercise intolerance in individuals with chronic respiratory disease may result from ventilatory constraints, pulmonary gas exchange abnormalities, peripheral muscle dysfunction, cardiac dysfunction, or any combination of the above. Anxiety, depression, and poor motivation may also contribute to exercise intolerance. Here are some common limitations for an individual with CRD.

- **Ventilatory Limitation:** In CRD, ventilatory requirements during exercise are often higher than expected because of increased work of breathing, increased dead space ventilation, impaired gas exchange, and increased ventilatory demand because of deconditioning and peripheral muscle dysfunction. Adding to this increased demand is the limitation to maximal ventilation during exercise resulting from expiratory airflow obstruction and dynamic hyperinflation in individuals with CRD. This leads to further increased work of breathing, increased load and mechanical constraints on the respiratory muscles, with a resulting intensified sense of dyspnea.
- **Gas Exchange Limitation**: Hypoxia directly increases pulmonary ventilation through augmenting peripheral chemoreceptor output and indirectly through stimulation of lactic acid production. Lactic acidemia resulting from anaerobic metabolism by the muscles during higher intensity exercise contributes to muscle failure and increases pulmonary ventilation, as lactic acid buffering results in an increase in carbon dioxide production and acidosis stimulates the carotid bodies. Supplemental oxygen therapy during exercise allows for higher intensity training.
- **Cardiac Limitation:** The cardiovascular system is affected by CRD in a number of ways, the most important being an increase in right ventricular afterload. Contributing factors include

elevated pulmonary vascular resistance resulting from combinations of hypoxic vasoconstriction, vascular injury, and increased effective pulmonary vascular resistance. An overloaded right ventricle may lead to right ventricular hypertrophy and failure. Right ventricular hypertrophy may also compromise left ventricular filling by producing septal shifts; these further reduce the ability of the heart to meet exercise demands.

- **Lower Limb Muscle Dysfunction Limitation**: Lower limb muscle dysfunction is frequent in individuals with CRD and is an important cause of their exercise limitation. Peripheral muscle dysfunction in individuals with CRD may be attributable to single or combined effects of inactivity-induced deconditioning, systemic inflammation, oxidative stress, smoking, blood gas disturbances, nutritional impairment, low anabolic hormone levels, aging, and corticosteroid use. Skeletal muscle dysfunction is frequently reported as fatigue; in many individuals this is the main limiting symptom, particularly during cycle-based exercise. This could be related to the fact that the peripheral muscle alterations render these muscles susceptible to contractile fatigue. The lactic acidosis resulting from exercising skeletal muscles at higher intensities is a contributory factor to exercise termination in healthy individuals and may also contribute to exercise limitation in patient with CRD. Individuals with CRD often have increased lactic acid production for a given exercise work rate, thereby increasing their ventilatory requirement. The increased ventilatory requirement imposes an additional burden on the respiratory muscles, which are already facing increased impedance to breathing. This rise in lactic acid is exacerbated by a tendency to retain carbon dioxide during exercise, further increasing acidosis and resultant ventilatory burden. In addition, the proportion of type I muscle fiber (slow twitch fiber) is smaller than in healthy persons and is accompanied by an increase in type IIb muscle fiber (fast twitch fiber), which might be an important factor in increased leg muscle fatigability and reduced endurance (Whittom, F. et al., 1998). Muscle fiber atrophy is a major systemic impairment in COPD. Respiratory and limb muscles are usually affected in these patients, thus contributing to impaired muscle function, poor exercise capacity, and reduced health status. The reduction in muscle fiber cross-sectional area is a generally accepted marker of muscle atrophy and can be a predictor of mortality in COPD (Gouzi, F et al., 1985). Improving skeletal muscle function is therefore an important goal of exercise training programs.
- **Respiratory Muscle Dysfunction Limitations:** The diaphragm of individuals with CRD adapts to chronic overload and has greater resistance to fatigue. As a result, at identical absolute lung volumes, the inspiratory muscles can generate more pressure than those of healthy control subjects. However, patients with CRD often have static and dynamic hyperinflation, which places their respiratory muscles at a mechanical disadvantage. Thus, despite adaptations in the diaphragm, both functional inspiratory muscle strength and inspiratory muscle endurance are compromised in CRD. Therefore, respiratory muscle weakness, as assessed by measuring maximal respiratory pressures, is often present. This contributes to hypercapnia, dyspnea, nocturnal oxygen desaturation, and reduced exercise performance.

The 6 Key Components of CRD Exercise

There are several challenges to exercise prescription and physical activity participation in the CRD population, but a large body of evidence demonstrates important health benefits and improving one's quality of life from exercise (Eves, N.D. and Davidson, W.J,. 2011). Every exercise routine should address six components to achieve a well-rounded and comprehensive program that focuses on the improvement of breathing, cardiorespiratory endurance, muscular strength, core stability, posture, and flexibility.

Lung Capacity and CRD

Proper Breathing Technique: One should breathe slowly during exercise. Inhale through the nose with the mouth closed. The inhalation warms and filters the air. Exhale through the mouth for twice as long as the inhale. Don't pant. That keeps the lungs from getting all the air out. When exercising avoid the Valsalva Maneuver. The Valsalva maneuver is performed by imagining that the chest and stomach muscles are very tight and bearing down as though straining to initiate a bowel movement. The Valsalva maneuver can be dangerous due to the sudden and abrupt changes in blood pressure. These dramatic changes in heart rate, blood pressure, and carbon dioxide may produce symptoms including dizziness, light headedness, and syncope. Because proper breathing is imperative to imperative to health, an entire lesson is dedicated to The Science of Healthy Breathing in Module II, Lesson 2.

Cardiorespiratory Fitness and CRD

Endurance cardiorespiratory exercise is good for the heart and lungs and allows one to use oxygen more efficiently. Walking, biking, and swimming are great examples of aerobic exercise. Endurance exercise training improves exercise-induced hyperinflation and exertional dyspnea, heart rate recovery, and counteracting muscle dysfunction in CRD (Iepsen, U.W., Munch G.D., Rugbjerg M., et al., 2016; Gimeon-Santos, E., Rodriguez, D.A., Barberan-Garcia, A., et al., 2014; and Chen, R., Chen, R., Chen, X., Chen, L., 2014).

The guidelines are approximately the same as generally healthy individuals. According to the American College of Sports Medicine, one should attempt to train the cardiorespiratory system 3-5 days a week for 30 minutes per session. If one cannot exercise for 30 minutes continuously, he/she should exercise as long as he/she can. One should pace him/herself and take breaks. Those with a respiratory disease are limited by how much air they can get in and out of their lungs and how much oxygen they can put into their blood. When exercising, muscles pull oxygen out of the blood. When muscles pull oxygen out of the blood faster than lungs can put it in the blood, an oxygen deficit occurs. That is when the oxygen level in the blood goes down below a critical level (usually an oxygen saturation of the blood of 90%). When this deficit occurs, individuals feel very SOB (short of breath) and the low blood oxygen is not good for the body. To avoid feeling SOB, one should slow down and take breaks. Most individuals eventually, through trial and error, figure out the pace at which he/she can exercise effectively and comfortably. The pace is the exercise level at which the lungs can move enough air in and out and put enough oxygen in the blood to support the exercise. Pace is different for everybody and may change over time. As one progresses, the goal is to exercise at an intensity level of 3-4 on the Rating of Perceived Exertion Scale (Scale Rating from 0 Nothing at All-10 Very, Very, Heavy).

- **Walking:** Just about everyone with CRD can exercise. Walking is a great choice, especially if one is just getting started. Do it anywhere – outside, in a mall, on a treadmill. If it seems daunting, add 30 seconds or 10 yards each day. Even a slow pace is beneficial.
- **Cycling:** A stationary bike can work well for people with CRD. One can cycle in his/her home, a gym, or rehab setting. It is recommended that before joining a cycle class, one should consult with the cycle instructor about the intensity level of the class. However, because stationary cycling is very much a "go-at-you-own-pace" type of a class, those with CRD are encouraged to do what they can in a class setting. One can find supervision and meet people. As one improves, he/she can try to cycle outside on a traditional bike and soak up the scenery.
- **Chair Dancing:** If one loves to dance, he/she can try a lower impact version with a chair in a class or with a DVD at home. Different programs can focus on just the cardio improvements or may also add hand weights to improve strength. This format is set to different genres of music from big band to hip hop. Beginners might start with a class to learn the safest ways to swing and bend.
- **Tai Chi:** This form of exercise is an ancient Chinese practice of gentle, flowing movements. This is an excellent form of exercise for people with CRD. It's a mild workout for the heart and lungs and helps tone the muscles. It also eases stress and helps one relax if he/she is experiencing anxiety. One can participate in a group class or follow a DVD.
- **Water Aerobics:** Participating in a water-based fitness class or even simply performing self-guided water-based exercises increases aerobic capacity, increases muscular strength and endurance, increases the respiratory muscle strength, increases core stability, and improves poster and flexibility.

Interval cardiorespiratory exercise may be an alternative to standard endurance training for individuals with chronic respiratory disease who have difficulty in achieving their target intensity or duration of continuous exercise because of dyspnea, fatigue, or other symptoms. Interval training is a modification of endurance training in which high-intensity exercise usually lasting less than one minute is regularly interspersed with periods of rest or lower intensity exercise. This may result in significantly lower symptom scores despite high absolute training loads, thus maintaining the training effects of endurance training. The practical difficulty of interval training is its mode of delivery, which typically requires a cycle-based program and continuing the regimen in unsupervised settings. There has been considerable research interest in interval training in COPD, with the publication of several randomized, controlled trials (Arnardottir, R.H. et al., 2007; Mador, M.J. et al., 2009; Varga, J. et al. 2007; Nasis, I.J., 2009; and Vogiatzis, I, 2005) and systematic reviews (Beauchamp, M.K. et al., 2010 and Zainuldin, R. et al., 2011). Moreover, there is no evidence regarding the role of interval training for individuals with respiratory conditions other than COPD. Overall, these studies have found no clinically important differences between interval and continuous training modes in outcomes including exercise capacity, health-related quality of life, and skeletal muscle adaptation immediately after training. Practically speaking, health and fitness professionals who develop an interval exercise plan should consider that the heavier the work rate, the shorter should be the exercise periods (~30 seconds) and the longer the rest intervals (~60 seconds) ought to be. Health and fitness professionals should teach their clients to perform all daily activities (e.g., stair climbing, uphill walking) at an interval mode consisting of short bouts of activity lasting 10 to 15 sec and rest periods of 15 seconds.

One should perform interval training sessions three-four days a week. For a more detailed format, view the FIIT Principle section for Interval Exercise.

Muscular Strength and CRD

Over the last decade, the potential use of resistance training for those with chronic obstructive pulmonary disease (COPD) has gained increasing attention. Individuals with COPD experience muscle dysfunction and reduced muscle mass, primarily as a result of chronic immobilization. These symptoms have been associated with reduced exercise tolerance and complaints of fatigue and dyspnea even after minimal exertion. Supporting evidence reveals that resistance training produces a clinically and statistically significant effect on respiratory function (such as forced vital capacity) and is therefore recommended in the management of COPD and other chronic respiratory diseases (Strasser, B., Siebert, U., and Schobersberger W., 2012).

Resistance exercise increases muscular strength including the respiratory muscles that assist in breathing. Resistance training usually involves weights or resistance bands but using one's own body weight works just as well depending on the severity of the symptoms. Strengthening exercises build individual muscles and muscle groups and can help patients with chronic respiratory disease to be more functional. In advanced respiratory disease, muscle proteins are sometimes broken down by the disease process itself and by a process called "disuse atrophy". Disuse atrophy occurs when one doesn't use muscles. Those with CRD often avoid tasks that require some muscle exertion, because such activities make them short of breath. Lack of muscle use results in muscle loss, which causes further decreased ability to work and exercise. According to the American College of Sports Medicine (ACSM), resistance training should be performed 2-3 days a week working all major muscle groups.

- It is recommended to perform exercises that work several muscle groups at once.
- If one is going to exercise individual muscles or a small number of muscle groups, it is imperative that he/she works upper, lower, and core muscles to ensure a balanced workout optimizing function.
- Light weights and more repetitions are better than heavy weights and fewer repetitions. This type of resistance training also improves muscular endurance important for those with CRD.
- One should pace him/herself and allot for several breaks when needed.

Peripheral Muscle Strength

Peripheral muscle weakness is a common hallmark in CRD patients and negatively affects exercise performance. Systemic effects of CRD especially COPD involve respiratory and skeletal muscles with loss of myosin heavy chain and elevated level of ubiquitin-conjugated proteins, suggesting accelerated muscle protein degradation. The remaining contractile proteins in these fibers are dysfunctional, and the calcium sensitivity of force generation is reduced. These abnormalities could all contribute to muscle weakness (Ahmed, S. et al., 2012).

- **Upper Limb Strength**

  Patients with CRD frequently experience marked dyspnea and fatigue when performing simple upper limb (UL) activities. Upper limb activities commonly require unsupported arm exercise, which poses a unique challenge for patients with CRD, whose UL muscles are required to act as accessory muscles of respiration. During unsupported arm exercise, the participation of the accessory muscles in ventilation decreases, and there is a shift of respiratory work to the diaphragm. This is associated with thoracoabdominal desynchrony, severe dyspnea, and termination of exercise at low workloads. Many problematic activities of daily living in individuals with chronic respiratory disease involve the upper extremities, including dressing, bathing, shopping, and many household tasks. Because of this, upper limb training is typically integrated into an exercise regimen. Examples of upper extremity exercises include aerobic regimens (e.g., arm cycle ergometer training) and resistance training (e.g., training with free weights and elastic bands, which provide resistance). Typical muscles targeted are the biceps, triceps, deltoids, latissimus dorsi, and the pectorals. Moreover, because those with CRD tend to have kyphotic posture, it is imperative that special attention should be given to the posterior deltoids, rhomboids, and latissimus dorsi.

- **Lower Limb Strength**

Reduced muscle strength and endurance in the lower limbs (LL) are related to decreased muscle mass, decreased aerobic capacity, a predominance of glycolytic metabolism, and rapid accumulation of lactate during exercise, factors that might be responsible for early muscle fatigue in COPD patients. The effectiveness of LL exercise training for patients with COPD has been well documented, with consistent clinically significant improvements in exercise capacity, symptoms, and quality of life [6]. Multi-joint LL strength exercises that focus on the quadriceps, hamstrings, glutes, and gastrocnemius have shown to improve exercise tolerance, lower muscle fatigue threshold, and improve overall quality of life (ATS, 1999).

Respiratory Muscular Strength

Inspiratory muscle training (IMT) is defined as a course of therapy consisting of a series of breathing exercises that aim to strengthen the bodies' respiratory muscles making it easier for one to breathe. Inspiratory muscle training is normally aimed at people who suffer from asthma, bronchitis, emphysema and COPD. However, many people adopt IMT as part of their sports training as this training is designed to strengthen the muscles used for breathing. This is done through a series of controlled breathing exercises. See the section in Breathing Exercises. Studies have shown that regular IMT can increase a person's endurance during cardiovascular exercise. (See Figure 6.2)

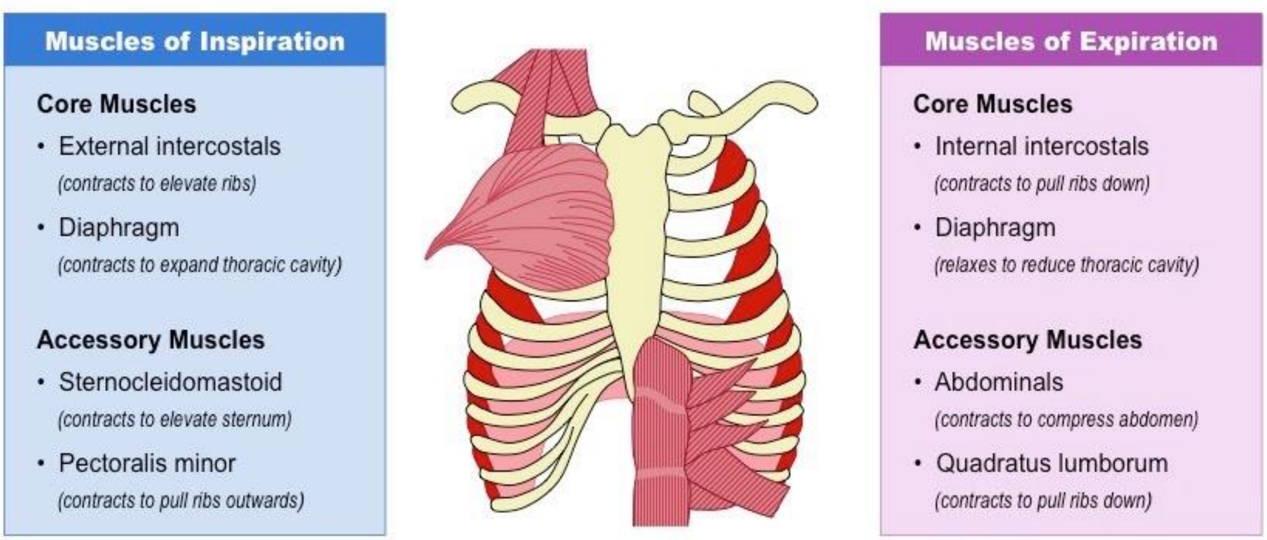
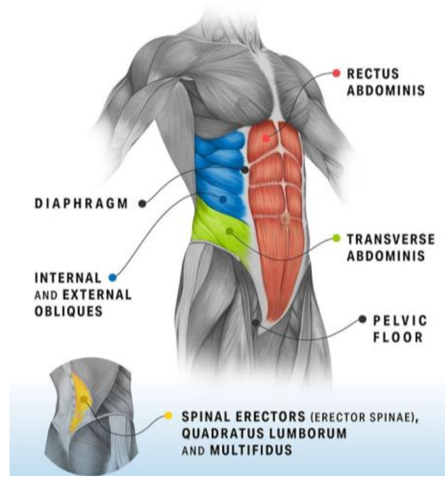


Figure 6.2

Core Stability and CRD

The word core itself implies deep and central. The anatomical structure that is the deepest and most central is the spine. The core is directly related to the spine specifically and generally to the torso. The spine is primarily what one wants to stabilize with the core muscles. There is also a dynamic component to the core. This aspect of core is all about movement and the specific control of movement from the deep intrinsic muscles that move the body. The major muscles that move, support, and stabilize the spine are called the muscles of the core or trunk.

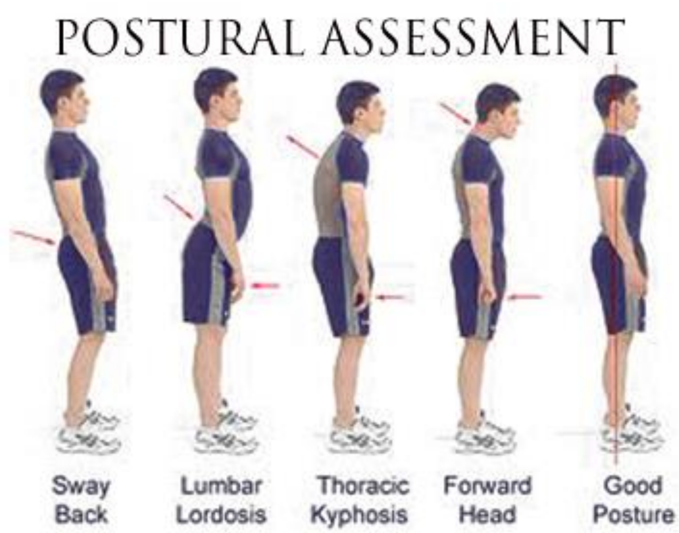


Strength and Stability- Currently, the strength that comes from the core is what is gaining the most attention. It is important, however, that equal emphasis is placed on both strength and flexibility regarding the core. In other words, there should be a balanced relationship between the two components of strength and flexibility within the core muscles. The balance between strength and flexibility begets stability. Being balanced in the core makes an individual more adaptable in real life situations. For instance, the core is used every time one walks on uneven surfaces. Also, if one trips, starts to fall and then catches him/herself, it's the adaptability of the core muscles that is catching the individual.

Movement- Movement from the core is how the center of gravity is controlled. Controlling the center of gravity comes from the iliopsoas muscle. The iliopsoas is strategically located around the center of gravity, which is located at a spot close to the top and just forward of the sacrum. When one's center of gravity is in line with gravity itself relative to one's body parts, he/she is in balance and in control. When one moves from his/her center, the movements are not only controlled but expansive and light. Control is a synergy of strength, stability, lightness, and ease during movement. Because one establishes a relationship with the iliopsoas, movement from the core then becomes intentional.

Posture and CRD

Patients with chronic obstructive pulmonary disease (COPD) tend to attain forward shoulder posture (kyphosis) and this affects their respiratory functions. In one study, Gonglaves et al. (2017) compared the posture between patients with COPD and healthy individuals. Postural alignment of the anterior tilt of the right and left pelvis and thoracic kyphosis is different between patients with COPD and healthy individuals. The results were that there is a relationship between pulmonary function and postural misalignment in COPD patients. (See Figure 6.3)



re 6.3

Lee, et al. (2017) systematically reviewed the literature of the skeletal structural alignment in children and adults with an obstructive respiratory disease. A total of 18 studies were included, 12 in cystic fibrosis (CF), 5 in asthma, and 1 in chronic obstructive pulmonary disease (COPD). The overall quality assessment rating was 12.6 out of 16. Increased thoracic kyphosis or scoliosis was found in both children and adults with CF. Increased shoulder protraction and elevation were evident in asthma and COPD, although changes in spinal curvature were variable. The clinical impact of postural changes was diverse, with an inconsistent influence on lung function; however, skeletal structural misalignment does appear to be present in some individuals with an obstructive respiratory disease.

Loss of postural control is one of the most common comorbidities in elderly subjects. It is known that 30% of subjects over 60 years of age fall at least once a year, and that the fall rate increases up to 45% in subjects over 70 years of age. Impaired postural control is more frequent when the elderly person has a chronic disease such as chronic respiratory disease. There is some evidence that can explain a possible association between aging, COPD, and impaired postural control that might predispose these patients to an increased risk of falls. Porto, et al (2015) determined from a metanalysis that patients with COPD present postural control impairment when compared with age-matched healthy controls. Associated factors contributing to impaired postural control were muscle weakness, physical inactivity, elderly age, need for supplemental oxygen, and limited mobility.

Improved thoracic mobility and posture may increase the vital capacity in patients with chronic respiratory disease. Because respiration and posture have a coupled relationship, a thorough evaluation includes both the assessment and treatment of patients with chronic respiratory disease. Common postural impairments include thoracic kyphosis, increased chest anterior–posterior diameter, shoulder elevation and protraction, and trunk flexion. Postural abnormalities are associated with a decline in pulmonary function, decreased quality of life, poor bone mineral density, and increased work of breathing. Postural deviations are known to alter body mechanics, resulting in back pain, which in turn alters breathing mechanics. One approach in pulmonary rehabilitation is to have patients perform both upper and lower body flexibility exercises (including stretching of major muscle groups such as the calves, hamstrings, quadriceps, and biceps, as well as range of motion exercises for the neck, and shoulders and trunk).
Correcting kyphosis in particular leads to straightening of the spine leading to improvement in the lung functions. Gaude et al. (2014) evaluated the additional effect of correction of kyphosis in COPD patients and found that postural correction is a meaningful addition to pulmonary rehabilitation programs directed toward COPD patients in improving the overall quality-of-life. In addition, health and fitness professionals should include balance exercises to improve static and dynamic postural control in individuals with CRD.

Flexibility and CRD

Flexibility is the ability to move a muscle or joint through its full range of motion without discomfort or pain. Flexibility is determined by the range of motion of a given joint or group of joints or the level of tissue extensibility that a muscle group possesses. In other words, each joint and each group of muscles in the body might have a different range of motion (ROM) or a different level of flexibility. Some areas of the body may be very tight, meaning that the muscles feel short and restricted. Some other areas of the body may feel very loose and may be able to lengthen and move freely. For example, one might be very flexible in the hamstrings, allowing him/her to bend over and touch his/her toes. But the thigh (quadriceps) muscles might be tight (inflexible) so it may be harder for one to stand up straight or bend backward. Many people who work in an office all day develop inflexible hips as a result of sitting all day. This is one of the reasons that health experts recommend standing and moving for a few minutes every hour.

Flexibility Training

Stretching improves flexibility. But it is not absolutely necessary to do hours of stretching to enjoy the benefits of flexibility training. One can take a stretching class or follow an online video that focuses just on stretching exercises to improve range of motion throughout the body. Flexibility training must begin with a gentle warm up to increase the body's core temperature. Then, progresses through a series of stretching exercises to lengthen the muscles in the feet, legs, hips, torso, and finally up through the head and neck.

Types of Stretching

- Static Stretching is a stretch that is held in a challenging but comfortable position for a period of time, usually somewhere between 10 to 30 seconds. Static stretching is the most common form of stretching found in general fitness and is considered safe and effective for improving overall flexibility. However, many experts consider static stretching much less beneficial than dynamic stretching for improving range of motion for functional movement, including sports and activities for daily living.
- Dynamic Stretching is a stretch that is performed by moving through a challenging but comfortable range of motion repeatedly, usually 10 to 12 times. Although dynamic stretching requires more thoughtful coordination than static stretching (because of the movement involved), it is favorable in improving functional range of motion and mobility in sports and activities for daily living. Dynamic stretching should not be confused with ballistic stretching which is bouncy in nature. Dynamic stretching is controlled, smooth, and deliberate, whereas ballistic stretching is uncontrolled, erratic, and jerky. Although there are unique benefits to ballistic stretches, they should be done only under the supervision of a professional because, for most people, the risks of ballistic stretching far outweigh the benefits.
- Active stretching is stretching a muscle by actively contracting the muscle in opposition to the one being stretched. There is no use of body weight, strap, leverage, gravity, another person, or a stretching device. With active stretching, one relaxes the muscle being stretched and relies on the opposing muscle to initiate the stretch. Active stretching can be challenging because of the muscular force required to generate the stretch but is generally considered lower risk because one is controlling the stretch force with his/her own strength rather than an external force. Active Isolated Stretching (AIS) is another widely used term.
- Passive stretching is using some sort of outside assistance to help achieve a stretch. This assistance could be from body weight, a strap, leverage, gravity, another person, or a stretching

device. With passive stretching, one relaxes the muscle that is being stretched and relies on the external force to stabilize the body in place. Very little effort is involved in passive stretching; however, there is a risk that the external force is stronger than the individual's flexibility which could cause injury.

- Proprioceptive Neuromuscular Facilitation (PNF) is a form of passive stretching. PNF stretching requires stretching a muscle and then forcefully contracting that muscle before stretching it again. As one moves into the stretch after the contraction, one will be able to stretch further than he/she did before. This allows one to create more length in the muscle and receive a greater flexibility benefit from the stretch.

In addition, one doesn't have to take a dedicated class to do flexibility training. Many exercisers simply add a few minutes of stretching to the end of their daily workout to relax muscles and improve range of motion. One could also take 5 to 10 minutes to stretch in the morning after getting out of bed. Just a few minutes of flexibility training each day can provide benefits. When stretching, one should practice slow and controlled breathing. Not only does proper breathing help to deepen the stretch, but it also helps one to increase lung capacity. One should gently stretch all major muscles to the point of mild discomfort while holding the stretch for 15 to 30 seconds, slowly breathing in and out. Repeat each stretch 2-3 times. Stretching is an effective method to warming up and cooling down before and after workout sessions.

Stretching exercises can help to decrease stress and improve the way the body moves and feels throughout the day. Improved flexibility can even lead to better posture. These benefits help one to move more often throughout the day, burn more calories, and lead a more functional life.

FITT Principle with CRD

When prescribing exercise for one with CRD, the fitness professional should implement the FITT Principle which is an acronym for *Frequency, Intensity, Time, and Type*. The American Thoracic Society/European Respiratory Society established exercise guidelines (Spruit, M.A. et al., 2013) for those with CRD based off the American College of Sports and Medicine Exercise Guidelines (ACSM, 2011) and should be implemented when applying the FIIT principle to exercise prescription for one with CRD.

Frequency: How often or how many times one exercises during the week.

- Endurance/Aerobic Capacity: 3-5 Days Per Week
- Interval Training: 3-5 Days Per Week
- Resistance Training: 2-3 Days Per Week
- Flexibility: 2-3 Days Per Week or After Each Workout

Intensity: How hard one exercises or the level at which heart rate, ventilation, and blood pressure increases to elicit a training response in the body. (Horowitz, M.B. et al., 1996)

- Endurance/Aerobic Capacity:
  - >60% of MHR (Maximum Heart Rate of 220-Age)
  - Borg Dyspnea or Fatigue Score of 4 to 6 (moderate to very severe) (See Chart 6.1)
  - Rating of Perceived Exertion of 12 to 14 (somewhat hard) (See Chart 6.2)
  - Talk Test: Should be able to say a short sentence while breathing heavy and 2-3 stops for a breath
- Interval Training: During the Work Phase <60 Seconds
  - 85-90% of MHR (Maximum Heart Rate of 220-Age)
  - Borg Dyspnea or Fatigue Score of 7-9 (very severe to very, very severe)
  - Rating of Perceived Exertion of 15 to 17 (hard)
  - Talk Test: Able to say one or two words

Shortness of Breath Modified Borg Dyspnea Scale	
0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight
3	Moderate
4	Somewhat Severe
5	Severe
6	
7	Very Severe
8	
9	Very, very severe (almost maximal)
10	Maximal

Chart 6.1

Rating of Perceived Exertion Borg RPE Scale		
6		How you feel when lying in bed
7	Very, very light	or sitting in a chair relaxed.
8		Little or no effort.
9	Very light	Target area when doing
10		general physical activities
11	Fairly light	
12		Target area when doing
13	Somewhat hard	exercise
14		
15	Hard	
16		
17	Very hard	How you felt with the hardest
18		work you have ever done
19	Very, very hard	
20	Maximum exertion	Don't work this hard!

Chart 6.2

- Resistance Training: The optimal resistance training prescription for patients with chronic respiratory disease is not determined, as evidenced by the wide variation in its application among clinical trials. However, exercise guidelines established by American College of Sports Medicine (ACSM) is widely accepted when working with those with CRD. (ACSM, 2009)
    - Initial loads equivalent to either 60 to 70% of the one repetition maximum (i.e., the maximal load that can be moved only once over the full range of motion without compensatory movements
    - A load that evokes fatigue 8 to 12 repetitions
    - Progressive Overload: The exercise dosage must increase over time to facilitate improvements in muscular strength and endurance. This increase occurs when an individual can perform the current workload for 1 or 2 repetitions over the desired number of 6 to 12, on 2 consecutive training sessions. Overload can be achieved by modulating several prescriptive variables: increasing the resistance or weight, increasing the repetitions per set, increasing the number of sets per exercise, and/or decreasing the rest period between sets or exercises (O'Shea, S.D. et al., 2009).
- Flexibility: Stretch a specific muscle the point of mild discomfort. No bouncing.

Time: The duration period that one spends during one exercise session.
- Endurance/Aerobic Capacity: 20-60 Minutes
- Interval Training: 30-90 Minutes
- Resistance Training: 1-3 Sets
- Flexibility: Hold each stretch for 15-30 Seconds and Repeat 2-3 Times

Type: The preferred exercise to achieve the specific results for or improvements of Cardiorespiratory Fitness, Muscular Strength and Endurance, and Flexibility. Refer to the section on *Beneficial Types of Exercise.*

Exercise Safety and Proper Exercise Technique

Pre-Exercise: Before starting any form of exercise, one with CRD should speak to his/her doctor, nurse or another health care professional to ensure it is safe to exercise. For most people with CRD, the best way to learn how to exercise at the right level for him/her is to take part in a pulmonary rehabilitation (PR) program referred by his/her doctor.

Proper Pace: One with CRD should try doing a variety of exercises to prevent tiring out one set of muscles too quickly or getting unpleasantly breathless. One should work at a pace that allows one to exercise for longer. For example, one could do some exercises in the morning and some later in the day.

Breathing: When exercising, it is important to remember to inhale in preparation of the movement and exhale on the exertion phase of the movement. An individual should take slow deep breaths and pace him/herself. It is recommended to purse the lips while exhaling. It is not dangerous to feel out of breath when exercising. This is a normal response to exercise, and one will recover. Use the talk test to monitor intensity and level of breathlessness. (See the talk test in the intensity section.) Breathing techniques can help one control breathing.

Medication Use: If an individual uses medication for the treatment of respiratory disease, he/she should continue to take the medication based on his/her doctor's advice. His/her doctor may adjust the dosage according to the physical activity demands. For example, the doctor may adjust the flow rate of oxygen during exercise if one is using an oxygen tank. In addition, one should have his/her inhaler on hand in case of a need due to the increase of oxygen demand during exercise.

Exercise Avoidance: One should take a day off if the CRD symptoms are acting up: one is wheezing, coughing up more fluids than usual, or is unusually short of breath. One may want to talk to his/her doctor. He/she should call for help right away for shortness of breath that doesn't improve, fast or irregular heartbeat, and feeling dizzy or lightheaded.

Module II Lesson 1 Study #1

Physical activity end-points in trials of chronic respiratory diseases: summary of evidence

Cassie Rist, Niklas Karlsson, Sofia Necander, Carla A. Da Silva
ERJ Open Research 2022 8: 00541-2021; DOI: 10.1183/23120541.00541-2021
Read entire article here.

Background
Physical activity contributes to improving respiratory symptoms. However, validated end-points are few, and there is limited consensus about what is a clinically meaningful improvement for patients. This review summarizes the evidence to date on the range of physical activity end-points used in COPD, asthma and idiopathic pulmonary fibrosis (IPF) whilst evaluating their appropriateness as end-points in trials and their relation to patients' everyday life.

Methods
Trials reporting physical activity end-points were collected using Citeline's database Trialtrove; this was supplemented by searches in PubMed.

Results
The daily-patient-reported outcome (PRO)active and clinical visit-PROactive physical activity composite end-points appeared superior at capturing the full experience of physical activity in patients with COPD and were responsive to bronchodilator intervention. Time spent in moderate-to-vigorous physical activity is a recently validated end-point for IPF that correlates with exercise capacity and quality of life. Step count appears the best available physical activity measure for asthma, which consistently declines with worse disease status. However, evidence suggests a time lag before significant improvement in step count is seen which may reflect the impact of human behavior on physical activity.

Conclusion
Physical activity represents a challenging domain to accurately measure. This is the first review evaluating physical activity measures used specifically within the respiratory field. Whilst physical activity can be effectively captured using PROactive in patients with COPD, this review highlights the unmet need for novel patient-focused end-points in asthma and IPF which would offer opportunities to develop efficacious medicines with impact on patients' therapeutic care and quality of life.

Module II Lesson 1 Study #2

Evidence Around the Impact of Pulmonary Rehabilitation and Exercise on Redox Status in COPD: A Systematic Review

Alastair Watson, Tom M. A., Wilkinson, and Anna Freeman. Front. Sports Act. Living, 26 November 2021 | https://doi.org/10.3389/fspor.2021.782590
Read entire article here.

Background
Oxidative stress is increasingly recognized as a significant factor in the pathogenesis of chronic obstructive pulmonary disease (COPD). Pulmonary rehabilitation, a major component of which is prescribed exercise, is essential in COPD care. Regular exercise has been proposed to increase antioxidant defenses and overall enhance the ability of the body to counteract oxidative stress. However, the mechanisms through which it improves COPD outcomes remain unclear.

Objectives
We aimed to appraise the current evidence around the impact of pulmonary rehabilitation on redox status, compared with other exercise interventions, to gain an understanding of optimal exercise interventions to modify this pathophysiological mechanism.

Methods
We performed a systematic review through searching CENTRAL, MEDLINE, PubMed, Scopus, and Web of Science. Results were independently reviewed and relevant studies were selected by two independent assessors. Studies were assessed by two independent people using the modified RoB 2 tool and discrepancies were resolved through discussion.

Results
We identified 1,710 records and 1,117 records after duplicate removal. Six studies were included in the final analysis. The evidence available was low quality and four studies had high risk of bias and two studies had unclear risk of bias. Studies were small (15–56 participants); only two included details of randomization and patient cohorts were of varying ages and poorly described. Differences in smoking status and previous exercise levels, which are known to impact redox status, were not well documented. Studies were not standardized and used different exercise doses and measured different outcomes. One study reported lower malondialdehyde levels, a marker of lipid peroxidation, after pulmonary rehabilitation, compared with control. However, one study saw no difference following whole-body vibration training and another study showed higher malondialdehyde levels following supervised modified arm swing exercise compared with control.

Conclusion
Understanding the impact of exercise on oxidative stress in COPD could lead to tailored exercise programs and modification of pathological mechanisms. However, we identify a lack of high-quality evidence to determine this. Larger, standardized, and high quality randomized controlled trials (RCTs) are essential, which use carefully clinically characterized and controlled cohorts to determine the relative impact of different exercise interventions on redox status to guide COPD management. We propose an idealized RCT design, which could be used to try and meet this need.

Module II Lesson 1 Study #3

Effects of continuous aerobic exercise on lung function and quality of life with asthma: a systematic review and meta-analysis

Xinggui Wu#, Shiyuan Gao#, Yixin Lian. Journal of Thoracic Disease; Vol 12, No 9 (September 2020): Journal of Thoracic Disease. 2020. https://jtd.amegroups.com/article/view/43351
Read entire article here.

Background
Despite the obvious benefits of aerobic exercise for asthmatic patients, controversies persist. The current study evaluated the effectiveness of continuous aerobic exercise on lung function and quality of life of asthmatic patients.

Methods
We searched PubMed, EMBASE, and the Cochrane Central Register of Controlled Trials databases up to May 2019 and included randomized controlled trials (RCTs) of asthmatic patients intervened with whole body continuous aerobic exercise (moderate intensity, at least 20 minutes and two times a week, over a minimum period of four weeks), in which the endpoint measures were lung function and asthma-related quality of life. A fixed-effects model ($I2 \leq 50\%$) or random-effects model ($I2 > 50\%$) was applied to calculate the pooled effects according to the I2-and Chi-squared ($\chi 2$) test, funnel plots were quantified to present publication bias, and a P value <0.05 was statistically significant.

Results
Eventually, 22 trials conformed to the selection criteria. In the aerobic exercise group, the forced expiratory volume improved in one second (FEV1) (I2=10.2%, WMD: 0.12, P=0.011), peak expiratory flow (PEF) (I2=87.3%, WMD: 0.66, P=0.002), forced vital capacity (FVC) (I2=0.0%, WMD: 0.18, P<0.001), FVC/predict (I2=3.9%, WMD: 4.3, P=0.014), forced expiratory flow between 25% and 75% of vital capacity (FEF25–75%) (I2=0.0%, WMD: 9.6, P=0.005), Asthma Quality of Life Questionnaire (AQLQ) (I2=0.0%, WMD: 0.20, P=0.002), and Pediatric Asthma Quality of life Questionnaire (PAQLQ) (I2=72.1%, WMD: 0.81, P<0.001), respectively, while no statistical significance existed in FEV1%predict (I2=36.0%, WMD: 0.68, P=0.312) and FEV1/FVC ratio (I2=0.0%, WMD: 0.27, P=0.443) compared with the control group. When the exercise mode was taken into account, we observed significant improvement in FEV1, PEF, and FVC in the swimming (P<0.05) or indoor treadmill (P<0.05) training group.

Conclusions
Our meta-analysis proved that regular continuous aerobic exercise benefits asthma patients on FEV1, PEF, FVC, FVC%pred, FEF25–75%, and quality of life, and was well tolerated, while there were no improvements in FEV1%pred and FEV1/FVC%. As such, swimming and treadmill training may be appropriate options.

Module II Lesson 1 Study #4

Interval training compared with continuous training in patients with COPD

Ragnheiður Harpa Arnardóttira, Gunnar Boman, Kjell Larsson, Hans Hedenström, and Margareta Emtner. Respiratory Medicine. Volume 101, Issue 6, June 2007, Pages 1196-1204.
https://doi.org/10.1016/j.rmed.2006.11.004

Read entire article here.

Objective
The aim of this study was to compare the effects of interval training (3-min intervals) with continuous training on peak exercise capacity (W peak), physiological response, functional capacity, dyspnoea, mental health and health-related quality of life (HRQoL) in patients with moderate or severe COPD.

Methods
Sixty patients exercised twice weekly for 16 weeks after randomization to interval- or continuous training. Target intensity was ⩾80% of baseline W peak in the interval group (I-group) and ⩾65% in the continuous group (C-group). Patients were tested by spirometry, ergometer cycle test, cardiopulmonary test and a 12 min walk test. Dyspnoea was measured by the dyspnoea scale from Chronic Obstructive Disease Questionnaire (CRDQ), mental health by Hospital Anxiety and Depression scale (HAD) and HRQoL by the Medical Outcomes Survey Short Form 36 (SF-36).

Results
After training, W peak, peak oxygen uptake (VO2 peak) and exhaled carbon dioxide (VCO2 peak) increased significantly in both groups, no significant differences between the groups. Minute ventilation (VE peak) increased only in the C-group. At identical work rates (isotime) VO2, VCO2 and VE were significantly more decreased in the I-group than in the C-group ($p<0.05$). Functional capacity, dyspnoea, mental health, and HRQoL improved significantly in both groups, no difference between the groups.

Conclusion
Interval training and continuous training were equally potent in improving peak exercise capacity, functional exercise capacity, dyspnoea, mental health and HRQoL in patients with moderate or severe COPD. At isotime, the physiological response to training differed between the groups, in favor of the interval training.

Module II Lesson 1 Study #5

Effect of Passive Stretching of Respiratory Muscles on Chest Expansion and 6-Minute Walk Distance in COPD Patients

Rehman A, Ganai J, Aggarwal R, Alghadir AH, Iqbal ZA. Effect of Passive Stretching of Respiratory Muscles on Chest Expansion and 6-Minute Walk Distance in COPD Patients. Int J Environ Res Public Health. 2020 Sep 6;17(18):6480. doi: 10.3390/ijerph17186480. PMID: 32899902; PMCID: PMC7559714.

Read entire article here.

Background

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide. Hyperinflation of the lungs leads to a remodeling of the inspiratory muscles that causes postural deformities and more labored breathing. Postural changes include elevated, protracted, or abducted scapulae with medially rotated humerus, and kyphosis that leads to further tightening of respiratory muscles. As the severity of the disease progresses, use of the upper limbs for functional tasks becomes difficult due to muscle stiffness. There are various studies that suggest different rehabilitation programs for COPD patients; however, to the best of our knowledge none recommends passive stretching techniques. The aim of this study was to assess the effect of respiratory muscle passive stretching on chest expansion and 6-min walk distance (6MWD) in patients with moderate to severe COPD.

Methods

Thirty patients were divided into two groups, experimental ($n = 15$) and control ($n = 15$). The experimental group received a hot pack followed by stretching of the respiratory muscles and relaxed passive movements of the shoulder joints. The control group received a hot pack followed by relaxed passive movements of the shoulder joints.

Results

In the control group, there was no difference in chest expansion at the levels of both the axilla and the xiphisternum or in 6MWD between baseline and post treatment ($p > 0.05$). In the experimental group, chest expansion at the level of the axilla ($p < 0.05$) and 6MWD ($p < 0.001$) were significantly higher post treatment, while there was no difference in chest expansion at the level of the xiphisternum ($p > 0.05$). A comparison between control and experimental groups showed that chest expansion at the level of the axilla ($p < 0.05$) and 6MWD ($p < 0.01$) were significantly higher in the experimental group, while there was no difference in chest expansion at the level of the xiphisternum ($p > 0.05$).

Conclusion

Although COPD is an irreversible disease, results of this study indicate that passive stretching of respiratory muscles can clinically improve the condition of such patients, especially in terms of chest expansion and 6MWD. Given the good effects of muscle stretching and the fact that such an exercise is harmless, clinicians and physiotherapists should consider including passive stretching of respiratory muscles in the rehabilitation plan of COPD patients.

Module II Lesson 1 Study #6

Strength training increases maximum working capacity in patients with COPD – Randomized clinical trial comparing three training modalities

Karin Vonbank, Barbara Strasser, Jerzy Mondrzyk, Beatrice A. Marzluf, Bernhard Richter, Stephen Losch, Herbert Nell, Ventzislav Petkov, Paul Haber. Respiratory Medicine, Volume 106, Issue 4, 2012, Pages 557-563, ISSN 0954-6111, https://doi.org/10.1016/j.rmed.2011.11.005.

Read entire article here.

Background and objective
Skeletal muscle dysfunction contributes to exercise limitation in patients with chronic obstructive pulmonary disease (COPD). Strength training increases muscle strength and muscle mass, but there is an ongoing debate on the additional effect concerning the exercise capacity. The purpose of this study was to compare the effects of three different exercise modalities in patients with COPD including endurance training (ET), progressive strength training (ST) and the combination of strength training and endurance training (CT).

Design
A prospective randomized trial.

Methods
Thirty-six patients with COPD were randomly allocated either to ET, ST, or CT. Muscle strength, cardiopulmonary exercise testing, lung function testing and quality of life were assessed before and after a 12-week training period.

Results
Exercise capacity (Wmax) increased significantly in all three training groups with increase of peak oxygen uptake (VO2peak) in all three groups, reaching statistical significance in the ET group and the CT group. Muscle strength (leg press, bench press, bench pull) improved in all three training groups, with a higher improvement in the ST (+39.3%, +20.9%, +20.3%) and the CT group (+43.3%, +18.1%, +21.6%) compared to the ET group (+20.4%, +6.4%, +12.1%).

Conclusion
Progressive strength training alone increases not only muscle strength and quality of life, but also exercise capacity in patients with COPD, which may have implications in prescription of training modality.

Take Module II Lesson 1 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. List 5 benefits of exercise as it pertains to respiratory disease.
2. Explain the importance of the timing for initiating an exercise program soon after a hospitalization for COPD.
3. List 5 exercise limitations for those with respiratory disease.
4. What is the proper breathing technique for one with CRD?
5. Describe pursed lip breathing.
6. Describe Bhastrika breathing.
7. Describe Anulom Vilom breathing.
8. Describe Kapalbhati breathing.
9. According to ACSM guidelines, how many minutes should one perform cardio exercises?
10. According to ACSM guidelines, how many repetitions should one perform when weight training for basic muscular development?
11. Describe Peripheral Muscle Strength including the application of Upper and Lower Limb training.
12. Describe inspiratory muscle training (IMT) as it relates to respiratory muscle strength.
13. When one trains the core muscles, what two components are vital to a healthy core?
14. What is the main posture deviation of one with CRD?
15. List and define the 5 types of flexibility training?
16. List and define the components that make up the FITT principle.
17. What should one do if the CRD symptoms are acting up: one is wheezing, coughing up more fluids than usual, or is unusually short of breath?
18. If one is training for the purpose of cardio endurance, what should the intensity level be for the below measurement tools:
    a. % of MHR
    b. Borg Dyspnea or Fatigue Score
    c. Rating of Perceived Exertion
    d. Talk Test

Lesson Two

The Science of Healthy Breathing

Evidence of proper breathing surprisingly originated hundreds and even thousands of years ago through the evidence from ancient texts of Eastern cultures. Chinese, Hinduists, and Buddhists cultures alike believe that through proper inhaling and exhaling many modern ailments like asthma, ADHD, anxiety, psoriasis, etc. could either be reduced or reversed. In addition, these cultures equate breath with the spirit viewing proper breathing as either killing or healing an individual mentally and physically. Buddhists use the breath to lengthen their lives and reach a higher plane of consciousness. Some expert breathers have used proper breathing to straighten spines with scoliosis, impede autoimmune diseases, and increase body temperatures in subzero temperatures. Researchers discovered that through evolution and especially during the Industrial Age, approximately 90 percent of humans breathe incorrectly leading to an indefinite list of chronic diseases including chronic respiratory disease. The average individual breathes 670 million times in a lifespan. The quality of those breaths will in turn determine the quality of one's life.

Benefits of Proper Breathing

- Positively affects body weight
- Positively affects the size and function of the lungs
- Positively balances the nervous system
- Positively controls the immune response
- Reduces blood pressure
- Boosts athletic performance
- Increases overall energy
- Positively affects and restores overall health
- Increases Lifespan

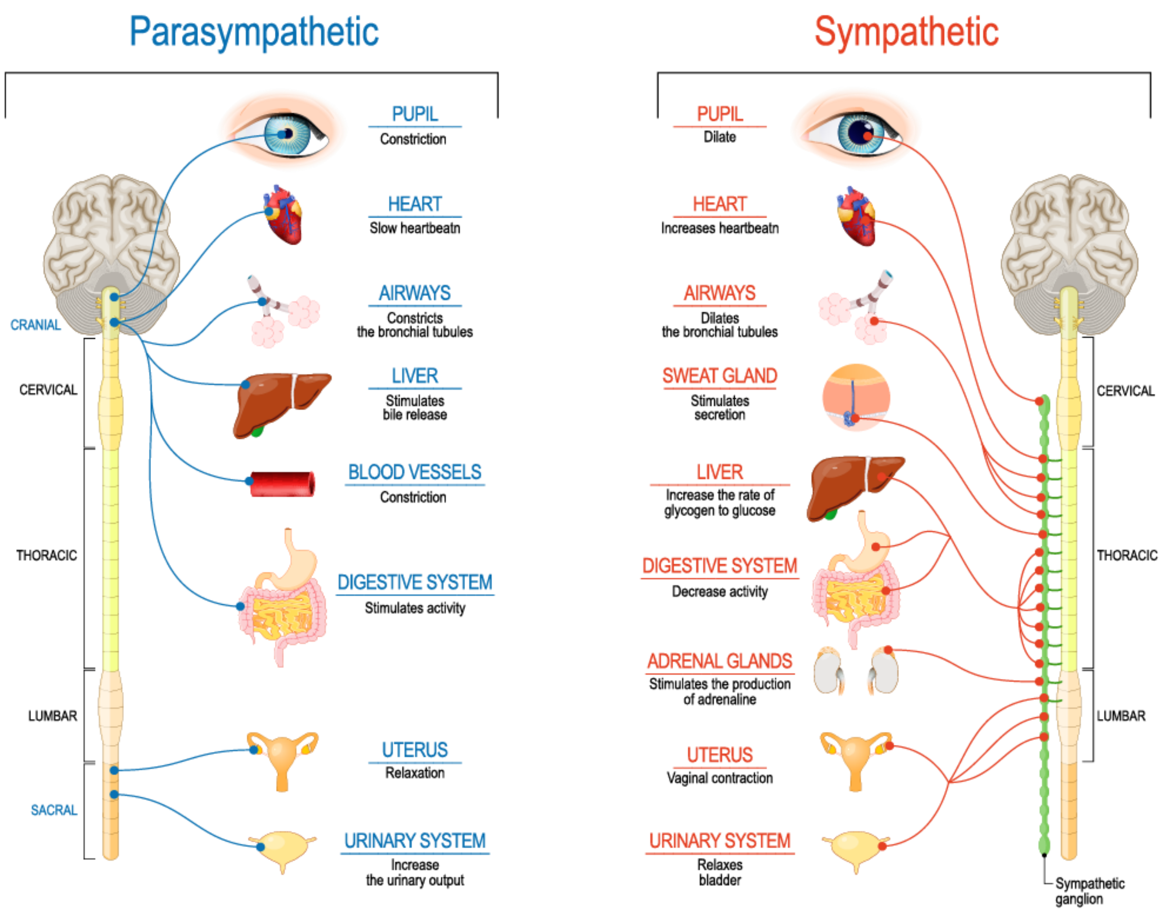
Characteristics of Healthy Breathing

Sympathetic/Parasympathetic Nervous Systems

The autonomic nervous system: involved in a number of typically automatic, regulatory functions and consists of two components, the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). These two systems are activated in times of arousal or recovery.

- Sympathetic Nervous System (SNS): "Fight or Flight" response
  - The fight or flight response involves the SNS changing activity in the body to help prepare for a perceived threat and includes: inhibition of the digestive and immune systems, increases in pupil size and heart rate, expansion of the lungs, and the release of epinephrine/norepinephrine. These processes are meant to optimize functions in the body when it's under attack.
  - Breathing is fast and shallow

- Parasympathetic Nervous System (PSN): “Rest and Digest” response
    - To facilitate the rest and digest response, the PNS alters a number of functions in the body to help it recover. These functions are largely mirror opposites of SNS activation and include: stimulation of the digestive and immune systems, decreases in pupil size and heart rate, and contraction of the lungs. These processes optimize functions in the body at rest and allow it to focus on maintenance and being calm.
    - Breathing is slow and deep



Mouth Breathing

- 40% of humans suffer from chronic nasal obstruction leading to mouth breathing
- 50% of humans are mouth breathers
- Adverse Effects of Mouth Breathing
    - Mood disturbances and anxiety
    - Increased blood pressure
    - Headaches
    - Negatively changes the physical body and transforms airways
    - Mouth and face structure abnormalities including slack-jaw and narrow face
    - Decreases pressure which causes the soft tissues in the back of the mouth to become loose and flex inward, creating less space and making breathing more difficult.

- Decreases oxygen levels in the body as low as 90 percent or even below. When oxygen levels in the body are this low, the blood cannot carry enough oxygen to body tissues which could lead to heart failure, depression, memory problems, and early death.
    - The body loses 40 percent more water as compared to nasal breathing.
    - Increased sleep apnea episodes
    - The body decreases its release of the hormone vasopressin during sleep because of an individual's inability to reach a deep sleep due to mouth breathing. Vasopressin communicates with the cells to store more water preventing one from getting thirsty and having to urinate throughout the night. Therefore, if one is unable to reach a deep sleep due to sleep apnea from mouth breathing, then the body cannot release vasopressin and the body thinks it needs to relieve itself and drink more water throughout the night.
    - Snoring occurs more often because of mouth breathing. Evidence supports that this affliction leads to bed wetting, ADHD, diabetes, high blood pressure, and cancer.
    - Chronic insomnia which has been long assumed to be a psychological problem is often due to mouth breathing.
    - Mouth breathing impedes oxygen to the prefrontal cortex or the brain affecting critical thinking and decision-making.
- Positive note: Evidence supports that after regaining the ability to properly breathe, individuals experience the reverse effects of many ailments.

Nasal Breathing

- The nose is crucial to breathing because it clears air, heats it, and moistens it for easier absorption.
- Forces air against all soft tissue at the back of the throat, making the airways wider and breathing easier. Over time those tissues become stronger and more "toned" to stay in a wide and more opened position.
- Respiration leads to restoration. Many adverse health effects due to mouth breathing can be reversed with proper nasal breathing.
- Right and Left Nostril Breathing
    - Right Nostril: Breathing through the right nostril is a gas pedal speeding up circulation, increasing body temperature, increasing cortisol levels, increasing blood pressure, and increasing heart rate. Breathing through the right nostril activates the SNS putting one in a more elevated state of alertness and readiness. More oxygen is delivered to the prefrontal cortex which is associated with logical decisions, language, and computing.
    - Left Nostril: Breathing through the left nostril works as a brake system and is connected to the PNS lowering blood pressure, cooling the body, and reducing anxiety. Left nostril breathing delivers oxygen to the hemisphere of the brain that influences creative thought, plays a role in the formation of mental abstractions, and produces negative emotions.

- Positive effects of nasal breathing
    - Decreased blood pressure
    - Increased energy
    - Boosts nitric oxide, a molecule that is essential for increasing circulation and delivering oxygen into the cells.
    - Improved immune function
    - Controlled body weight
    - Improved circulation
    - Improved mood
    - Improved sexual function

Complete Exhalation

One should exhale every drop of air out of the lungs before taking another breath. The diaphragm should move down and up optimally and maximally as one inhales and exhales respectively. The exhale should be longer than the inhale. Training the body to breathe in this manner enables the body to receive more oxygen and function optimally. This technique is helpful for those who have emphysema. This disease is characterized as damage and deterioration to the structure or mechanism of the lung tissue for exhalation. Research has discovered that those with emphysema can breathe in air/oxygen but have difficulty exhaling all the stale air out enough to receive a full inhalation of more oxygen. Emphysema is described as an exhalation disease and may be improved through the practice of full exhalations.

Slow

One should slow the breathing down to a calm pace to receive more oxygen. Ancient eastern culture believed that one only has a certain number of breaths per lifespan and should slow the breath down to preserve life.

- Benefits of slow breathing
    - Decreased blood pressure
    - Lowered heart rate
    - Increased oxygen levels
    - Increased blood flow to the brain
    - Coherent body systems: cardiovascular, nervous, and respiratory systems working together at peak efficiency

More or Less

One should practice slow steady breathing more often. This practice overtime will help one eliminate improper breathing and improve overall health.

Chewing

Research has discovered that our ancestors had big facial features, large mouths, strong jaws, large sinus cavities, and straight teeth. These features were due to their proper breathing methods. In addition, because of these large features, they were able to continue to get in the necessary oxygen to function. Proper breathing begets proper breathing. In addition, their diet contributed to their strong jaws and larger facial features. Their diet consisted of food that compelled them to chew for an extended period of time. Today, diets consist of overly soft and processed foods which does not require one to chew as much. Facial bones continue to grow and adapt well into one’s 70s; therefore, changing one's diet to foods that require a lot of chewing may be beneficial for breathing properly and improving one's overall respiratory function.

Methods of Breathing

Diaphragm Exercises: This move strengthens a key breathing muscle, the diaphragm. One lies down with the knees bent or sits in an easy chair -- one hand on the chest, one below the rib cage. Slowly inhale through the nose so that the stomach raises one hand. Exhale with pursed lips and tighten the stomach. The hand on the chest should not move. Do this for 5 to 10 minutes, three or four times a day. Breathing this way will become easy and automatic.

Pursed Lip Breathing: This exercise reduces the number of breaths one takes and keeps the airways open longer. More air is able to flow in and out of the lungs, so that one can be more physically active. To practice it, simply breathe in through the nose and breathe out at least twice as long through your mouth, with pursed lips. Gently puff out the cheeks to create pressure. Creating pressure opens up the airways and it also slows down the breath.

Yoga Breathing: Yogic breathing exercises improve diffusion capacity. They are beneficial to COPD patients in particular and they can be used as an adjunct therapy with the conventional medical therapy (Soni, R. et al., 2012).

1. Bhastrika: 5 min
    - Sit up tall, relax your shoulders, and take a few deep, breaths in and out from the nose. With each inhale, expand the belly fully as you breathe.
    - Begin bellows breathing by exhaling forcefully through your nose. Follow by inhaling forcefully at the rate of one second per cycle.
    - Make sure the breath is coming from your diaphragm; keep your head, neck, shoulders, and chest still while your belly moves in and out.
    - For your first cycle, move through a round of 10 *Bhastrika* breaths, then take a break and breathe naturally, observing the sensations in your mind and body. After a 15- to 30-second break, begin the next round with 20 breaths. Finally, after pausing for another 30 seconds, complete a third round of 30 bellows breaths.
    - Make sure to listen to your body during the practice. Bellows breathing is a safe practice, but if you feel light-headed in any way, take a pause for a few minutes while breathing naturally. When the discomfort passes, try another round of bellows breathing, slower and with less intensity.
    - Practice bellows breath on an empty stomach. Wait at least two hours after eating.

2. Anulom vilom: 15 min Also known as the alternate breathing technique, Anulom yilom is excellent for respiratory problems and asthma. It facilitates proper functioning of the lungs, mitigates stress, lifts up one's mood and keeps stress at bay.
    - Always sit with the legs crisscrossed and the hands resting sideways on the knees.
    - Close the right nostril with your right thumb and inhale slowly through the left nostril to fill up your lungs.
    - Now, release the right nostril and close the left nostril with the ring finger and exhale slowly through the right nostril. Inhale through the right nostril
    - Now, release the left nostril and close the right nostril with the right thumb and exhale through the left nostril.
    - It is essential to focus on your breath and practice the technique slowly.
    - Repeat 60 times or for 5 minutes. One can do this any time of the day.
    - Ensure that the back is straight, and shoulders relaxed while the pranayama is performed.

3. Kapalbhati: 10 min Also known as forehead shining breathing technique or breath of fire, Kapalbhati flushes out toxic air from the body, cleansing it in the process. With cleansing come various mental and physical benefits.
    - With the legs in crisscrossed position, sit up tall, lengthening the space between your navel and the heart. Place the hands on the knees. Ensure they are facing upwards. Direct the focus and awareness to the belly region.
    - Breathe in and out through the nose and start to pull your abdomen in during the exhale and press it out during the inhale. Imagine your belly fills up with air during the inhale and use your abdominal muscles to push the air out during the exhale.
    - Start to shorten each breath and pick up the pace. The breathing should be loud and quick.
    - Try to equalize the inhale and the exhale in both strength and length.

Tummo "Inner Fire"

- Ancient Tibetan Breath Practice/Chandali yoga
- It pairs a specific breath pattern and the visualization of a flame going up the spine.
- Tips
    1. Practice with a guide at initially before practicing individually.
    2. Practice on an empty stomach: Because of the contracting of the abdomen, and the need to breathe deeply into the belly, you will be much more comfortable practicing tummo breath without a full stomach.
    3. Consult your doctor if you have serious health conditions.
- Method
    1. Sit comfortably with good posture and close your eyes. Your hands will rest over your stomach for the entirety of the practice. (Note: Once you become more acquainted with the practice, it can be done standing or walking.)
    2. Begin to relax your mind as best you can, allowing thoughts to flow until your mind has quieted.
    3. Visualize a fire in your stomach around your belly button. Imagine you are a large hollow balloon with this ball of fire inside. Continue visualizing throughout the practice.

4. Inhale deeply through your nose, arching your back slightly, expanding your torso and chest. Imagine the oxygen is fueling the fire within you, helping it to grow larger and hotter.
5. Exhale strongly through your mouth with rounded lips, as if you were blowing through a straw. Curl forward, rounding the spine, still holding your hands to your stomach. Imagine the flame and its heat are spreading all throughout your body.
6. Continue this breath pattern for five breaths and notice the heat start to build. After the fifth inhale, swallow gently and feel how that holds the inhale below the diaphragm. Contract your pelvic floor muscles, so you're simultaneously pushing the breath down with the diaphragm and up with the pelvic floor.
7. Exhale after holding the breath for as long as you can, relaxing your muscles.
8. Repeat the sequence for a few rounds, and you should start to feel warmer and more mentally clear.

Box Breathing

- Box breathing, also referred to as square breathing, is a deep breathing technique that can help you slow down your breathing. It works by distracting your mind as you count to four, calming your nervous system, and decreasing stress in your body.
- Tips
  1. Sit in a chair, stand, or lie down on your back with one hand on your chest and one hand on your stomach. When you sit on a chair, ensure that your back is supported, and your feet are firmly on the floor.
  2. Breathe as you would normally for a minute.
  3. Observe the rise and fall of your chest and stomach.
  4. If you notice that your chest is rising but your stomach is not, you are shallow breathing. If your stomach is rising, you are deep breathing activating full relaxation in your body.
  5. Be aware of your breath to ensure that you are taking deep breaths, allowing your stomach to rise.
  6. If you are lying down or seated on a chair, you will feel your back pressed against the surface when you take a deep breath.
  7. If this is your first time practicing box breathing, push your stomach out while focusing on smooth, deep breaths.
- Method
  1. Step 1: Breathe in counting to four slowly. Feel the air enter your lungs.
  2. Step 2: Hold your breath for 4 seconds. Try to avoid inhaling or exhaling for 4 seconds.
  3. Step 3: Slowly exhale through your mouth for 4 seconds.
  4. Step 4: Repeat steps 1 to 3 until you feel re-centered.

Repeat this exercise as many times as you can. 30 seconds of deep breathing will help you feel more relaxed and in control.

4-7-8 Breathing "Relaxing Breath"

- Reduces anxiety
- Helps one sleep
- Manages cravings
- Controls or reduces anger responses
- Method
  1. Before starting the breathing pattern, adopt a comfortable sitting position and place the tip of the tongue on the tissue right behind the top front teeth.
  2. Empty the lungs of air.
  3. Breathe in quietly through the nose for 4 seconds.
  4. Hold the breath for a count of 7 seconds.
  5. Exhale forcefully through the mouth, pursing the lips and making a "whoosh" sound, for 8 seconds.
  6. Repeat the cycle up to 4 times.

Module II Lesson 2 Study #1

The physiological effects of slow breathing in the healthy human

Russo, M. A., Santarelli, D. M., & O'Rourke, D. (2017). The physiological effects of slow breathing in the healthy human. Breathe (Sheffield, England), 13(4), 298–309.
https://doi.org/10.1183/20734735.009817

Read entire article here.

Abstract
Slow breathing practices have been adopted in the modern world across the globe due to their claimed health benefits. This has piqued the interest of researchers and clinicians who have initiated investigations into the physiological (and psychological) effects of slow breathing techniques and attempted to uncover the underlying mechanisms. The aim of this article is to provide a comprehensive overview of normal respiratory physiology and the documented physiological effects of slow breathing techniques according to research in healthy humans. The review focuses on the physiological implications to the respiratory, cardiovascular, cardiorespiratory and autonomic nervous systems, with particular focus on diaphragm activity, ventilation efficiency, haemodynamics, heart rate variability, cardiorespiratory coupling, respiratory sinus arrhythmia and sympathovagal balance. The review ends with a brief discussion of the potential clinical implications of slow breathing techniques. This is a topic that warrants further research, understanding and discussion.

Key points

- Slow breathing practices have gained popularity in the western world due to their claimed health benefits, yet remain relatively untouched by the medical community.
- Investigations into the physiological effects of slow breathing have uncovered significant effects on the respiratory, cardiovascular, cardiorespiratory and autonomic nervous systems.
- Key findings include effects on respiratory muscle activity, ventilation efficiency, chemoreflex and baroreflex sensitivity, heart rate variability, blood flow dynamics, respiratory sinus arrhythmia, cardiorespiratory coupling, and sympathovagal balance.
- There appears to be potential for use of controlled slow breathing techniques as a means of optimizing physiological parameters that appear to be associated with health and longevity, and that may extend to disease states; however, there is a dire need for further research into the area.

Educational aims

- To provide a comprehensive overview of normal human respiratory physiology and the documented effects of slow breathing in healthy humans.
- To review and discuss the evidence and hypotheses regarding the mechanisms underlying slow breathing physiological effects in humans.
- To provide a definition of slow breathing and what may constitute “autonomically optimised respiration”.
- To open discussion on the potential clinical implications of slow breathing techniques and the need for further research.

Module II Lesson 2 Study #2

The Effect of Diaphragmatic Breathing on Attention, Negative Affect and Stress in Healthy Adults

Ma, X., Yue, Z. Q., Gong, Z. Q., Zhang, H., Duan, N. Y., Shi, Y. T., Wei, G. X., & Li, Y. F. (2017). The Effect of Diaphragmatic Breathing on Attention, Negative Affect and Stress in Healthy Adults. Frontiers in psychology, 8, 874. https://doi.org/10.3389/fpsyg.2017.00874

Read entire article here.

Background
A growing number of empirical studies have revealed that diaphragmatic breathing may trigger body relaxation responses and benefit both physical and mental health. However, the specific benefits of diaphragmatic breathing on mental health remain largely unknown.

Objective
The present study aimed to investigate the effect of diaphragmatic breathing on cognition, affect, and cortisol responses to stress.

Method
Forty participants were randomly assigned to either a breathing intervention group (BIG) or a control group (CG). The BIG received intensive training for 20 sessions, implemented over 8 weeks, employing a real-time feedback device, and an average respiratory rate of 4 breaths/min, while the CG did not receive this treatment. All participants completed pre- and post-tests of sustained attention and affect. Additionally, pre-test and post-test salivary cortisol concentrations were determined in both groups.

Results
The findings suggested that the BIG showed a significant decrease in negative affect after intervention, compared to baseline. In the diaphragmatic breathing condition, there was a significant interaction effect of group by time on sustained attention, whereby the BIG showed significantly increased sustained attention after training, compared to baseline. There was a significant interaction effect of group and time in the diaphragmatic breathing condition on cortisol levels, whereby the BIG had a significantly lower cortisol level after training, while the CG showed no significant change in cortisol levels.

Conclusion
In conclusion, diaphragmatic breathing could improve sustained attention, affect, and cortisol levels. This study provided evidence demonstrating the effect of diaphragmatic breathing, a mind-body practice, on mental function, from a health psychology approach, which has important implications for health promotion in healthy individuals.

Take Module II Lesson 2 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. List 3 benefits for proper breathing.
2. List 3 adverse effects of mouth breathing.
3. Describe breathing as it relates to the Sympathetic Nervous System.
4. Describe breathing as it relates to the Parasympathetic Nervous System.
5. What percentage of people are mouth breathers?
6. Why is the nose crucial in breathing?
7. Explain why complete exhalation would help one with emphysema.
8. Explain how chewing helps breathing.
9. Describe box breathing.
10. Describe diaphragm breathing.

Lesson Three

Scope of Practice for the Health and Fitness Professional

The health and fitness professional can play a vital role in the overall health and well-being of one who has respiratory disease. As a health and fitness professional, one should understand the extent of his/her scope of practice and be able to identify when a referral to a healthcare provider would be appropriate to avoid legal implications and potential injuries to his/her clients (Kompf, J., Tumminello, N., and Nadolsky, S., 2014). The American College of Sports Medicine (ACSM) and the National Strength and Conditioning Association (NSCA) have delineated the specific job description of a personal trainer or health and fitness professional.

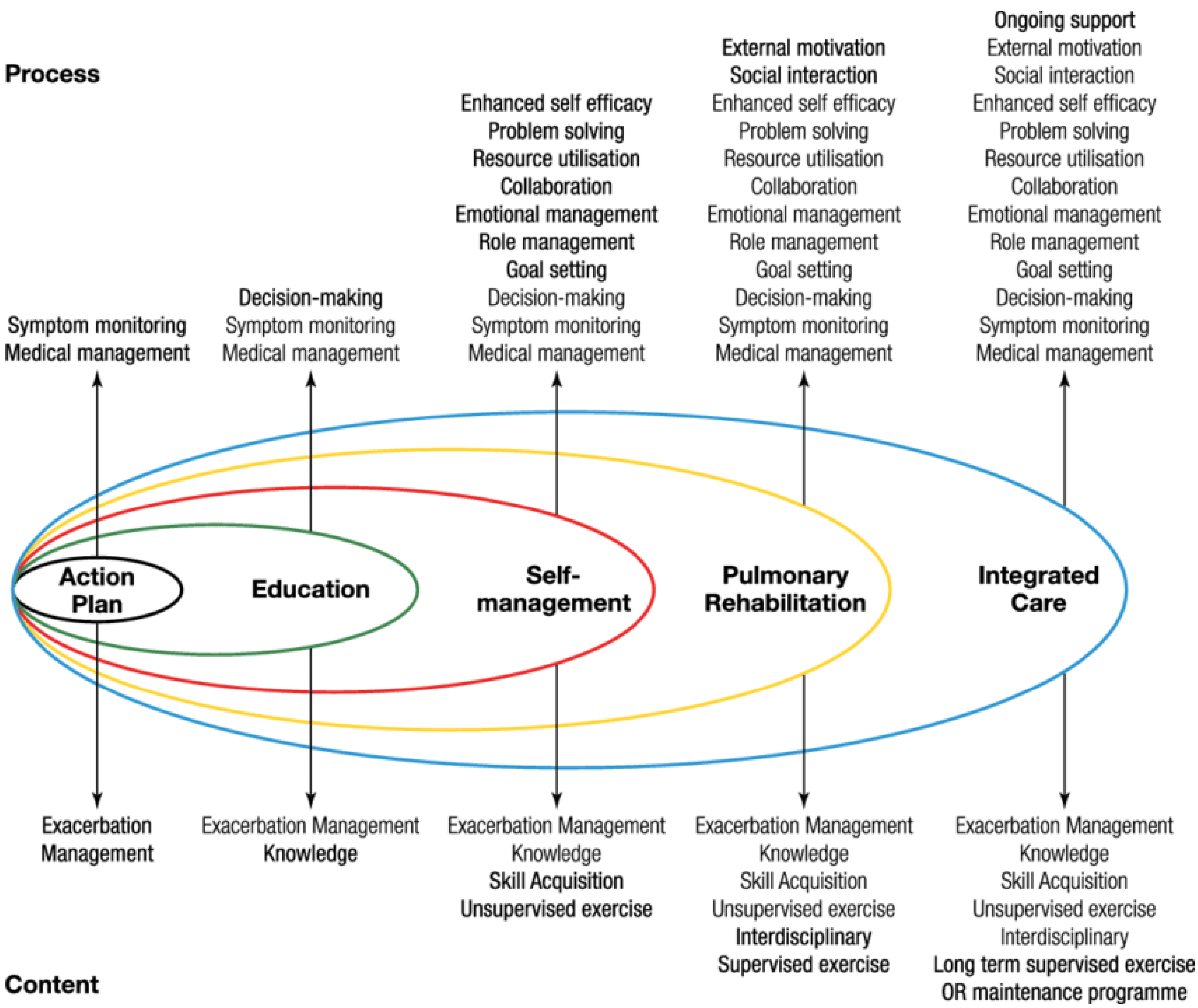
According to the ACSM: The ACSM Certified Personal Trainer (CPT) works with apparently healthy individuals and those with health challenges who are able to exercise independently to enhance quality of life, improve health-related physical fitness, performance, manage health risk, and promote lasting health behavior change. The CPT conducts basic pre-participation health screening assessments, submaximal aerobic exercise tests, and muscular strength/endurance, flexibility, and body composition tests. The CPT facilitates motivation and adherence as well as develops and administers programs designed to enhance muscular strength/endurance, flexibility, cardiorespiratory fitness, body composition, and/or any of the motor skill related components of physical fitness (i.e., balance, coordination, power, agility, speed, and reaction time).

According to the NSCA: Personal trainers are health/fitness professionals who, using an individualized approach, assess, motivate, educate, and train clients regarding their health and fitness needs. They design safe and effective exercise programs, provide the guidance to help clients achieve their personal health/fitness goals and respond appropriately in emergency situations. Recognizing their own area of expertise, personal trainers refer clients to other healthcare professionals when appropriate. Personal trainers should fulfill a specific role within the healthcare system and as a healthcare provider. Trainers should have a strong knowledge base in kinesiology, psychology, injury prevention, nutrition, and knowledge of simple medical screening tests. Because of this, they may share certain roles with other healthcare providers such as dietitians, physical therapists, doctors, and psychologists.

It is necessary for health and fitness professionals to identify two major components of their profession; research and practical application of that research. In other words, evidence base training must be applied. In addition, the health and fitness professional must take into consideration the population he/she is training and apply proper methodology or intervention.

When working with clients who have a chronic respiratory disease, health and fitness professionals should focus specifically on exercise screening and prescription. The health and fitness professional can also have general training in injury management, psychology, and nutrition. Given the appropriate educational background, health and fitness professionals may play a role in working with populations with specific medical impairments such as respiratory disease.

Because of the complex nature of chronic respiratory disease, its multisystem manifestations, and frequent comorbidities, integrated care principles are being adopted to optimize the management of these individuals. Pulmonary rehabilitation is now recognized as a core component of this process (Figure 1). Health behavior change is vital to optimization and maintenance of benefits from any intervention in chronic care, and pulmonary rehabilitation has taken a lead in implementing strategies to achieve this goal. The scope of the health and fitness professional's skills and expertise is appropriate within the *Integrated Care* phase of one with CRD. (Wagg, K., 2012). (See Figure 7.1)



A spectrum of support for chronic obstructive pulmonary disease (COPD) Figure 7.1

Injured Clients
Physical therapists and orthopedic specialists work specifically to fix what is broken or severely injured, whereas health and fitness professionals work to enhance what is not broken. Training clients consists of assessing for weaknesses and improving upon those weaknesses while working around what is severely injured or broken. Diagnosis and using corrective exercises for injuries is in the scope of the physical therapist and/or orthopedic specialist. The health and fitness professional should follow two criteria when prescribing exercise: 1. Comfort: Movement is pain-free, feels natural, and works within the client's current physiology 2. Control: The client can demonstrate the movement technique and body positioning as provided in each exercise description. To allow for comfort and control, the health and fitness professional may have to modify the range of motion or adjust body alignment best fit the client's current ability and anatomy.

Psychology and Nutrition Counseling
The personal training profession has a solid base not just in exercise, but in nutrition as well. However, a personal trainer is not qualified like a Registered Dietitian (RD), who can write meal plans for clients. Nutrition is related to psychology in that most clients have a fair and very general understanding of what they need to do to improve their eating habits. The real question is why do they not take the steps to become healthy? Health and fitness professionals should be able to disseminate information on nutrition, serve as counselors to behavior change, and act as a motivator for health change. This can all be done without writing a specific meal plan for a client. Health and fitness professionals can implement an effective change protocol to be used to hasten behavior change.

Medical Care and Special Populations
Practicing medicine is not within the scope of practice for the health and fitness professional. However, there are certain conditions that could be easily screened by a health and fitness professional especially if a client does not spend much time with their physician or even go to their physician regularly. Health and fitness professionals encourage a healthy all-around lifestyle, which includes diet, exercise, and even sleep. As the obesity epidemic continues, so do the comorbid conditions that accompany it, including osteoarthritis, diabetes, hypertension, and obstructive sleep apnea (OSA). OSA may be missed in a quick doctor visit. While a health and fitness professional cannot diagnose OSA, it would benefit the client if his/her health and fitness professional could recognize the signs of OSA, so that it might not go unnoticed. Health and fitness professionals could ask questions from validated questionnaires to know when to refer to a doctor. See the section on "Screening and Assessments".

Table 7.1 provides an overview of what a personal trainer does and does not do. It is important for all health and fitness professionals to be familiar with local bylaws on scope of practice, as they may be different depending on where the health/fitness professional lives.

General Scope of Practice

Fitness Professionals DO NOT:	Fitness Professionals DO:
Diagnose	• Receive exercise, health, or nutrition guidelines from a physician, physical therapist, registered dietician, etc. • Follow national consensus guidelines for exercise programs for medical disorders • Screen for exercise limitations • Identify potential risk factors through screening • Refer clients to an appropriate allied health professional or medical practitioner
Prescribe	• Design exercise programs • Refer clients to an appropriate allied health professional or medical practitioner for an exercise prescription
Prescribe diets or recommend specific supplements	• Provide general information on healthy eating, according to the MyPyramid Food Guidance System • Refer clients to a dietician or nutritionist for a specific diet plan
Treat injury or disease	• Refer clients to an appropriate allied health professional or medical practitioner for treatment • Use exercise to help improve overall health • Help clients follow physician or therapist advice
Monitor progress for medically referred clients	• Document progress • Report progress to an appropriate allied health professional or medical practitioner • Follow physician, therapist, or dietician recommendations
Rehabilitate	• Design an exercise program once a client has been released from rehabilitation
Counsel	• Coach • Provide general information • Refer patients to a qualified counselor or therapist
Work with patients	• Work with clients

Table 7.1

Scope of Practice for the Medical Fitness Specialist/Respiratory Disease

A fitness professional who has specifically completed the online course titled, Medical Fitness Specialist, or has completed a fitness specialist course focused on a specific chronic disease or medical condition, and through MedFit Classroom, is considered a Medical Fitness Specialist. Through completion of course(s) focusing on a specific condition, the Medical Fitness Specialist has received advanced education and training in that respective medical condition and is qualified to work with clients who have been diagnosed with that respective medical condition. Medical conditions may include, but are not limited to: Alzheimer's disease, arthritis, cancer, diabetes, heart disease, hypertension, lung disease, multiple sclerosis, neuromuscular disorders, obesity, orthopedic disease, Parkinson's disease, mental illness, and type 2 diabetes.

Medical Fitness Specialist courses on MedFit Classroom are considered advanced, continuing education, and do not supplant a general comprehensive fitness certification. Individuals completing a Medical Fitness Specialist course on MedFit Classroom are eligible to earn a Certificate of Specialization once they are able to provide evidence of either a current, general fitness certification, or relevant degree in the field, as well as proof of professional liability insurance.

Medical Fitness Specialists shall first and foremost adhere to the scope of practice as defined by their primary fitness certification, shall also follow all local, regional, state, and/or national regulations (e.g., those defined by their accredited certification organizations, national licensing boards, State licensing and/or registration requirements, primary industry trade organizations, etc.), and shall adhere to the procedures and actions applicable to their credentials.

Medical Fitness Specialists shall not diagnose injury, chronic disease, or any other medical condition, nor provide treatment beyond the scope of their training, and shall refer clients with such needs to properly licensed medical and/or allied healthcare professionals. Medical Fitness Specialists are trained to recognize the signs and symptoms suspicious of a disease process in order to understand when an exercise program should be modified or stopped for the client to seek further evaluation and/or diagnosis.

Clients may be referred to a Medical Fitness Specialist by a licensed healthcare professional (i.e., medical doctor, chiropractic physician, physiotherapist, etc.), to participate in a structured physical exercise program, and/or to begin behavioral change programs (e.g., dietary or mental health). This may also include clients who seek a referral for a specific health or fitness goal, and have taken it upon their own merit to begin an exercise and/or behavior change program.

To ensure coordination of care, Medical Fitness Specialists are trained to competently communicate in written, verbal, and/or HIPAA-secure electronic formats with other allied health professionals or healthcare professionals. Medical Fitness Specialists' communication with, and education of, their client about medical fitness, and/or about a client's diagnosed medical condition(s), should stay within the scope of their own specific Medical Fitness Specialist course credentials (i.e., specific to the condition in which the Medical Fitness Specialist was trained).

Medical Fitness Specialists are trained to recognize when it is appropriate to refer their client to a licensed healthcare professional, as well as how and to whom their client needs to be referred. For example, Medical Fitness Specialists should refer their client for the following scenarios:

4. A current client who demonstrates symptoms and signs of an undiagnosed condition or is experiencing an exacerbation or worsening of a current medical condition;
5. Or, a prospective or current client who would be placed at risk if physical exercise or behavioral change programs were started or continued.

Medical Fitness Specialists are also trained to take a thorough health history, monitor their client through accurate record-keeping and, once again, to work within the scope of their respective education and training. They understand how to create progressive exercise programs for respective medical conditions, monitor and assess the success of a program, make modifications when necessary, and monitor for circumstances that demand the cessation of the program, and/or referral to an appropriate healthcare professional.

Ultimately, the primary goal of a Medical Fitness Specialist is to responsibly guide a client through a medical fitness program that creates improvements in overall health and wellness, consistent with the goals of both the client and their healthcare team.

Take Module II Lesson 3 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. A health and fitness professional should identify two major components of their profession. What are they?
2. Fill in the blank: Health behavior change is vital to optimization and maintenance of benefits from any intervention in chronic care, and _______________ ________________ has taken a lead in implementing strategies to achieve this goal.
3. The health and fitness professional should follow two criteria when prescribing exercise. What are they?
4. List 3 tasks that a personal trainer does not do because it is outside the scope of practice.
5. List 3 tasks that a personal trainer can do within the scope of practice.
6. Briefly explain the "scope of practice" for a Medical Fitness Specialist in the field of respiratory disease.

Lesson Four

Screening and Assessments

Before starting an exercise training program, an exercise assessment is needed to individualize the exercise prescription, evaluate the potential need for supplemental oxygen, help rule out some cardiovascular comorbidities, and help ensure the safety of the intervention. This client assessment may also include a maximal cardiopulmonary exercise test to assess the safety of exercise, to define the factors contributing to exercise limitation, and to identify a suitable exercise prescription.

When working with individuals with CRD, the health and fitness professional will still measure the traditional core components of fitness such as cardiorespiratory fitness, muscular strength and endurance, flexibility, and body composition. In addition, depending on the skills of the health and fitness professional, he/she may perform other assessments specific to CRD. The following baseline and outcome assessments at the end of a PR program are the most common when working with individuals with chronic respiratory diseases (Spiro, G., 1980 and Zeng, Y. et al., 2018).

PAR-Q Form

The health and fitness professional should have an established screening protocol including a physical activity readiness questionnaire (PAR-Q) which should be conducted before any cardiorespiratory or strength training. The PAR-Q is a screening test designed to determine an individual's risks in participating in physical activity. The PAR-Q allows the health and fitness professional to identify clients with cardiovascular disease or risk factors for disease. If a client is identified as "at risk" they should be referred to a medical professional who will provide a medical evaluation before beginning an exercise program. (See Appendix A)

Ventilation Function: modified Medical Research Council Dyspnea Scale (mMRC)

Dyspnea assessment by modified Medical Research Council dyspnea scale (mMRC dyspnea scale) is a 5-point scale based on degrees of variable physical activities that precipitate dyspnea with a score ranging from 0 to 4. (See Table 8.1) The mMRC Dyspnea Scale is best used to establish baseline functional impairment due to dyspnea attributable to respiratory disease. While measuring mMRC Dyspnea Scale scores in patients with respiratory disease (particularly COPD) to establish baseline functional dyspnea burden is appropriate, mMRC scores are not independently used in clinical practice to guide clinical management or therapeutic interventions. A patient's mMRC Dyspnea Scale score is combined with the patient's FEV_1 percent predicted and the frequency of COPD exacerbations to guide treatment interventions. The mMRC Dyspnea Scale score must be contextualized with an individual patient's history, physical, and available diagnostic test results. For patients with a higher mMRC grade (e.g. $\geq$2) and clinical circumstances consistent with respiratory disease, measuring spirometry (e.g., FEV_1 and FVC), determining the patient's BODE Index, and pursuing further targeted diagnostic and/or therapeutic interventions is appropriate.

The Modified Medical Research Council (MMRC) Dyspnoea Scale

Grade of dyspnoea	Description
0	Not troubled by breathlessness except on strenuous exercise
1	Shortness of breath when hurrying on the level *or* walking up a slight hill
2	Walks slower than people of the same age on the level because of breathlessness *or* has to stop for breath when walking at own pace on the level
3	Stops for breath after walking about 100 m *or* after a few minutes on the level
4	Too breathless to leave the house *or* breathless when dressing or undressing

Table 8.1

Pulmonary Function: Spirometry

Spirometry is a noninvasive test used to diagnose lung diseases or disorders such as asthma, bronchitis and emphysema (the latter two closely associated with COPD), or to detect other reasons for shortness of breath. In this test, a machine (a spirometer) measures how much air one can breathe in, and then how much and how forcefully one can exhale that air back out in a set matter of seconds. The test measures how well the lungs work. Results are recorded and displayed in a graphic, which will be examined by a specialist before results are reported. One of the advantages of this test is that it can detect the disease even before symptoms are fully evident. It can also track the severity of COPD and its progression (Johns, D.P. et al., 2014).

The machine measures how much air one can exhale out of the lungs. The two main measures include:

- Forced vital capacity (FVC). This is the amount of air that you breathe out in one complete breath (six seconds or more).
- Forced expiratory volume (FEV-1). This is the amount of air that you breathe out in the first second.

The results (in percentage) are compared to those of similar age, gender, height, and race. People with COPD have FEV-1/FVC of less than 80% of predicted value (moderate COPD). If FEV-1/FVC is less than 50%, COPD is likely to be diagnosed as severe. (See Table 8.2)

SPIROMETRY TEST	NORMAL	ABNORMAL	
FVC and FEV1	Equal to or greater than 80%	Mild Moderate Severe	70-79% 60-69% less than 60%
FEV1/FVC	Equal to or greater than 70%	Mild Moderate Severe	60-69% 50-59% less than 50%

Functional Performance: TUG

The Timed Up & Go (TUG) test is a simple, cheap and reliable functional performance test. Subjects are requested to stand up from a chair, walk a distance of 3 m at a comfortable and safe pace, turn and walk back to the chair to sit down again. This test has been used for the assessment of functional mobility, walking ability, dynamic balance and risk of falling in subjects with a variety of conditions including CRD. Despite its simplicity, the TUG has been shown to predict morbidity and mortality in different populations. Patients with a TUG time > 11 seconds have poorer health outcomes than patients with a TUG time below this threshold. Moreover, the TUG is responsive to pulmonary rehabilitation, especially in patients with a baseline TUG time > 11 seconds. The TUG is a simple functional performance test which provides valuable information and can be adopted in both clinical and research settings (Mesquita, R. et al. 2016). (See Appendix B)

Muscular Strength: Peripheral muscle strength

- Lower Body Strength
  - 30 Second Sit to Stand Test (30CST): The 30CST is a measurement that assesses functional lower extremity strength in older adults, but is also used in assessing functional strength in those with RD. It is part of the Fullerton Functional Fitness Test Battery. This test assesses balance, functional mobility, as well as lower body strength. (See Appendix C)

- Upper Body Strength
  - Arm Curl Test: This test measures upper body strength and endurance through lifting a weight for 30 seconds. Typically, women will lift 4-5 lbs and men will lift 8 lbs. (See Appendix D)
  - Dynamometer: A dynamometer is a machine that measures hand grip strength (HGS). Although HGS is not related to the presence or severity of airflow limitation, it could be used as a biomarker of general quality of life to risk-stratify patients with COPD (Jeong, M. et al., 2017). The muscle dysfunction and exercise impairment that occurs

in patients with COPD is explained by systemic inflammation arising from the lung and a decrease in the large muscle mass of the lower extremities. Both muscle endurance and muscle strength are indicators of muscular fitness, and reduced muscle strength – measured by HGS with a dynamometer – has been associated with a higher risk of mortality.

- Lower and Upper Body Strength: 1 Repetition Maximum Test (1RM)
  - The 1-RM measures maximum isotonic strength of various muscle and muscle groups. The 1-RM strength test is defined as the maximal weight that can be lifted once by proper lifting technique using a resistance machine (usually a leg extension or leg press machine). 1-RM is considered as the gold standard for assessing muscle strength in non-laboratory situations. The 1-RM is a well-tolerated test by patients included in PR programs and has been recently used to evaluate the muscle strength assessment in individuals with COPD (Zanini, A. et al., 2015)

Cardiorespiratory Assessment: Six-minute walking test (6MWT)

The 6-min walk test (6 MWT) is a submaximal exercise test that entails measurement of distance walked over a span of 6 minutes. It evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism (Tetzlaff, K. et al., 2016). It does not provide specific information on the function of each of the different organs and systems involved in exercise or the mechanism of exercise limitation, as is possible with maximal cardiopulmonary exercise testing. The self-paced 6MWT assesses the submaximal level of functional capacity. Most patients do not achieve maximal exercise capacity during the 6MWT; instead, they choose their own intensity of exercise and are allowed to stop and rest during the test. However, because most activities of daily living are performed at submaximal levels of exertion, the 6MWT may better reflect the functional exercise level for daily physical activities. Most 6MWTs will be done before and after PR, and the primary question to be answered after both tests have been completed is whether the patient has experienced a clinically significant improvement. It is not recommended to interpret single measurements to diagnose functional status; however, studies have shown that healthy adults have a mean score of approximately 500 meters walked during a 6MWT (ATS, 2002). (See Appendix E)

Flexibility

- Lower Body Chair Sit and Reach Test: This test measures flexibility in the lower body. The client, while seated with one leg extended, slowly bends forward sliding the hands down the extended leg in an attempt to touch (or pass) the toes. The number of centimeters short of reaching the toe (minus score) or reaching beyond it (plus score). (See Appendix F)
- Upper Body Back Scratch Test: This test measures flexibility of the upper body, more specifically a measure of overall shoulder range of motion. This test involves measuring the distance between (or overlap of) the middle fingers behind the back with a ruler. Participants can perform this test twice, alternating hands taking the best value of each hand. The average of both hands can be used. (See Appendix G)

Quality of Life

- Health-related quality of life (HRQoL) is a multi-dimensional concept that includes domains related to physical, mental, emotional, and social functioning. It goes beyond direct measures of population health, life expectancy, and causes of death, and focuses on the impact health status has on quality of life. A related concept of HRQoL is well-being, which assesses the positive aspects of a person's life, such as positive emotions and life satisfaction. Clinicians and public health officials have used HRQoL and well-being to measure the effects of chronic illness such as CRD, treatments, and short- and long-term disabilities.
- St. George's Respiratory Questionnaire (SGRQ) is a tool designed to measure health impairment in patients with asthma and COPD. The SGRQ is also valid for use in bronchiectasis and post tuberculosis and has been used successfully in patients with kyphoscoliosis, sarcoidosis. It is not suitable for cystic fibrosis. It is in two parts. Part I produces the Symptoms score, and Part 2 the Activity and Impacts scores. St. George's Respiratory Questionnaire for COPD patients (SGRQ-C) is a modified questionnaire use only for COPD patients an is not applicable to other respiratory diseases.

Mortality Rate: The BODE Index

The BODE index is a tool that is used by healthcare professionals to predict the mortality rate (death rate) from chronic obstructive pulmonary disease (COPD). After obtaining a BODE index, mortality can be predicted (Celli, B.R. et al., 2004). However, there are many other factors which can affect mortality in people with COPD, and this test is not perfect. Someone with a very high score could end up living for decades and someone with a low score could pass tomorrow. Tests like this are good for making general predictions and evaluating statistics, but they do not necessarily give predictive information for individual people.

Using points based on 4 different measures of lung function, the BODE score makes a prediction about how long someone will live after a diagnosis of COPD. (See Table 8.3)

- Body Mass Index: BMI is a calculation that is made by comparing height in meters by weight in kilograms. There are calculators for determining BMI, as well as tables BMI is an estimate of how overweight or underweight a person is. With COPD, being underweight or malnourished is a poor sign when it comes to prognosis.
- Obstruction of Airway: FEV1 (forced expiratory volume at 1 second) is a measure of the amount of air which can be forcefully exhaled in 1 second. FVC stands for forced vital capacity, which is the amount of air that can be exhaled altogether after a deep breath. The ratio FEV1/FVC, therefore, represents that percent of the total air that can be exhaled in 1 second over all the air that can be exhaled. Normally this ratio is around 1, which means that we exhale the majority of air in the 1st second of exhalation. If there is an obstruction in the airways slowing or preventing this rapid exhalation of air, the ratio decreases.
- Dyspnea: Dyspnea is the term that refers to the physical sensation of shortness of breath or breathlessness. Dyspnea is measured by using the mMRC Scale.
- Exercise Tolerance: Exercise tolerance refers to how active someone can be with the restrictions put forth by their lung disease. The 6-minute walk test is used to obtain the value for the BODE index.

Variable	Points on BODE Index			
	0	1	2	3
FEV1 (% predicted)	≥65	50-64	36-49	≤35
6-Minute Walk Test (meters)	≥350	250-349	150-249	≤149
MMRC Dyspnea Scale	0-1	2	3	4
Body Mass Index	>21	≤21		

Table 8.3

Approximate 4-year survival rates are then calculated as:

0-2 points - 80%
3-4 points - 67%
5-6 points - 57%
7-10 points - 18%

Postural Screening

There are many methods used to measure or screen posture. One method called photogrammetry is the science of making measurements from photographs. The input to photogrammetry is photographs, and the output is typically a map, a drawing, a measurement, or a 3D model of one's body alignment. Photogrammetry is a widely used non-invasive technique for postural evaluation. It is a viable option for healthcare professionals and researchers in the field of posture, possibly because it allows a succinct and accurate quantitative evaluation by recording subtle changes in posture in general. From the point of view of spinal evaluation, it is capable of providing information in the frontal and sagittal planes. In this method, photographs of the subjects are taken in frontal or sagittal plane with a camera which is mounted on a leveled tripod stand, which is placed at some distance from the subjects. This distance varies amongst various research. The photographs which are thus obtained are transferred to a computer system. They are used to calculate postural angles with the help of some software which has been installed in the computer system. The type of software too varies from research to research. Angles are then drawn between the markers by drawing horizontal and/or vertical lines. With the use of this method, quantifiable and reliable data can be obtained. Its use in measuring head posture, shoulder posture, cervical lordosis, thoracic kyphosis, lumbar lordosis, lower limb posture and pelvic tilt has been reported in the literature (Furlanetto, T. S., 2016). (See Figure 8.1)

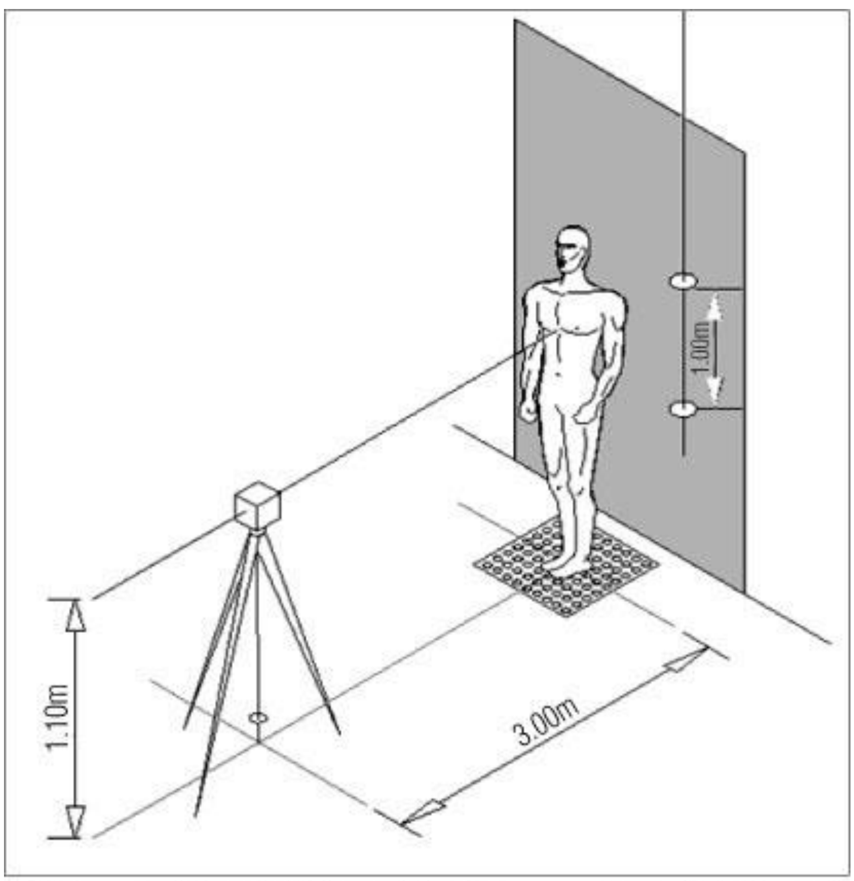


Figure 8.1

Another posture assessment used is the plumb line method. A plumb line is a string suspended overhead with a small weight, or plumb bob, attached at the end near the floor. Position the patient behind the line so you can see the body bisected by the plumb line. The assessor observes the individual from the anterior view, the lateral view, and the posterior view. The assessor then uses a checklist to record any deviations from normal. (See Figure 8.2)

Summary

The assessment of patients and program outcomes is a crucial element of a PR program. Before one should participate in an organized pulmonary rehabilitation program, rehabilitation therapists should measure the condition of patients, including symptoms, endurance and strength, and health-related quality of life. As well as during and after a certain time of training, rehabilitation therapists should reassess patient performance and program effectiveness. After a PR program which typically lasts 6-8 weeks, the client is encouraged to continue exercising. If working with a health and fitness professional, the client should foster an open line of communication between the health and fitness professional and his/her therapist.

Take Module II Lesson 4 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. What is a PAR-Q form?
2. What is the modified Medical Research Council Dyspnea Scale (mMRC)?
3. What test is being described, "a noninvasive test used to diagnose lung diseases or disorders such as asthma, bronchitis and emphysema (the latter two closely associated with COPD), or to detect other reasons for shortness of breath."
4. Explain how the above test is administered.
5. What is Forced vital capacity (FVC)?
6. What is Forced expiratory volume (FEV-1)?
7. Explain the TUG test and what the acronym means?
8. What assessment is good to measure cardiorespiratory fitness in those with CRD?
9. What two assessments are good to measure upper body strength in those with CRD?
10. What assessment is good to measure lower body strength in those with CRD?
11. What two assessments are used to measure flexibility in those with CRD?
12. What two measurements can be used to assess posture in those with CRD?
13. Describe the Health-related quality of life (HRQoL) tool.
14. Describe the St. George's Respiratory Questionnaire (SGRQ) tool.
15. What is The BODE Index?

Lesson Five

Goals and Program Design

Goal Profile

Once the health and fitness professional has screened and assessed the client, it is imperative to set clear and concise goals to track one's health and fitness progress. It is helpful for the client to think about the different aspects of his/her life and where he/she would like to make changes.

Some common goals for many people with chronic respiratory disease include:
To exercise on a regular basis and feel good doing it.
To be less short of breath.
To learn how to select and prepare healthy meals.
To lose or gain weight.

The goals must be S.M.A.R.T.
Specific
Measurable
Attainable
Realistic
Time-Bound

While a health and fitness program will not cure a chronic respiratory disease such as COPD, one can take control of his/her chronic respiratory disease and manage it and increase the quality of life. He/she should work with his/her healthcare team including the health/fitness professional and focus on reaching the goals he/she sets at the beginning of the program.

Program Design

A comprehensive health and fitness program for those with CRD should include cardiorespiratory exercise, strength training, core conditioning, flexibility training, breathing exercises, proper nutrition, and education. The overall exercise program should include milestones of progression. In other words, as one improves his/her cardiorespiratory fitness and strength, the program should be adjusted to become more challenging to continue improvements. Periodic testing every 3 months will provide data for the health and fitness professional to make concessions for adaptations that have occurred in one's fitness level. The health and fitness professional can use the FITT principle to adjust specific components of the exercises to elicit a continued positive response to exercise.

Exercise Format

Each exercise session should include 5 components: Warm-up, cardiorespiratory exercise, strength exercise, core exercise, and cool-down/stretching. Depending on one's personal schedule and time, he/she can follow different programs to ensure all five components to an exercise session are accomplished during the week.

Warm-Up and Cool-down: Warm up and cool-down are usually 5 to 10 minutes and may involve gentle stretching or exercise at a lower intensity or workload. It prepares your heart, lungs and muscles for the work to be done during exercise and cools them after a workout to prevent muscle soreness or injury.

Cardiorespiratory Exercise: Cardiorespiratory exercises like cycling, walking, and swimming should be performed 20-60 minutes per session at an RPE of 12-14 (somewhat hard) 3-5 days per week. If one is incorporating interval training, no more than 3 days a week of intervals should be performed

Strength Training: Resistance exercises should include all major muscles performing exercises at a load that can only elicit 8-12 repetitions for 2-3 sets for 2-3 days per week.

Core Conditioning: The core section of the workout should include exercises that focus on the rectus abdominis, obliques, transverse abdominis, and lower back. Each workout should include a section on core.

Sample Weekly Workout Formats

When first beginning an exercise program, one should introduce exercise at the low end of the recommendations. For example, one should only exercise 3 days a week incorporating cardio every time and one strength element at a time (i.e., only upper body on one day, only lower body on one day, and only core on one day). This method establishes a routine so not to start off too much too soon and get burned out.

Sample #1	**Total Body**	**3 Day/Week**				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Warm-up		Warm-up		Warm-up		
Cardio 30 min		Cardio 30 min		Cardio 30 min		
Chest		Leg Press		Ball Ab Crunches		
Upper Back		Leg Extension		Forearm Plank		
Shoulders		Leg Curl		Bosu Obliques		
Biceps		Stretch		Bridge		
Triceps				Stretch		
Stretch						

Sample #2	**Split Body**	**4 Day/Week**				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Intervals Upper Body Core		**Cardio Lower Body**		**Intervals Upper Body Core**		**Cardio Lower Body**
Warm-Up		Warm-Up		Warm-Up		Warm-Up
Cardio Intervals 20 min		Cardio 45 min		Cardio Intervals 20 min		Cardio 45 min
Chest		Leg Press		Chest		Leg Press
Upper Back		Leg Extension		Upper Back		Leg Extension
Shoulders		Leg Curl		Shoulders		Leg Curl
Biceps		Stretch		Biceps		Stretch
Triceps				Triceps		
Ball Ab Crunches				Ball Ab Crunches		
Forearm Plank				Forearm Plank		
Bosu Obliques				Bosu Obliques		
Bridge				Bridge		
Stretch				Stretch		

Sample #3	**Split Body**	**5 Day/Week**				
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Intervals Upper Body	**Cardio Lower Body**	**Cardio Core Balance**	**Intervals Upper Body**	**Cardio Lower Body**		
Warm-Up	Warm-Up	Warm-Up	Warm-Up	Warm-Up		
Cardio Intervals 20 min	Cardio 45 min	Cardio 45 min	Cardio Intervals 20 min	Cardio 45 min		
Chest	Leg Press	Ball Ab Crunches	Chest	Leg Press		
Upper Back	Leg Extension	Forearm Plank	Upper Back	Leg Extension		
Shoulders	Leg Curl	Bosu Obliques	Shoulders	Leg Curl		
Biceps	Stretch	Bridge	Biceps	Stretch		
Triceps		Stretch	Triceps			
Stretch			Stretch			

Take Module II Lesson 5 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. List 3 common goals for those who have CRD.
2. Explain S.M.A.R.T. goals.
3. What should a comprehensive health and fitness program for those with CRD include?
4. Each exercise session should include what 5 components?

Lesson Six

Nutrition and Healthy Weight Management

Another important component of a comprehensive pulmonary rehabilitation program is proper nutrition. This involves choosing healthy foods that can work to heal and repair the body and make it stronger against disease. This section addresses how to eat healthy and achieve a healthy body weight. In order to educate Americans on the importance of healthy eating and exercise, the USDA and the US Department of Health and Human Services developed the Choose My Plate Food Guide. The Choose MyPlate Food Guide helps one choose the foods and amounts that are healthy and encourages one to be active every day. Food choices and activity level affect one's health – both now and in the future. To adopt a healthy lifestyle and maintain a healthy weight, one should set daily nutrition and activity goals. Living a healthy lifestyle and following the Choose My Plate Food Guide is important for people of all ages, with and without chronic respiratory disease. One should consult with a registered dietitian about specific nutrition needs. (See Figure 10.1)

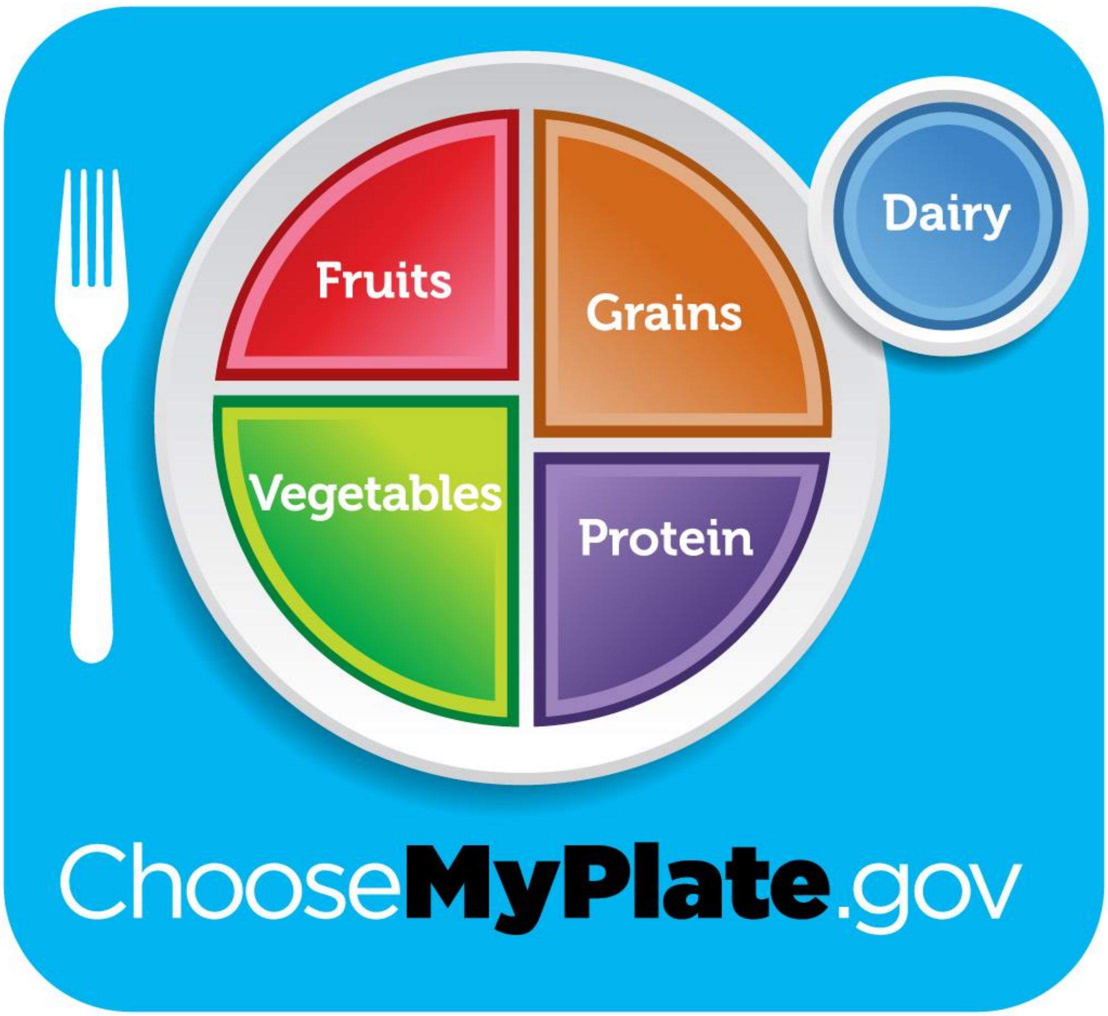


Figure 10.1

10 Tips to a Great Plate

1. Balance Calories: Find out how many calories YOU need for a day as a first step in managing your weight. Being physically active also helps you balance calories.
2. Enjoy Your Food But Eat Less: Take the time to fully enjoy your food as you eat it. Eating too fast or when your attention is elsewhere may lead to eating too many calories. Pay attention to hunger and fullness cues before, during, and after meals. Use them to recognize when to eat and when you’ve had enough.
3. Avoid Oversized Portions: Use a smaller plate, bowl, and glass. Portion out foods before you eat. When eating out, choose a smaller size option, share a dish, or take home part of your meal.
4. Foods to Eat More Often: Eat more vegetables, fruits, whole grains, and fat-free or 1% dairy products. These foods have the nutrients you need for health—including potassium, calcium, vitamin D, and fiber. Make them the basis for meals and snacks.
5. Make Half Your Plate Fruits and Vegetables: Choose red, orange, and dark green vegetables like tomatoes, sweet potatoes, and broccoli, along with other vegetables for your meals. Add fruit to meals as part of main or side dishes or as dessert.
6. Switch to Fat-Free or Low-Fat (1%) Milk: They have the same amount of calcium and other essential nutrients as whole milk, but fewer calories and less saturated fat.
7. Make Half Your Grains Whole Grains: To eat more whole grains, substitute a whole-grain product for a refined product such as eating whole-wheat bread instead of white bread or brown rice instead of white rice.
8. Foods to Eat Less Often: Cut back on foods high in solid fats, added sugars, and salt. They include cakes, cookies, ice cream, candies, sweetened drinks, pizza, and fatty meats like ribs, sausages, bacon, and hot dogs. Use these foods as occasional treats not everyday foods.
9. Compare Sodium in Foods: Use the nutrition facts label to choose lower sodium versions of foods like soup, bread, and frozen meals. Select canned foods labeled “low sodium,” “reduced sodium,” or “no salt added”.
10. Drink Water Instead of Sugary Drinks: Cut calories by drinking water or unsweetened beverages. Soda, energy drinks, and sports drinks are a major source of added sugar and calories in American diets.

Maintaining a Healthy Weight

Achieving and maintaining a healthy weight is an important part of treating chronic respiratory disease. Excess body weight, especially around the stomach, can increase shortness of breath. Insufficient body weight can decrease the ability to fight infections. A good way to determine if one needs to gain or lose weight is to look at body composition. A male’s body fat should be between 10% to 20% of his total body weight whereas a female’s body fat should range between 15% and 25% of her total body weight.

Weight Loss

If weight loss is the goal, one should focus on establishing a plan that includes a variety of foods. Avoid using the word "diet" as a diet is something one goes on and then goes off. One should try to make healthy lifestyle changes he/she can maintain for the long term. A healthy rate of weight loss is1-2 pounds per week. Rapid weight loss usually results in loss of fluid or muscle rather than body fat. Here are some weight loss tips:

- Do not skip meals.
- Include 3 food groups with each meal.
- Limit snacks to designated times, often midmorning and mid-afternoon.
- Limit sweetened beverages to no more than 12 ounces a day. This includes juice, soda, Kool-Aid and lemonade to name a few.
- Keep high fat or high sugar foods out of the house.
- Limit serving sizes. Refer to the package for information on serving size.
- Be aware that most of today's foods come in super-sized versions that are not helpful for weight control. Resist the temptation to super-size your order or to purchase super-sized food items. Share an entrée when dining out. Limit use of high calorie condiments such as mayonnaise or salad dressing. Use lower calorie versions instead.
- Increase activity to help strengthen your body and lose weight. Remember what you learned in exercise section of this book.
- Meet with a registered dietitian (RD) for additional advice on meal planning.

Weight Gain

The best way to gain weight is to eat more. However, people with chronic respiratory disease often feel full after eating a relatively small amount of food. If this is happening to you, try to eat smaller amounts more often. In addition, try to add calories to everything you eat with extra sauces and gravies. Here are some tips for weight gain:

- Eat five to six small meals a day and snack whenever you are hungry.
- Keep your favorite foods on hand for snacking and meals (such as frozen dinners).
- Fat is a concentrated source of calories. Small amounts of vegetable oil, butter or margarine can increase the calorie content of any food.
- Use higher calorie versions of foods you eat (butter crackers or cheese crackers instead of soda crackers).
- Avoid "lite" products (skim milk, low fat yogurt and cottage cheese, reduced calorie mayonnaise, low-fat salad dressings, etc).
- Don't fill up on fluids. Drink fluids between meals rather than with meals. Drinking during a meal can make you feel full quickly.
- Avoid filling up on low calorie foods like salad at meal times; instead eat the heartier foods first.
- Choose nutritious drinks, such as whole milk, milkshakes, and juices. Consider supplemental drinks such as Boost®, Ensure®, or Scandishake®
- Meet with a registered dietitian (RD) for additional advice on meal planning.

Suggested Calorie Boosters

- butter/margarine
- cream cheese
- dried fruit
- peanut butter/nuts
- granola
- honey/sugar

Mealtime Tips

Shortness of breath can make eating hard work. If you use all your energy preparing a healthy meal, you may find yourself unable to eat and/or enjoy what you have prepared. Here are a few practical suggestions on how to conserve energy and get the most from your meals:

- Eat six smaller meals instead of three big meals. Frequent meals are recommended since many people with chronic lung disease feel more short of breath when their stomach is full. This is because the diaphragm cannot work as well when the stomach is full. You can satisfy your nutritional needs, keep your stomach comfortable and help your diaphragm to work better by eating smaller amounts more often.
- Plan to eat before you are too hungry or tired.
- If you do not have an appetite, use the clock to remind you when it's time to eat. Think of food as medicine and do your best to eat "healthy" foods throughout the day. Try to eat something every 2-3 hours, and do not go longer than 4 hours without eating.
- Breathe evenly while you are chewing and eating. Stop eating if you need to catch your breath. Relax at mealtime.
- When cooking or baking, double or triple your favorite recipes to keep your freezer full for times when you do not feel like cooking. Freeze foods in small portions for when you do not feel like cooking.
- Use prepared foods to save time and energy in the kitchen. Frozen meals, prepared foods or take-out meals from a restaurant can make your life easier. Remember, the sugar, salt or fat content of these foods may be higher than homemade.
- Do the tasks that require the most effort when you have the most energy. For example, many people would agree that grocery shopping is a tiring task. This chore can be done when you feel freshest, in the morning or after a rest. Better yet, make a list and have a friend or family member pick up your groceries for you!
- Don't stand in the kitchen when you can sit. Bring your chopping, cutting and mixing projects over to the kitchen table and sit while you prepare the food or keep a barstool by the kitchen counter.

Built Up Gas

Another way to avoid that "too full" feeling is to eat less of the foods that cause gas. The following foods are common offenders. Keep a food diary to find out if they are a problem for you.

- asparagus
- beans (pinto, kidney, black, navy)
- broccoli
- brussels sprouts
- cabbage
- carbonated drinks
- cauliflower
- cucumbers
- melons
- garlic
- onions (raw)
- peas (split, blackeye)
- peppers
- radishes
- rutabagas
- sausage
- spicy foods
- turnips

Gastroesophageal Reflux

Many people with chronic respiratory disease also have gastroesophageal reflux disease (GERD). Gastroesophageal reflux is a backward flow or reflux of stomach contents into the esophagus. This occurs when the valve of smooth muscle between the esophagus and the stomach does not function properly. This muscle band is called the lower esophageal sphincter.

Signs and Symptoms: Some signs and symptoms of GERD include heartburn, sour taste in the mouth or swallowing problems, but many people with GERD may have no symptoms, but worsening lung disease.

Treatment for GERD

- Lifestyle changes
    - If you are overweight, talk with your healthcare provider about losing weight.
    - If you smoke, giving up smoking is important. Your healthcare provider will have ideas to help you quit.
- Dietary measures
    - Limit citrus and tomato products, strong spices, caffeinated drinks, carbonated drinks, fatty foods, chocolate, mint and alcohol.
    - Eat smaller, more frequent meals rather than three large ones.
    - Avoid food or liquids for 2-3 hours before bedtime.
- Physical measures
    - Elevate the head of the bed 6-8 inches, by placing blocks under the legs of the head of the bed.
    - Avoid bending forward at the waist.
    - Avoid wearing tight fitting clothing.
- Medications
    - In addition to the above measures, medications may be prescribed to help this condition also.

Steroids and Diet

Some people with chronic lung disease take steroid pills on a regular basis. Steroid pills (such as prednisone or methylprednisolone) are strong medicines that decrease swollen airways. They also have the potential to interfere with the way the body uses specific nutrients, including calcium, potassium, sodium, protein and vitamins C and D. If one takes steroid pills for chronic lung disease, it is very important to eat a balanced diet that meets the Choose My Plate Food Guidelines. A healthy diet that includes foods from each food group can make up for some of the nutritional effects of steroid therapy. Over a long period of time, steroid pills or liquids, can increase the risk of osteoporosis (loss of bone density). Therefore, it is very important to eat foods high in calcium, such as dairy products. If one does not get adequate calcium from foods, then taking a calcium supplement is beneficial. If one needs to control calories, low fat dairy products may be used. To prevent other side effects, one should limit the use of salt and foods that are high in sodium and decrease the amount of cholesterol and fats in the diet. In many cases, taking a multi-vitamin may help ensure adequate vitamin and mineral intake. One should consult with a doctor or a registered dietitian about specific concerns regarding steroids and diet.

Guidelines by American Lung Association

According to the American Lung Association, for some people with COPD, eating a diet with fewer carbohydrates and more fat helps them breathe easier. This can be substantiated by the explanation of metabolism, the process of changing food to fuel in the body. Oxygen and food are the raw materials of the process, and energy and carbon dioxide are the finished products. Carbon dioxide is a waste product that is exhaled. The right mix of nutrients in the diet can help one breathe easier. Metabolism of carbohydrates produces the most carbon dioxide for the amount of oxygen used; metabolism of fat produces the least. Therefore, eating a diet with fewer carbohydrates and more fat helps one breathe easier.

- Complex Carbohydrates: Choose complex carbohydrates like whole-grain bread and pasta, fresh fruits, and vegetables.
    - Weight Loss: Choose fresh fruits and veggies over bread and pasta for the majority of your complex carbohydrates.
    - Weight Gain: Eat a variety of whole-grain carbohydrates and fresh fruits and vegetables.
- Simple Carbohydrates: Limit simple carbohydrates, including table sugar, candy, cake, and regular soft drinks.
- Fiber: Eat 20 to 30 grams of fiber each day, from items such as bread, pasta, nuts, seeds, fruits and vegetables.
- Protein: Eat a good source of protein at least twice a day to help maintain strong respiratory muscles. Good choices include milk, eggs, cheese, meat, fish, poultry, nuts and dried beans or peas.
    - Weight Loss: Choose low-fat sources of protein such as lean meats and low-fat dairy products.
    - Weight Gain: Choose protein with a higher fat content, such as whole milk, whole milk cheese and yogurt.
- Fats: Choose mono- and poly-unsaturated fats, which do not contain cholesterol. These are fats that are often liquid at room temperature and come from plant sources, such as canola, safflower, and corn oils.
    - Weight Loss: Limit your intake of these fats.
    - Weight Gain: Add these types of fats to your meals.
    - Limit foods that contain trans fats and saturated fats. For example, butter, lard, fat and skin from meat, hydrogenated vegetable oils, shortening, fried foods, cookies, crackers, and pastries.
- Vitamins and minerals: Many people find taking a general-purpose multivitamin helpful. Often, people with COPD take steroids. Long-term use of steroids may increase the need for calcium. If one takes calcium supplements, they should include vitamin D. Calcium carbonate or calcium citrate are good sources of calcium. One should seek the advice of his/her doctor before adding any vitamins to his/her daily routine.
- Sodium: Too much sodium may cause edema (swelling) that may increase blood pressure. One can substitute spices and herbs in seasoning food to decrease sodium intake.
- Fluids: Drinking plenty of water is important not only to keep one hydrated, but also to help keep mucus thin for easier removal. A good goal for many people is 6 to 8 glasses (8 fluid ounces each) daily. Any healthy caffeine-free fluid counts toward one's fluid goal, and most foods contribute a substantial amount of fluid, as well.
- Using medical nutritional products: One may find it difficult to meet his/her nutritional needs with regular foods, especially if one needs a lot of calories every day. One's RDN or doctor may suggest drinking a liquid called a medical nutritional product (supplement). Some of these products can be

used as a complete diet by people who can't eat ordinary foods, or they can be added to regular meals by people who can't eat enough food.

- Diet Hints from the American Lung Association
    - Rest just before eating.
    - Eat more food early in the morning if you're usually too tired to eat later in the day.
    - Avoid foods that cause gas or bloating. They tend to make breathing more difficult.
    - Eat 4 to 6 small meals a day. This enables your diaphragm to move freely and lets your lungs fill with air and empty out more easily
    - If drinking liquids with meals makes you feel too full to eat, limit liquids with meals; drink an hour after meals.
    - Consider adding a nutritional supplement at night to avoid feeling full during the day.

Module II Lesson 6 Study #1

Chronic Obstructive Pulmonary Disease: A 2019 Evidence Analysis Center Evidence-Based Practice Guideline

Corrine Hanson, PhD, RD, Ellen K. Bowser, MS, RDN, LDN, RN, FAND, David C. Frankenfield, MS, RD, Tami A. Piemonte, MS, RDN, LD/N. The Academy Evidence Analysis Center. Volume 121, Issue 1, P139-165.E15, January 01, 2021. DOI:https://doi.org/10.1016/j.jand.2019.12.001

Read entire article here.

Background
Chronic obstructive pulmonary disease (COPD) is a progressive lung disorder in which patients are at high risk for both pulmonary and systemic complications of their disease. Medical nutrition therapy by a registered dietitian nutritionist can be an integral component of lifestyle treatment targeted at maintaining and improving outcomes, such as lung function, mortality, and quality of life.

Method
The Academy of Nutrition and Dietetics (Academy) convened an expert workgroup to conduct a systematic review to update the COPD Evidence-Based Nutrition Practice Guideline. This publication outlines the Academy's Evidence Analysis Library methods used to complete the systematic review and guideline and examines the recommendations and supporting evidence. A total of 14 recommendations were developed based on evidence from eight conclusions. Using the Nutrition Care Process as a framework for practice, recommendations rated as strong included assessing and monitoring and evaluating body weight and medical nutrition therapy by a registered dietitian nutritionist. Weak recommendations included predicting resting and total energy expenditure. All other recommendations were rated as fair. These included individualizing the calorie prescription and macronutrient composition of the diet; assessing and monitoring and evaluating energy intake, serum 25-hydroxyvitamin D levels, and frequency of exacerbations; and determining need for vitamin D supplementation. Fewer than one-third of the systematic review's conclusions could be used to support the recommendations due to conflicting results or limited or no evidence available.

Conclusion
The Evidence Analysis Library 2019 COPD Evidence-Based Nutrition Practice Guideline is a valuable resource for registered dietitian nutritionists and other health care professionals caring for those with COPD.

Module II Lesson 6 Study #2

The role of growth and nutrition in the early origins of spirometric restriction in adult life: a longitudinal, multicohort, population-based study.

Nipasiri Voraphani, Debra A Stern, Jing Zhai, Anne L Wright, Marilyn Halonen, Duane L Sherrill, Jenny Hallberg, Inger Kull, Anna Bergström, Clare S Murray, Lesley Lowe, Adnan Custovic, Wayne J Morgan, Fernando D Martinez, Erik Melén, Angela Simpson, Stefano Guerra. The Lancet Respiratory Medicine, 2022; 10 (1): 59 DOI: 10.1016/S2213-2600(21)00355-6

Read entire article here.

Background
Spirometric restriction, defined as a reduced forced vital capacity (FVC) with a preserved FEV1/FVC ratio, is associated with increased respiratory and non-respiratory comorbidities and all-cause mortality in adulthood. Little is known about the early origins of this condition. We sought to identify early-life risk factors for spirometric restriction in adult life.

Methods
In this longitudinal, multicohort, population-based study, we used data from the Tucson Children's Respiratory Study (TCRS), which recruited 1246 healthy infants at birth between April 1980, and October 1984, in Tucson, AZ, USA. Questionnaires were answered by the primary caregiver at enrolment, immediately after the child's birth, and multiple follow-up questionnaires were completed through childhood and adulthood. At the age of 22, 26, 32, and 36 years, lung function was measured with spirometry. At each survey, three mutually exclusive spirometric patterns were defined: (1) normal (FEV1/FVC ≥10th percentile and FVC ≥10th percentile); (2) restrictive (FEV1/FVC ≥10th percentile and FVC <10th percentile); and (3) obstructive (FEV1/FVC <10th percentile, independent of FVC). Data on demographic features and parental health factors were collected from questionnaires; pregnancy and perinatal data (including nutritional problems) and birth measurements were obtained from medical records; and weight, height, and body-mass index (BMI) during childhood (age 6–16 years) were measured by study nurses. The associations between early-life risk factors and spirometric patterns were assessed by multivariate multinomial logistic regression analysis, adjusted for survey year, sex, and race–ethnicity. Significant risk factors were further tested for replication in the Swedish Child (Barn), Allergy, Milieu, Stockholm, Epidemiological (BAMSE; n=1817; spirometry surveys were done at age 24 years) survey and the UK Manchester Asthma and Allergy Study (MAAS; n=411; spirometry surveys were done at age 18 years) birth cohorts, and fixed-effect meta-analyses of relative risk ratios (RRRs) from multinomial logistic regression models were done to generate a pooled estimate of the effect across the three cohorts. Measurements of body composition (MAAS; n=365) and total lung capacity (TCRS; n=173 and MAAS; n=407) were also available for a subset of participants.

Results

Of 1246 healthy infants included in TCRS, for the present study we included data for 652 participants who had at least one set of spirometry data, contributing up to 1668 observations. In the TCRS cohort, results from the multivariate models showed that maternal nutritional problems during pregnancy (RRR 2·48 [95% CI 1·30–4·76]; p=0·0062), being born small for gestational age (birthweight <10th percentile; 3·26 [1·34–7·93]; p=0·0093), and being underweight in childhood (BMI-for-age <5th percentile; 3·54 [1·35–9·26]; p=0·010) were independent predictors of spirometric restriction in adult life. Associations between being small for gestational age (p=0·0028) and underweight in childhood (p<0·0001) with adult spirometric restriction were supported by the results of meta-analysis of data from all three cohorts. In the MAAS cohort, having a low lean BMI (ie, <10th percentile) at age 11 years predicted adult (age 18 years) spirometric restriction (RRR 3·66 [1·48–9·02]; p=0·0048). These associations of spirometric restriction with small for gestational age, childhood underweight, and low lean BMI in childhood were verified in participants with spirometric restriction who had diminished total lung capacity, indicating that these factors specifically increase the risk of lung restriction.

Conclusion

Poor growth and nutritional deficits in utero and throughout childhood precede and predict the development of spirometric restriction in adult life. Strategies to improve prenatal and childhood growth trajectories could help to prevent spirometric restriction and its associated morbidity and mortality burden.

Module II Lesson 6 Study #3

Role of Diet in Chronic Obstructive Pulmonary Disease Prevention and Treatment
Scoditti, Egeria et al. "Role of Diet in Chronic Obstructive Pulmonary Disease Prevention and Treatment." Nutrients vol. 11,6 1357. 16 Jun. 2019, doi:10.3390/nu11061357

Read entire article here.

Background
Chronic obstructive pulmonary disease is one of the leading causes of morbidity and mortality worldwide and a growing healthcare problem. Identification of modifiable risk factors for prevention and treatment of COPD is urgent, and the scientific community has begun to pay close attention to diet as an integral part of COPD management, from prevention to treatment. This review summarizes the evidence from observational and clinical studies regarding the impact of nutrients and dietary patterns on lung function and COPD development, progression, and outcomes, with highlights on potential mechanisms of action. Several dietary options can be considered in terms of COPD prevention and/or progression. Although definitive data are lacking, the available scientific evidence indicates that some foods and nutrients, especially those nutraceuticals endowed with antioxidant and anti-inflammatory properties and when consumed in combinations in the form of balanced dietary patterns, are associated with better pulmonary function, less lung function decline, and reduced risk of COPD. Knowledge of dietary influences on COPD may provide health professionals with an evidence-based lifestyle approach to better counsel patients toward improved pulmonary health.

Module II Lesson 6 Study #4

Nutrition and Respiratory Health—Feature Review

Berthon, Bronwyn S, and Lisa G Wood. "Nutrition and respiratory health--feature review." Nutrients vol. 7,3 1618-43. 5 Mar. 2015, doi:10.3390/nu7031618

[Read entire article here.]

Abstract

Diet and nutrition may be important modifiable risk factors for the development, progression and management of obstructive lung diseases such as asthma and chronic obstructive pulmonary disease (COPD). This review examines the relationship between dietary patterns, nutrient intake and weight status in obstructive lung diseases, at different life stages, from in-utero influences through childhood and into adulthood. In vitro and animal studies suggest important roles for various nutrients, some of which are supported by epidemiological studies. However, few well-designed human intervention trials are available to definitively assess the efficacy of different approaches to nutritional management of respiratory diseases. Evidence for the impact of higher intakes of fruit and vegetables is amongst the strongest, yet other dietary nutrients and dietary patterns require evidence from human clinical studies before conclusions can be made about their effectiveness.

Dietary Patterns

- Mediterranean Dietary Pattern: The Mediterranean diet has been found to have protective effects for allergic respiratory diseases in epidemiological studies.
- "Western" Dietary Pattern
    - Children: The "western" dietary pattern, prevalent in developed countries, is characterized by high consumption of refined grains, cured and red meats, desserts and sweets, french fries, and high-fat dairy products. This pattern of intake has been associated with increased risk of asthma in children. Furthermore, in children, increased intake of fast food such as hamburgers and related eating behaviors, for example salty snack eating and frequent take away consumption, are correlated with the presence of asthma, wheezing and airway hyperresponsiveness (AHR).
    - Adults: In adults, a western diet has been shown to be positively associated with increased frequency of asthma exacerbation, but not related to asthma risk. In addition, an acute challenge with a high fat fast food meal has been shown to worsen airway inflammation.

Foods that are Beneficial in Association with Respiratory Disease

- Fruits and Vegetables: antioxidants, vitamins, minerals, fiber and phytochemicals
- Omega-3 Fatty Acids and Fish: Omega-3 polyunsaturated fatty acids (PUFA) from marine sources and supplements have been shown to be anti-inflammatory through several cellular mechanisms including their incorporation into cellular membranes and resulting altered synthesis of eicosanoids.

Nutrients and Respiratory Disease

- Antioxidants and Oxidative Stress: Dietary antioxidants are an important dietary factor in protecting against the damaging effects of oxidative stress in the airways, a characteristic of respiratory diseases.
- Vitamin C: Vitamin C has been enthusiastically investigated for benefits in asthma and links to asthma prevention. In vitro data from endothelial cell lines showed that vitamin C could inhibit NF-

κB activation by IL-1, TNF-α and block production of IL-8 via mechanisms not dependent on the antioxidant activity of vitamin C.

- Vitamin E: The vitamin E family comprises of 4 tocopherols and 4 tocotrienols, with the most plentiful in the diet or in tissues being α-tocopherol and γ-tocopherol [70]. Vitamin E works synergistically with vitamin C, as following neutralization of ROS, oxidized vitamin E isoforms can be processed back into their reduced form by vitamin C.
- Flavonoids: Flavonoids are potent antioxidants and have anti-inflammatory as well as anti-allergic actions due in part, to their ability to neutralize ROS. There are 6 classes of flavonoids including flavones, flavanols, flavanones, isoflavones and flavanols, which are widely distributed throughout the diet and found in fruit, vegetables, nuts, seeds, stems, flowers, roots, bark, dark chocolate, tea, wine and coffee.
- Vitamin D: Epidemiological studies show promising associations between vitamin D and lung health; however, the mechanisms responsible for these effects are poorly understood. Vitamin D can be obtained from dietary sources or supplementation; however, sun exposure is the main contributor to vitamin D levels.
- Minerals: Some minerals have also been found to be protective in respiratory conditions. In children, increased intake of magnesium, calcium and potassium is inversely related to asthma prevalence.

Obesity, Adipokines and Respiratory Disease

Overnutrition and resulting obesity are clearly linked with asthma, though the mechanisms involved are still under investigation. COPD is characterized not only by pulmonary deficits but also by chronic systemic inflammation and co-morbidities which may develop in response to the metabolic dysregulation that occurs with excess adipose tissue.

Undernutrition and Respiratory Disease

Though underweight has not been well studied in asthma, an observational study in Japan reported that subjects with asthma who were underweight had poorer asthma control than their normal weight counterparts. While there is widespread acknowledgement that malnutrition in pregnant women adversely effects of the lung development of the fetus, a recent review reported that the offspring of mothers who were underweight did not have an increased risk of asthma. Amongst the obstructive lung diseases, undernutrition is most commonly recognized as a feature of COPD.

Conclusion

Dietary intake appears to be important in both the development and management of respiratory diseases, shown through epidemiological and cross-sectional studies and supported by mechanistic studies in animal models. Although more evidence is needed from intervention studies in humans, there is a clear link for some nutrients and dietary patterns.

The dietary patterns associated with benefits in respiratory diseases include high fruit and vegetable intake, Mediterranean style diet, fish, and omega-3 intake, while fast food intake and westernized dietary patterns have adverse associations. Figure 1 shows a diagrammatic representation of the relationships of nutrition and obstructive lung diseases.

Though antioxidants are associated with positive effects on inflammation, clinical outcomes and respiratory disease prevention, intervention studies of individual antioxidants do not indicate widespread adoption of supplementation [196]. Differences in results from individual studies including whole foods such as fruit and vegetables and fish could be influenced by the nutritional profile owing to the region it was grown or produced. In considering studies using single nutrients it is also important to acknowledge that nutrients in the diet are consumed as whole foods that contain other micronutrients, fiber and compounds with both known and unknown anti and pro-inflammatory potential. Furthermore, investigations of single nutrients should ideally control for other antioxidants and dietary sources of pro-inflammatory nutrients. While this limitation is common, it is a significant challenge to control for dietary intake of other nutrients in clinical trials. A whole foods approach to nutrient supplementation—for example, increasing intake of fruit and vegetables, has the benefit of increasing intake of multiple nutrients, including vitamin C, vitamin E, carotenoids and flavonoids and shows more promise in respiratory diseases in terms of reducing risk of COPD [3] and incidence of asthma exacerbations [25].

The evidence for mechanisms of vitamin D in lung development and immune function are yet to be fully established. It appears that vitamin D is important in respiratory diseases and infections, however the temporal role of vitamin D deficiency in disease onset, pathogenesis, and exacerbations and whether supplementation is indicated is yet to be clarified.

Overnutrition in respiratory disease is clearly associated with adverse effects, highlighted by detrimental effects induced by immunometabolism. Further understanding of the relationship between mediators of immunometabolism and respiratory diseases and their mechanisms may provide therapeutic options. Undernutrition still poses risk in some respiratory conditions. Appropriate nutritional supplementation in advanced COPD is indicated, and several nutrients appear to be beneficial in COPD development and exacerbation.

The field of nutrition and respiratory disease continues to develop and expand, though further work is required in the form of randomized controlled dietary manipulation studies using whole foods to enable provision of evidence-based recommendations for managing respiratory conditions.

Take Module II Lesson 6 Quiz

Below are a series of questions designed to help you remember the course material efficiently. Before proceeding to the next page of the course content, please answer the following review questions.

1. What nutritional guideline did the USDA and the U.S. Department of Health and Human Services develop to help individuals select healthy foods and healthy amounts?
2. List 5 tips to a great plate.
3. What is a healthy body fat percentage for a male and female?
4. If one needs to lose weight, at what rate is healthy and is more likely to be more permanent?
5. List 3 mealtime tips to help one maintain a healthy body weight.
6. What is GERD and how should one manage it?
7. What are the implications of taking steroids as it pertains to diet?

Module III: Business

- Lesson One: Specialization to Expand and Monetize Your Heath/Fitness Career
- Lesson Two: Strategies to Market your RD Fitness Specialist Business
- Lesson Three: How to Network and Formulate Local and National Relationships to Expand your Reach

Lesson One

Specialization to Expand and Monetize Your Heath/Fitness Career

Why the RD Fitness Specialist Course?

- According to the World Health Organization (WHO), hundreds of millions of people suffer every day from chronic respiratory diseases (CRD).
- Currently in the United States
    - 24.6 million people have asthma
    - 15.7 million people have chronic obstructive pulmonary disease (COPD)
    - Greater than 50 million people have allergic rhinitis and other often-underdiagnosed chronic respiratory diseases.
- Respiratory diseases do not discriminate and affect people of every race, sex, and age.
- The RD community is in desperate need of QUALIFIED trainers who know how to create a proper fitness program for them.
- Every day requests are received for RD qualified trainers.
- To be successful as a trainer you have to specialize in areas that separate you from the crowded landscape of the industry.
- By becoming an RD Fitness Specialist, you become part of a well-respected worldwide organization: MedFit Network.

The Importance of Continuing Education

- Career Expansion
- Brand Marketability and Image
- Referral Systems and Collaborations
- Maintaining Relevancy
- Increases Personal Development
- Increases Salary-More Valuable

Steps of an Entrepreneur

- It's not enough to be a trainer to be successful at being a trainer. You MUST develop yourself into an entrepreneur.
- So, how do you do that?!
    - Stop thinking like a trainer!
    - Start thinking like a business owner.
- Write down your goals for your training business.
- How do you believe you can reach those goals?
- You MUST have a plan of action.
- Running a successful business does NOT happen by accident.
- Steps to success.
    - Decide who your market is. In this case it's RD clients.
    - What is the offer you are giving this client base?
    - Why should these clients come to you? (Credentials/experience, personality, heart)
    - Plan a strategy on how to reach that market.
    - Implement that strategy: social media, local RD community, RD organizations, and personal contacts.
    - Stay relevant.

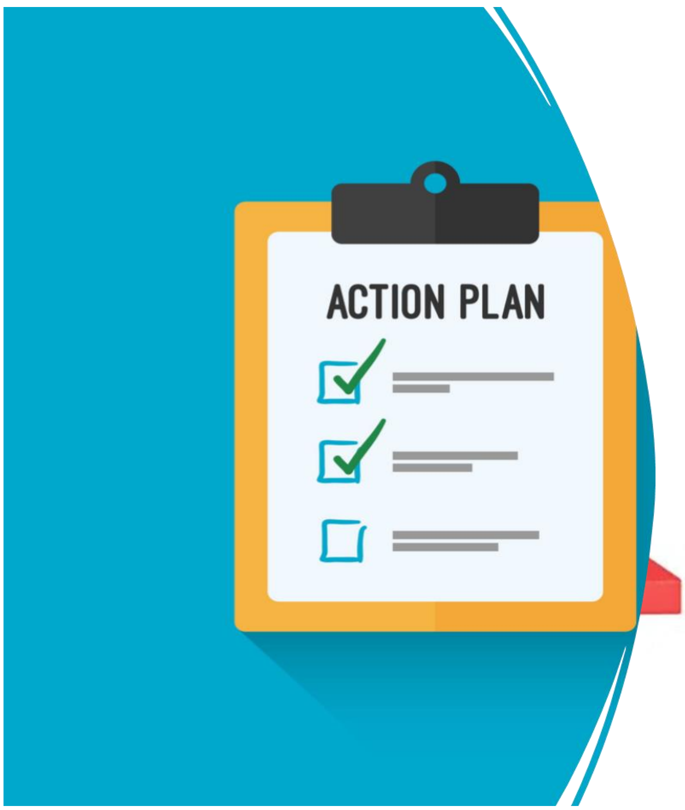
The Business

- Name of Business
- Taxes
    - W-2
    - 1099
- Set Up Corporation (Corp, C-Corp, S-Corp, LLC)
- EIN Number
- Professional Liability Insurance
- Waiver/Informed Consent
- Marketing
    - Warm Market: Social Media, Blogs, Workshops
    - Gym
    - Allied Health Professionals

Complete Module III Lesson 1 Action Plan

Before proceeding to the next page of the course content, please complete the below action plan.

1. List what education you need to elevate to RD Fitness Specialist.
2. List 3 Goals to achieve in the next year to serve the RD community.
3. Type of RD Training?
4. W-2
5. 1099 (Sub-Contract)
6. Business/Self-Employed-Name the Business



Lesson Two

Strategies to Market your RD Fitness Specialist Business

Website/Email

- Your website is part of your calling card online combined with FB, Twitter, Instagram, etc.
- Websites must look professionally created.
- Tell YOUR story and add a section dedicated specifically for the RD community.
- If you have experience with RD and RD clients, post that on your website. Show what you DO know and what you HAVE done.
- Make sure you have your RD Fitness Specialist credentials and your affiliation with MedFit Network in your email signature.
- You want people to see what education and affiliations you have without them having to ask. Impress people!

Social Media

- Social media is KEY in the success or failure of your training business.
- There are now many ways to get yourself and your expertise in front of a worldwide audience through FB, Twitter, Instagram, LinkedIn, TikTok, etc.
- BUT…the posts should be targeted to what you want to say, what you want to offer and to who you are offering your services.
- Ask yourself:
    - Who do I want to reach?
    - What do I want this market to know about me?
    - What am I offering them?
- You can NOT expect a "shotgun" approach to social media marketing to be successful.
- Join a social media platform that reaches your target audience. Don't reinvent the wheel!

Blogging/Vlogging

- Definition: Blogging first started as a way to have an online personal web log, in which a person would journal about their day. From "web log" came the term "blog."
- Blog Vs. Websites
    - Blogs are updated frequently
    - Blogs allow for reader engagement
- Why Blogging is So Popular
    - Search engines love new content
    - Blogging provides an easy way to keep your customers and clients up-to-date
    - A blog allows you to build trust and rapport with your prospects
    - Blogging is flexible and portable
- Starting a Blog
    - Setting up the Blog
    - Add Content
    - Market
    - Add Income Streams
- Platforms
    - Square Space
    - Wix*
    - Go Daddy
    - Word Press*
    - Vista Print
    - Constant Contact
    - Blogger*
    - Ghost

*FREE

Webinars

- Permanent Benefits
  - Generate Content
  - Engaging Audience
- Generate Leads
- Build cumulative brand value, directly to RD audience
- Cost Effective
- Purpose is Teaching NOT Presentation
- Platforms
  - FB Live
  - Zoom
  - SambaLive
  - Go To Webinar
  - GlobalMeet

Complete Module III Lesson 2 Action Plan

Before proceeding to the next page of the course content, please complete the below action plan.

1. What platform will you use to build a website?
2. What Social Media will I use?
3. Will I blog and what platform will I use?
4. Will I educate on RD doing webinars? Platform?

Lesson Three

How to Network and Formulate Local and National Relationships to Expand your Reach

Work with Local RD Organizations to Build Client Base

- If you want to be successful as an RD Specialist, your local RD community MUST know you are there.
- Get connected to the local RD groups and organizations.
- Reach out and initially give NO COST programs under the group or organization so you win their confidence in you and your ability to work with the RD community.

Work With Local Allied Health Professionals

- It's important for the local pulmonary therapists, chiropractors, RD clinics, hospitals and other health professionals and practices to know you are an RD qualified trainer.
- Business cards and brochures are must have tools.
- Create an RD specific brochure that mimics your RD page on your website.
- Offer a NO COST "seminar" on the importance of fitness in managing RD.
- Once you develop the connection, you can ask to be listed on the health professional website as their go-to RD trainer.
- You should put the time into these relationships. You can have hundreds-thousands of clients referred to you as an RD trainer. Use your website as a resource and your FB group as a platform for RD fitness education because of relationships.

Offer Community Workshops

- Develop a RD fitness workshop that you can bring to the community under your brand.
- Facilitate a 12 Week Challenge and/or Training Camp.

Guest Blogging to increase SEO

- Guest blogging, also called "guest posting," is the act of writing content for another company's website. Generally, guest bloggers write for similar blogs within their industry in order to:
    - Attract traffic back to their website
    - Boost their domain authority using external links to high-authority domains
    - Increase their brand credibility and awareness
    - Build relationships with peers in their industry
    - Establish you as the expert and authority on RD
    - Featuring guest bloggers gives you fresh content and new perspective.
    - Increases SEO

MFN Relationship

- The MFN will help make connections.
- After the exam is passed and the MFN public profile page is 100% completed, connections will be made.
- MFN will spotlight you on social media and feature/promote you to RD community in a 20-mile radius of your zip code (once exam is passed and public profile 100% complete).
- Video on the benefits of being an MFN member & how to set your profile page.

Complete Module III Lesson 3 Action Plan

Before proceeding to the next page of the course content, please complete the below action plan.

1. Become an RD Fitness Specialist.
2. Get Connected with local RD Organization.
3. Get Connected with One FB RD Group.
4. Develop One Allied Health Professional Relationship.

Conclusion

Chronic respiratory disease rehabilitation requires an active partnership. Taking medicine, staying active, eating healthy and working with one's doctor and PR team are important. One is more successful in his PR program if he/she has support. Support can come in a variety of forms. Family is often a support group. Spouse, adult children, siblings or other relatives can help meet the demands of one's rehabilitation program on a daily basis. Other support groups include friends, people with chronic lung disease, people with whom a hobby is shared, church groups and clergy, neighbors, volunteer organizations and even a pet. One should not be embarrassed or afraid to ask people for help when needed.

Fitness professionals can effectively work with those who have a chronic respiratory disease providing them with a better quality of life through movement. You as their health and fitness coach can provide a positive experience to facilitate an effective path to better health and wellness.

Respiratory Disease Fitness Specialist Evaluation Checklist

As a health and fitness professional working with clients with chronic respiratory disease, it is imperative that he/she master the skills below and have a working knowledge of the fundamentals, principles, anatomy, and exercise programming for clients with CRD. Take a moment and check off the skills that you have mastered and make notes and adjustments to the ones upon which you need improvement.

Respiratory Anatomy and Physiology	
Conducting Zone	
Respiratory Zone	
Respiratory Disease Epidemiology	
Respiratory Terms	
Respiratory Diseases	
Signs and Symptoms	
Causes	
Risk Factors	
Treatment	
Prevention	
Respiratory Categories	
Obstructive v. Restrictive Respiratory Diseases	
Exercise and Respiratory Disease	
Benefits of Exercise	
Timing of Exercise Initiation	
Exercise Limitations	
6 Key Components of Respiratory Disease Exercise	
Lung Capacity: Proper Technique of Breathing Exercises Presented	
Cardiorespiratory Fitness: Proper Technique of Cardio Exercises Presented	
Muscular Strength: Proper Technique of Strength Exercises Presented	
Core Stability and Control: Proper Technique of Core Exercises Presented	
Posture: Obtain Working Knowledge of Correcting Poor Posture	
Flexibility: Proper Technique of Stretches Presented	
FITT Principle	
The Science of Healthy Breathing	
Scope of Practice of the Health and Fitness Professional	
Screening and Assessments	
Goal Profile	
Program Design	
Nutrition and Healthy Weight Management	

Specialization to Expand and Monetize Your Heath/Fitness Career	
Strategies to Market your RD Fitness Specialist Business	
How to Network and Formulate Local and National Relationships to Expand your Reach	

Appendix A

PAR-Q Form

Data Collection Sheet

NAME:____DATE:________________
HEIGHT:____________in.   WEIGHT:__________________lbs.   AGE:_______________
PHYSICIANS NAME:_______________________________ PHONE:___________________

PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)

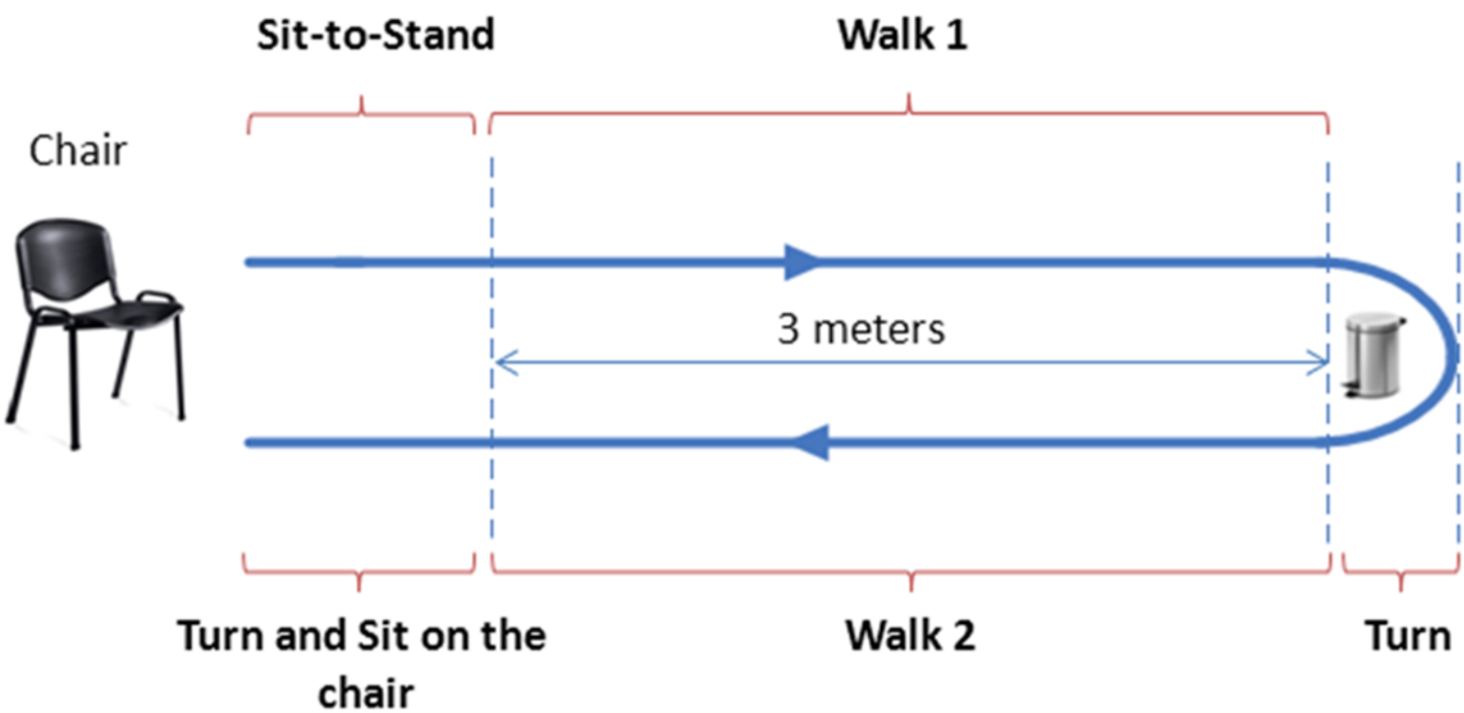
Questions	**YES**	**NO**
1. Has your doctor ever said that you have a heart condition and that you should only perform physical activity recommended by a doctor?		
2. Do you feel pain in your chest when you perform physical activity?		
3. In the past month, have you had chest pain when you were not performing any physical activity?		
4. Do you lose your balance because of dizziness or do you ever lose consciousness?		
5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?		
6. Is your doctor currently prescribing any medication for your blood pressure or for a heart condition?		
7. Do you know of any other reason why you should not engage in physical activity?		

If you have answered “Yes” to one or more of the above questions, consult your physician before engaging in physical activity. Tell your physician which questions you answered “Yes” to. After a medical evaluation, seek advice from your physician on what type of activity is suitable for your current condition.

Appendix B
TUG Test

TUG Test: The Timed Up and Go Test

- Measures Functional Performance
- Measure Off 3 Meters
- Poorer Health: Results >11 Seconds



Appendix C

Muscular Strength: Lower Body

30 Second Sit to Stand Test (30CST): The 30CST is a measurement that assesses functional lower extremity strength in older adults, but is also used in assessing functional strength in those with RD. It is part of the Fullerton Functional Fitness Test Battery. This test assesses balance, functional mobility, as well as lower body strength.

Chair height: 17” (43 cm), placed against wall for stability.

Starting position: sitting in the middle of the chair, back straight, arms crossed over chest, feet flat on floor.

1. Take resting vital signs.
2. Demonstrate the movement, first slowly, then quickly.
3. Have the patient/client practice one or two repetitions to ensure proper form, and adequate balance.
4. On the signal “go” the patient/client rises to a full stand, then returns to a fully seated position, as many times as possible in 30 seconds.
5. If a person is more than halfway up at the end of the 30 seconds, count it as a full stand.
6. One trial.
7. Take post exercise vital signs.
8. Document any modifications (chair height, assistance needed)

Scores less than 8 (unassisted) stands are associated with lower levels of functional ability.

AGE	MEN: # of Stands	WOMEN: # of Stands
60-64	14-19	12-17
65-69	12-18	11-16
70-74	12-17	10-15
75-79	11-17	10-15
80-84	10-15	9-14
85-89	8-14	8-13
90+	7-12	4-11

Rikli RE, Jones CJ (1999). Functional fitness normative scores for community residing older adults ages 60-94. Journal of Aging and Physical Activity, 7, 160-179.

Appendix D

Muscular Strength: Upper Body

The Arm Curl Test: This test measures upper body strength and endurance through lifting a weight for 30 seconds. Typically, women will lift 4-5 lbs. and men will lift 8 lbs. It is part of the Senior Fitness Test (SFT) and the AAHPERD Functional Fitness Test designed to test the functional fitness of seniors. This test is also used for subjects or clients with RD. There are slight differences between the protocols for the Senior and AAHPERD tests, such as the weight used for women. The differences are indicated below.

- **Purpose:** This test measures upper body strength and endurance.
- **Equipment required:** 4-pound weight (women, AAHPERD), 5-pound weight (women, SFT), 8-pound weight (for men). A chair without armrests, stopwatch.
- **Pre-test:** Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender, test conditions. Ensure that the subjects are adequately warmed-up
- **Procedure:** The aim of this test is to do as many arm curls as possible in 30 seconds. This test is conducted on the dominant arm side (or stronger side). The subject sits on the chair, holding the weight in the hand using a suitcase grip (palm facing towards the body) with the arm in a vertically down position beside the chair. Brace the upper arm against the body so that only the lower arm is moving (tester may assist to hold the upper arm steady). Curl the arm up through a full range of motion, gradually turning the palm up (flexion with supination). As the arm is lowered through the full range of motion, gradually return to the starting position. The arm must be fully bent and then fully straightened at the elbow. The protocol for the AAHPERD test describes the administrator's hand being placed on the biceps, and the lower arm must touch the tester's hand for a full bicep curl to be counted. Repeat this action as many times as possible within 30 seconds.
- **Target population:** the aged population which may not be able to do traditional fitness tests.
- **Comments:** It's important that the upper arm is stable throughout the test, and doesn't swing.
- **Scoring:** The score is the total number of controlled arm curls performed in 30 seconds. Below is a table showing some recommended ranges for this test based on age groups (from Jones & Rikli, 2002).

Men’s Results

AGE	**BELOW AVERAGE**	**AVERAGE**	**ABOVE AVERAGE**
60-64	<16	16-22	>22
65-69	<15	15-21	>21
70-74	<14	14-21	>21
75-79	<13	13-19	>19
80-84	<13	13-19	>19
85-89	<11	11-17	>17
90+	<10	10-14	>14

Women’s Results

AGE	**BELOW AVERAGE**	**AVERAGE**	**ABOVE AVERAGE**
60-64	<13	13-19	>19
65-69	<12	12-18	>18
70-74	<12	12-17	>17
75-79	<11	11-17	>17
80-84	<10	10-16	>16
85-89	<10	10-15	>15
90+	<8	8-13	>13

Appendix E
6-Minute Walk Test (6MWT)

According to ATS guidelines, a 30 m distance course is recommended. Turnaround points should be identified. Three-meter interval measurements are marked with colored tape on the floor. Shorter corridor lengths may increase the 6 MWD due to more frequent turns involved.

Required equipment
1. Stopwatch or timer
2. Two small cones to mark the lap boundaries
3. Measurement scale for floor measurement
4. Mechanical lap counter
5. Resuscitation equipment

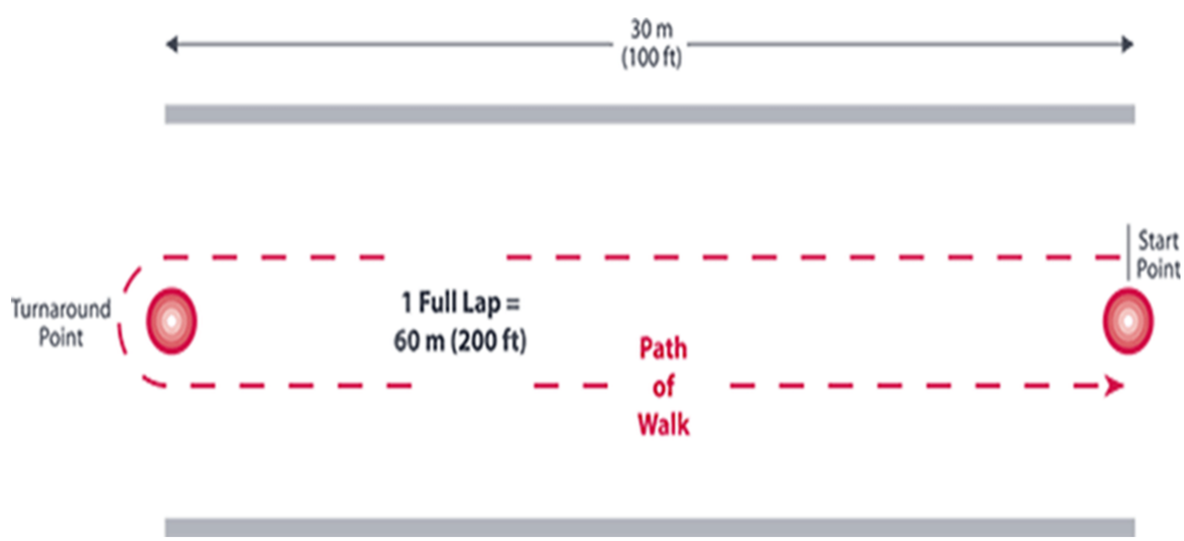
The 6 MWT is performed on a walking track in a facility. The track has been marked at 3-m intervals so that accurate measurement of the walking distance can be performed. Chairs are available at 30-m intervals in case the patients become so symptomatic that they have to stop and sit.

Client Preparation
1. Comfortable clothing should be worn
2. Environment temperature should be ambient
3. Shoes should be comfortable and any walking aids that the patient ordinarily uses should be used
4. Light meals are acceptable before morning and afternoon tests

Technique
1. Don't perform a warmup before the test.
2. The subject should rest comfortably for 10 minutes prior to the test. During this time blood pressure and heart rate should be measured and potential contraindications assessed.
3. Before the test starts, the subject should stand up and rate his/her dyspnea and fatigue. The Borg scale may be used for this.
4. Set the lap counter to zero and timer to 6 minutes. Assemble all necessary equipment and move to starting point.
5. The tester may walk a lap to demonstrate performance of the test to the client. During the test the tester should never walk with or in front of the subject as the subject may try to match the tester's pace. The tester may walk behind the subject to support him/her in case of staggering or to prevent falling. The subject is allowed to rest during the test if he/she gets fatigued.
6. Use standardized phrases and an even tone for encouragement at completion of each minute of the test. For an example of a standardized script, the reader is referred to the 2002 ATS guidelines. It is recommended to give standardized encouragement every 30 seconds using phrases "keep up the good work" or "you are doing fine".
7. Resting during the test is allowed, but don't stop the clock. If the subject cannot go any further, the test should be stopped and distance covered recorded.
8. Stop the test if patient develops chest pain, intolerable dyspnea, staggering, diaphoresis, intolerable cramps, and/or ashen appearance. Test supervisors should be trained to provide appropriate care at this point.
9. At the conclusion of the test, ask the subject to rate his/her dyspnea and fatigue levels. Record the reason for stopping the test.

Norms: The six-minute walk distance in healthy adults has been reported to range from 400m to 700m. Age and sex-specific reference standards are available and may be helpful for interpreting 6MWT scores for both healthy adults and those with chronic diseases such as RD. However, it is difficult to use normative values because of the differing methods used in studies. An improvement of 54m has been shown to be a clinically important difference.

6 Minute Walk Test		
Age	Distance Covered by Women in Meters	Distance Covered by Men in Meters
60-64	498-603	558-673
65-79	457-580	512-640
70-74	439-571	498-622
75-79	398-535	430-585
80-84	352-454	407-553
85+	311-466	347-521



Appendix F

Flexibility: Chair Sit and Reach

Purpose

This test measures lower body flexibility, especially the hamstrings. It is associated with the lifestyle tasks of movement in and out of a vehicle, walking and climbing stairs, and also with a person's gait and posture.

Equipment Required

- ruler or tape measure
- straight back or folding chair (about 44 cm high)

Procedure

- Sit on the edge of the chair (placed against a wall for safety). One foot must remain flat on the floor. The other leg is extended forward with the knee straight, heel on the floor, and ankle bent at 90°.
- Place one hand on top of the other with tips of the middle fingers flush.
- Inhale, and then as you exhale, slowly reach forward toward the toes by bending at the hip. Keep the back straight and head up. Avoid bouncing or quick movements, and never stretch to the point of pain.
- Keep the knee straight and hold the reach for 2 seconds. If your knee bends, straighten your leg and start again.
- The distance is measured between the tips of the fingertips and the toes. If the fingertips touch the toes, then the score is zero. If they do not touch, measure the distance between the fingers and the toes (a negative score), if they overlap, measure by how much (a positive score).
- Record the measurement to the nearest ½ inch or 1 cm and which leg you performed the test.
- Repeat the test 2 times on each leg.

Contraindications: This test should not be done if you have severe osteoporosis.

WOMEN	**Age**	**below average**	**average (inches)**	**above average**
	60-64	< -0.5	-0.5 to 5.0	> 5.0
	65-69	< -0.5	-0.5 to 4.5	> 4.5
	70-74	< -1.0	-1.0 to 4.0	> 4.0
	75-79	< -1.5	-1.5 to 3.5	> 3.5
	80-84	< -2.0	-2.0 to 3.0	> 3.0
	85-89	< -2.5	-2.5 to 2.5	> 2.5
	90-94	< -4.5	-4.5 to 1.0	> 1.0

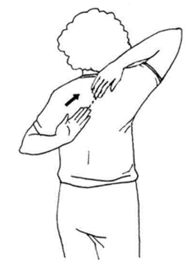
MEN	**Age**	**below average**	**average (inches)**	**above average**
	60-64	< -2.5	-2.5 to 4.0	> 4.0
	65-69	< -3.0	-3.0 to 3.0	> 3.0
	70-74	< -3.5	-3.5 to 2.5	> 2.5
	75-79	< -4.0	-4.0 to 2.0	> 2.0
	80-84	< -5.5	-5.5 to 1.5	> 1.5
	85-89	< -5.5	-5.5 to 0.5	> 0.5
	90-94	< -6.5	-6.5 to -0.5	> -0.5

Appendix G

Flexibility: Back Scratch Test

Purpose

The Back Scratch Test measures how close the hands can be brought together behind the back, so provides an indication of the general shoulder range of motion, and the upper body and shoulder flexibility. It is associated with lifestyle activities such as getting dressed, reaching for objects and putting on a car seat belt.



Required equipment

• ruler or a yardstick or a tape measure

Procedure

• Perform this test in the standing position.
• Place one hand behind the head and back over the shoulder, and reach as far as possible down the middle of your back, your palm touching your body and the fingers pointing downwards.
• Place the other arm behind your back, palm facing outward and fingers pointing upward and reach up as far as possible, attempting to touch or overlap the middle fingers of both hands.
• An assistant is required to direct you so that the fingers are aligned, and to measure the distance between the tips of the middle fingers.
• If the fingertips touch then the score is zero. If they do not touch, the assistant should measure the distance between the finger tips (a negative score), if they overlap, then measure by how much (a positive score). Practice two times with the arms in opposite positions to determine the preferred side for reaching over the shoulder, and then test two times. Record the best score to the nearest 1/2 inch.

Safety Issues

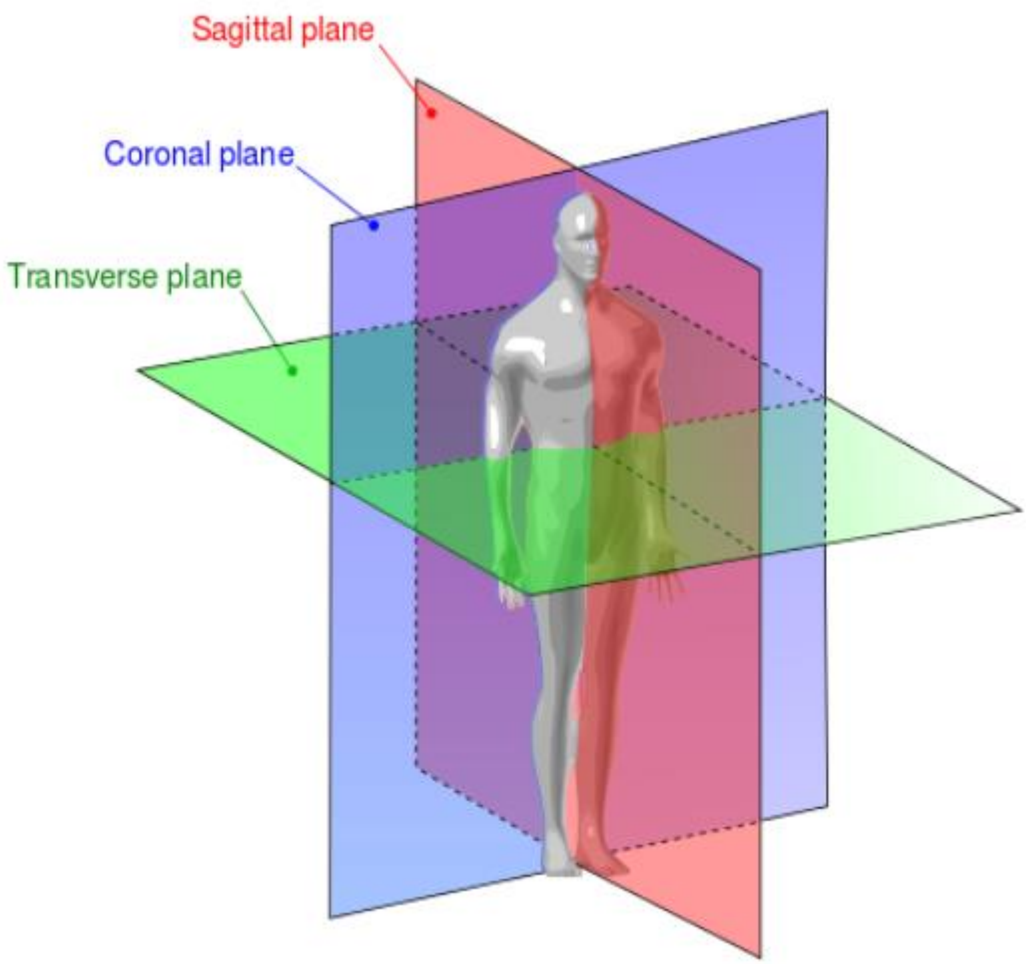
Stop the test if you experience pain.

MEN	Age	below average	normal (inches)	above average
	60-64	< -6.5	-6.5 to 0	> 0
	65-69	< -7.5	-7.5 to -1.0	> -1.0
	70-74	< -8.0	-8.0 to -1.0	> -1.0
	75-79	< -9.0	-9.0 to -2.0	> -2.0
	80-84	< -9.5	-9.5 to -2.0	> -2.0
	85-89	< -10.0	-10.0 to -3.0	> -3.0
	90-94	< -10.5	-10.5 to -4.0	> -4.0

WOMEN	Age	below average	normal (inches)	above average
	60-64	< -3.0	-3.0 to 1.5	> 1.5
	65-69	< -3.5	-3.5 to 1.5	> 1.5
	70-74	< -4.0	-4.0 to 1.0	> 1.0
	75-79	< -5.0	-5.0 to 0.5	> 0.5
	80-84	< -5.5	-5.5 to 0	> 0
	85-89	< -7.0	-7.0 to -1.0	> -1.0
	90-94	< -8.0	-8.0 to -1.0	> -1.0

Appendix H

Planes of Movement



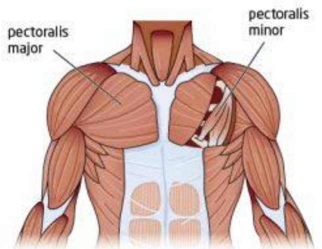
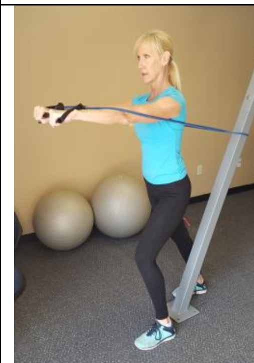
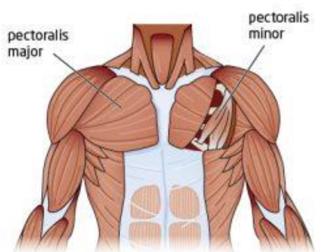
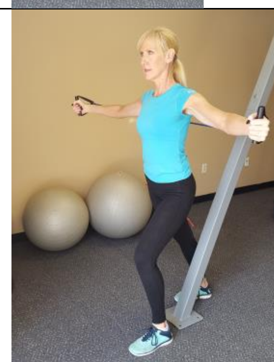
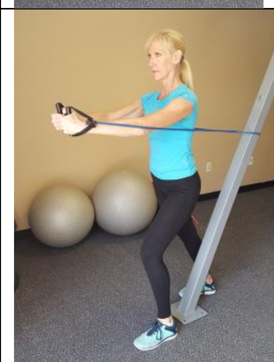
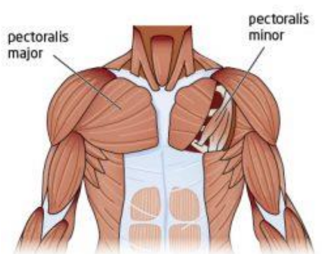
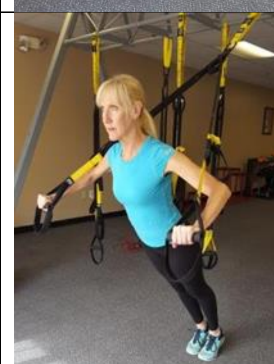
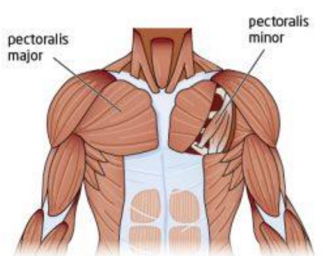
Planes of Movement: Imaginary lines that dissect the body into sections or planes. Movement occurs parallel to the plane of movement. The point at which all planes of movement intersect dictates one's center of gravity and balance.

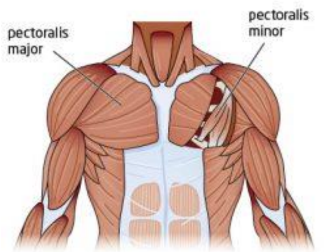
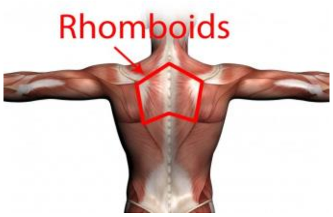
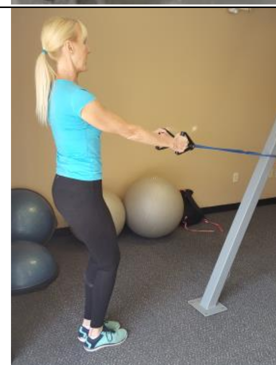
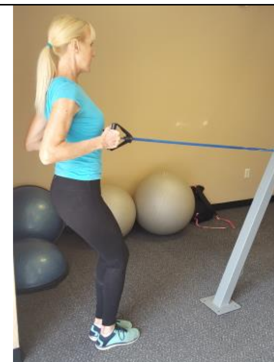
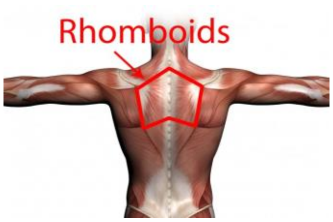
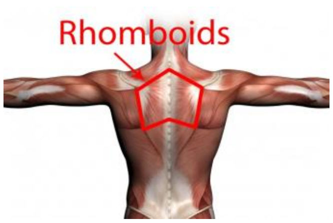
- Coronal or Frontal Plane: Front and Back Sides
    - Example Movement: Jumping Jacks
- Sagittal Plane: Left and Right Sides
    - Example Movement: Running
- Transverse Plane: Superior and Inferior Sections (top & bottom)
    - Example Movement: Oblique Crunches or Swinging a Bat

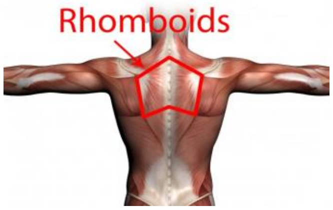
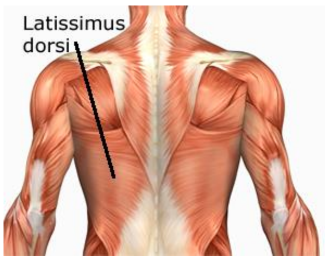
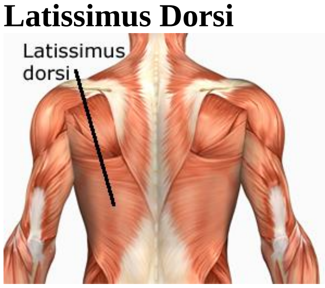
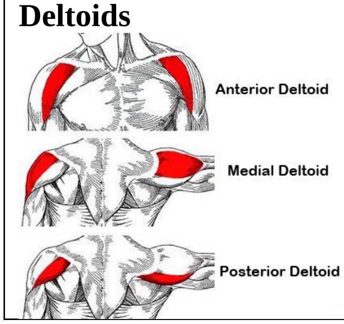
Appendix I

Exercises

Each exercise presented offers the following equipment options: Bands, Suspension Straps, Machines, Free Weights, and Body Weight.

Upper Body Exercise	Equipment	Start Position	Contraction Position
Chest **Pectorals** 	**Chest Press** **Bands**		
Chest **Pectorals** 	**Chest Fly** **Bands**		
Chest **Pectorals** 	**Push Up** **Suspension** **Strap**		
Chest **Pectorals** 	**Chest Press** **Machine**		

Upper Body Exercise	Equipment	Start Position	Contraction Position
Chest **Pectorals** 	**Incline Bench** **Chest Press** **Dumbbells**		
Upper Back **Rhomboids** 	**Upper Back** **Low Row** **Bands**		
Upper Back **Rhomboids** 	**Upper Back** **Low Row** **Suspension** **Strap**		
Upper Back **Rhomboids** 	**Upper Back** **Seated Row** **Cable Machine**		

Upper Body Exercise	Equipment	Start Position	Contraction Position
Upper Back **Rhomboids**  	**Back** **Bent Over Row** **Dumbbells**		
Back **Latissimus Dorsi**  	**Back** **Lat Pulldown** **Bands**		
Back **Latissimus Dorsi**  	**Back** **Lat Pulldown** **Machine**		
Shoulders **Deltoids**  	**Medial Deltoid** **Shoulder Press** **Bands**		

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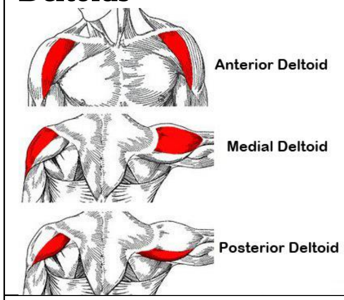
Deltoids

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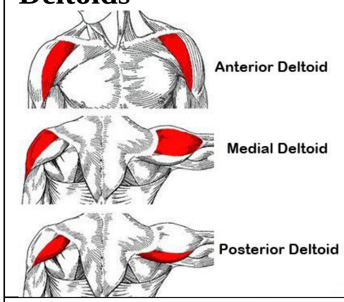
Deltoids

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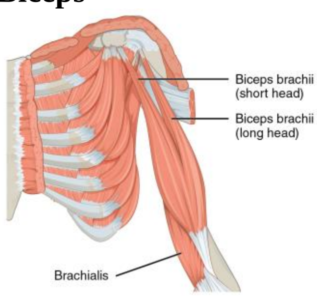
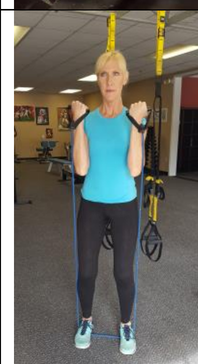

</td><td>Bicep Curl Bands</td><td></td><td></td></tr>
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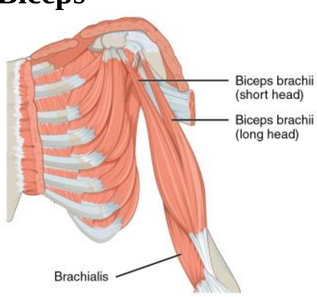
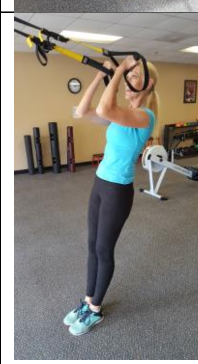

</td><td>Bicep Curl Suspension Strap</td><td></td><td></td></tr>
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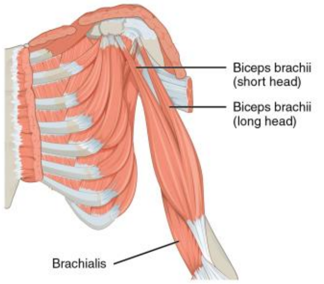
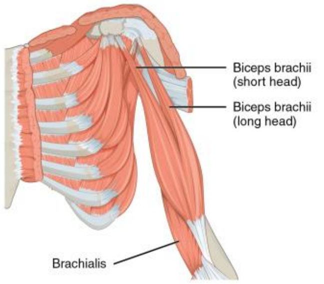
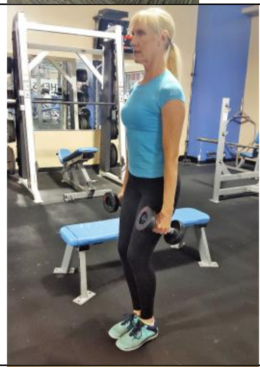
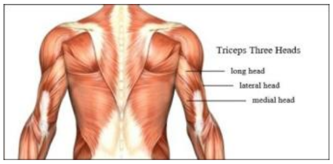
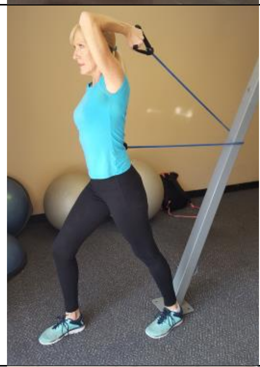
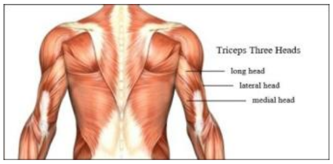
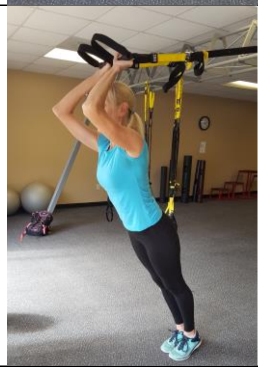
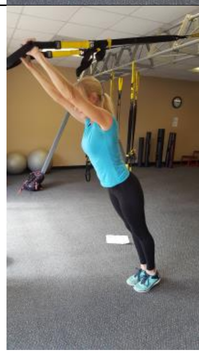
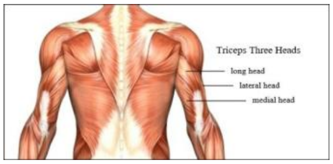
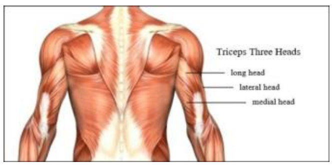
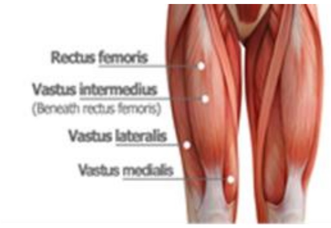
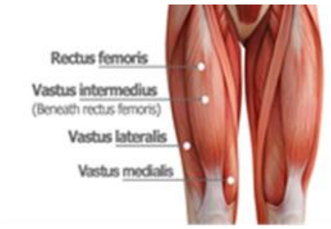
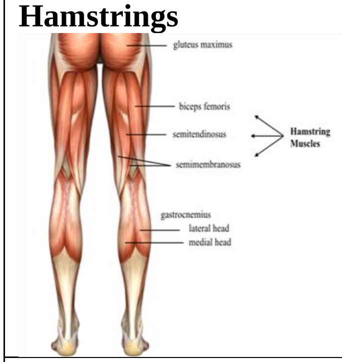
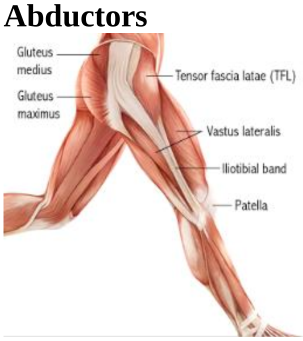
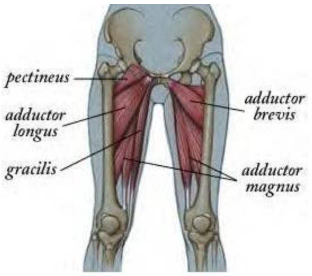
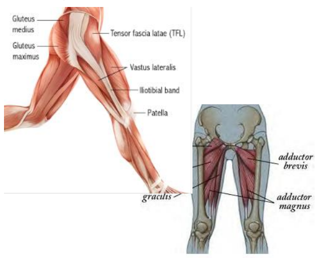
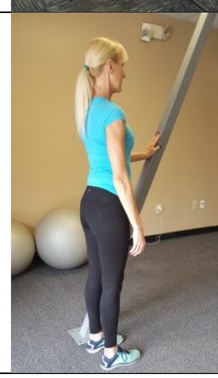
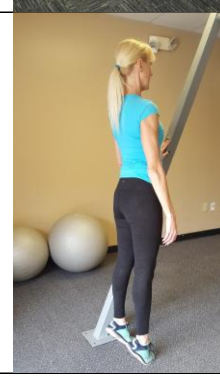
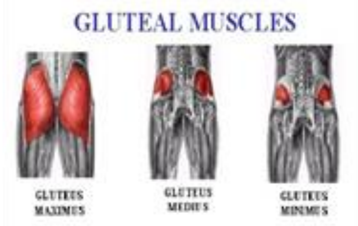
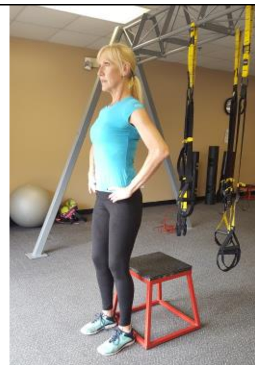
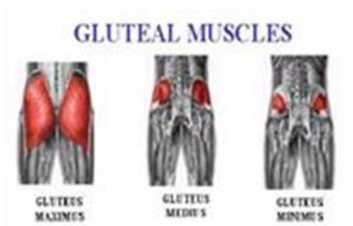
Upper Body Exercise	Equipment	Start Position	Contraction Position
Biceps 	**Bicep Curl Machine**		
Biceps 	**Bicep Curl Dumbbells**		
Triceps 	**Overhead Triceps Extension Bands**		
Triceps 	**Overhead Triceps Extension Suspension Strap**		

Upper Body Exercise	Equipment	Start Position	Contraction Position
Triceps 	**Triceps Press Down Machine**		
Triceps 	**Triceps Kick Back Dumbbells**		

Lower Body Exercise	Equipment	Start Position	Contraction Position
Quadriceps 	**Seated Leg Extension with Ankle Weight**		
Quadriceps 	**Seated Leg Extension Machine**		
Hamstrings 	**Seated Leg Curl Machine**		
Abductors 	**Abductor Machine**		

Lower Body Exercise	Equipment	Start Position	Contraction Position
Adductors  	**Adductor Machine**		
Abductors and Adductors  	**Side Lunge** **Disc** **Wall or Post**		
Gastrocnemius  	**Calf Extension Machine**		
Gastrocnemius  	**Standing Calf Raise**		

Lower Body Exercise	Equipment	Start Position	Contraction Position
Glutes, Quads, & Hamstrings  	**Squat** **Stand to Sit to Stand Box**		
Glutes, Quads, & Hamstrings  	**Squat** **Bands**		
Glutes, Quads, & Hamstrings  	**Squat** **Suspension Strap**		
Glutes, Quads, & Hamstrings  	**Seated Leg Press Machine**		

Glutes, Quads, & Hamstrings 	**Lunge Disc with Wall or Post**		

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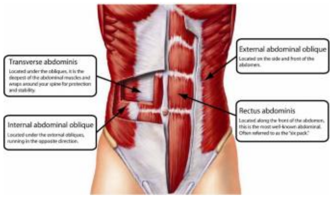
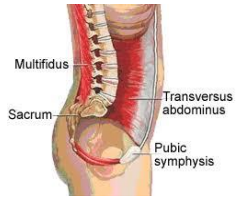
</td><td>Standing Balancing Bosu
</td><td></td><td></td></tr>
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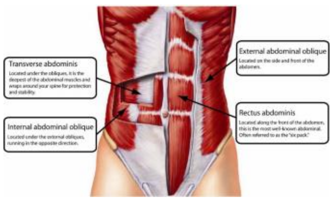
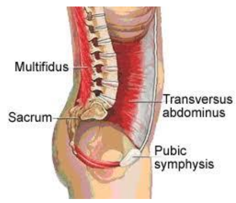
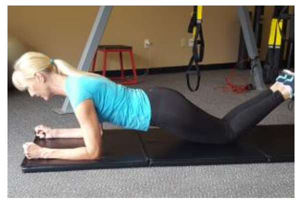
</td><td>Forearm Plank
</td><td>Knees
</td><td>Toes
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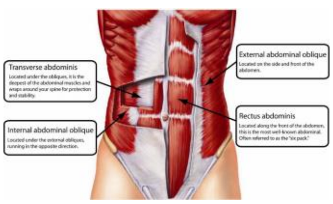
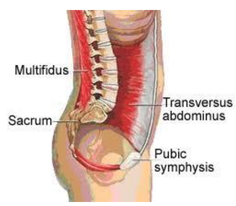
</td><td>Forearm Plank Bosu
</td><td>Knees
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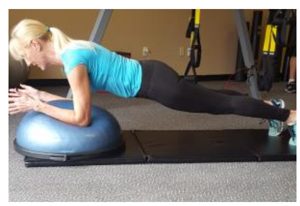</td></tr>
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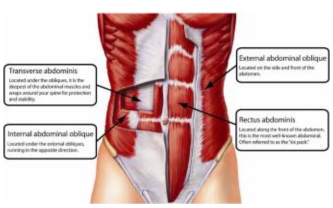
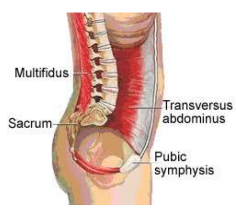
</td><td>High Plank Bosu
</td><td>Dome Side Up
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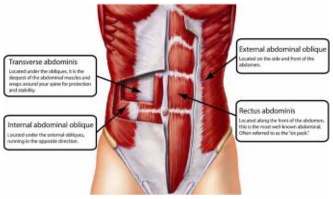
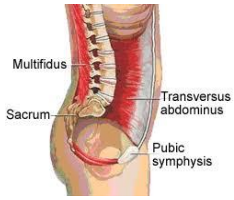
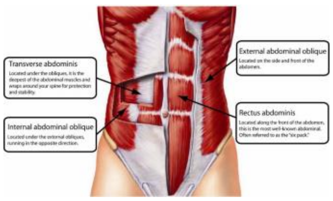
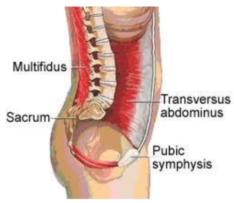
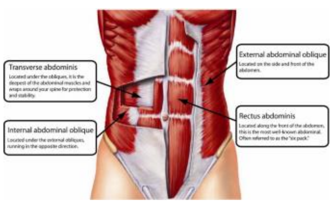
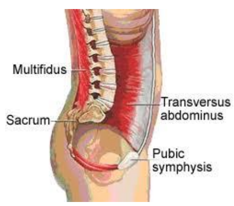
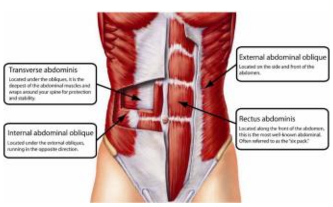
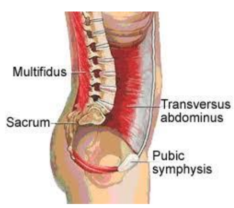
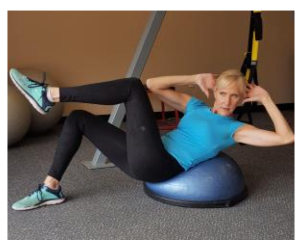
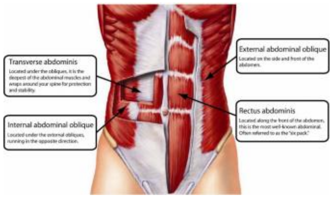
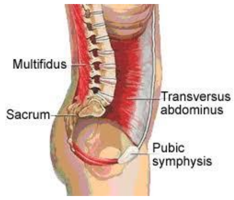
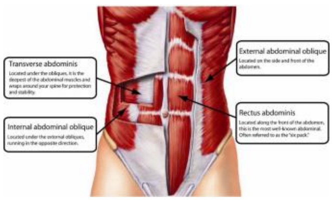
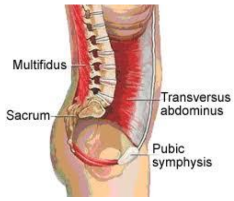
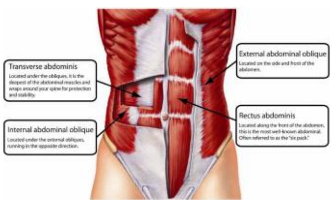
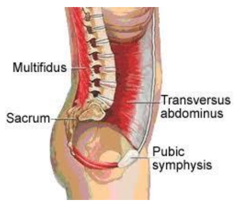
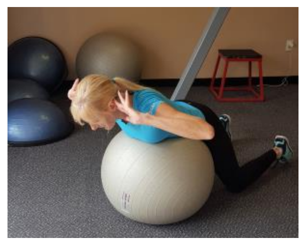
Core and Balance	Equipment	Start Position	Contraction Position
Balancing Core 	**Four Point Bridge** 		
Balancing Core 	**Four Point Bridge Bosu** 	**Fist** 	**Palm** 
Balancing Core 	**Abdominal Crunch Bosu** 		
Balancing Core 	**Oblique Crunch Bosu** 		

Core and Balance	Equipment	Start Position	Contraction Position
Balancing Core 	**Abdominal Crunch Ball** 		
Balancing Core 	**Oblique Crunch Ball** 		
Balancing Core 	**Back Extension Ball** 		

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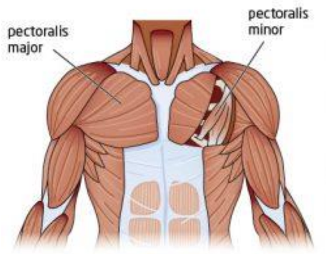
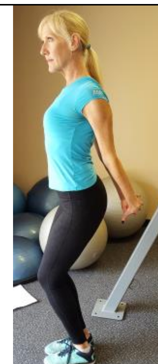
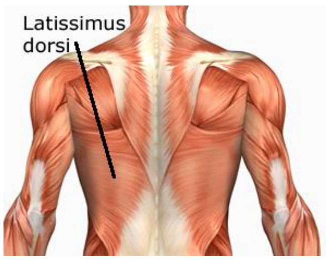
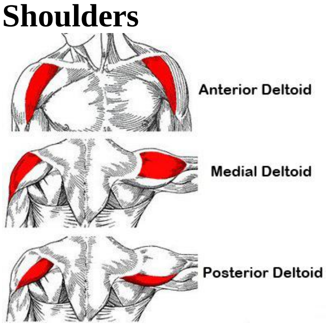
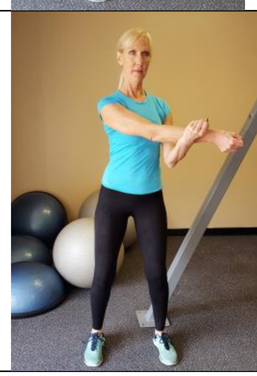
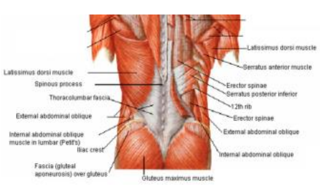
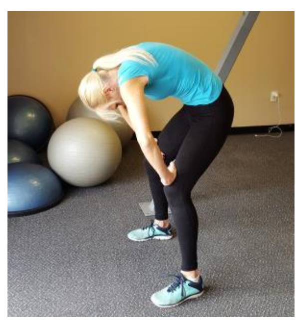
Chest/Pectorals/Biceps 	**Body Weight or Wall or Post**		
Upper Back/Lats/Triceps 	**Body Weight or Wall or Post**		
Shoulders 	**Body Weight**		
Lower Back 	**Body Weight**		

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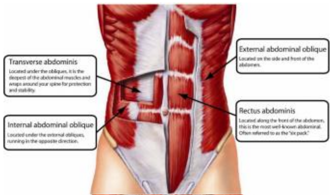
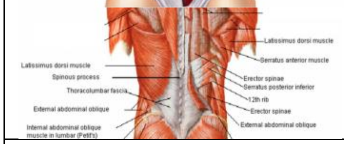
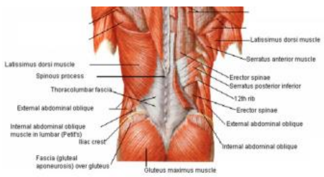
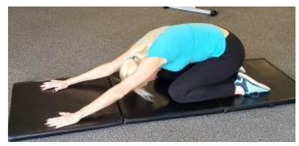
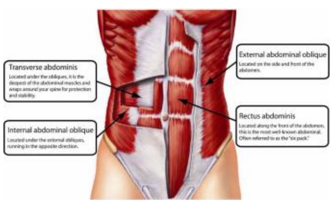
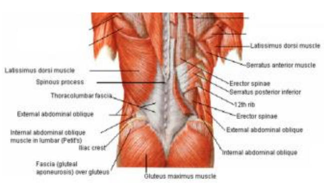
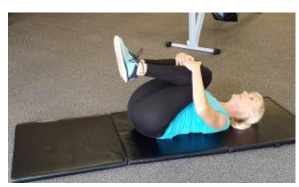
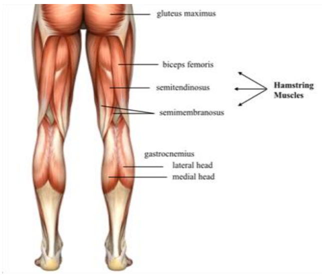
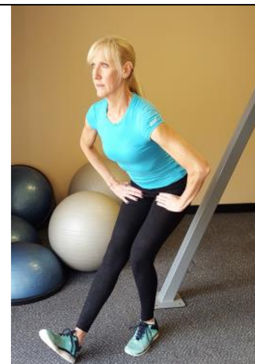
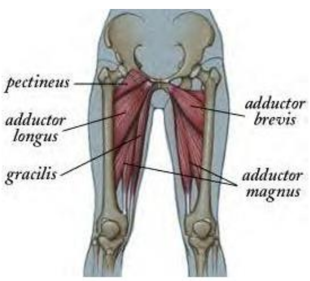
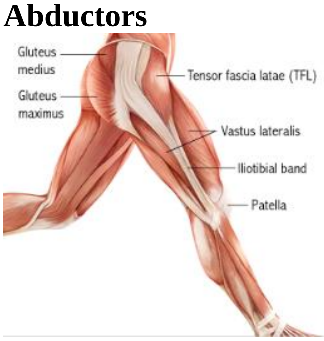
Back and Abs  	**Cat/Cow Body Weight**		
Back/Arms/Hips 	**Child's Pose Body Weight**		
Abs 	**Modified Cobra Body Weight**		
Lower Back 	**Knee Hug Body Weight**		

Stretch	Equipment	Start Position	Contraction Position
Hamstrings  	**Body Weight**		
Quadriceps/Hip Flexors  	**Body Weight**		
Adductors  	**Body Weight**		
Abductors  	**Body Weight**		

Stretch	Equipment	Start Position	Contraction Position
Abductors 	**Body Weight**		

Glossary

Term	Definition/Details
Action of the diaphragm	When the dome-shaped diaphragm contracts, it moves inferiorly and flattens out. As a result, the superior-inferior dimension (height) of the thoracic cavity increases.
Action of the Intercostal Muscles	Contraction of the external intercostal muscles lifts the rib cage and pulls the sternum superiorly. Because the ribs curve downward as well as forward around the chest wall, the broadest lateral and anteroposterior dimensions of the rib cage are normally directed obliquely downward. But when the ribs are raised and drawn together, they swing outward, expanding the diameter of the thorax both laterally and in the anteroposterior plane.
Acute Asthma Attack	Histamine and other inflammatory chemicals can cause such strong bronchoconstriction that pulmonary ventilation almost completely stops, regardless of the pressure gradient.
Acute Mountain Sickness (AMS)	Headaches, shortness of breath, nausea, and dizziness. When you travel quickly from sea level to elevations above 8000 ft, where atmospheric pressure and PO2 are lower
Adenocarcinoma	A disease which about 40% originates in peripheral lung areas as solitary nodules that develop from bronchial glands and alveolar cells.
Airways	These are the tubes that carry air in and out of the lungs (bronchi and bronchioles).
Airways Resistance	The major nonelastic source of resistance to gas flow is friction, or drag, encountered in the respiratory passageways.
Alveolar Dead Space	If some alveoli cease to act in gas exchange (due to alveolar collapse or obstruction by mucus, for example)
Alveolar Ducts	Within the walls of alveoli that consist of diffusely arranged rings of smooth muscle cells, connective tissue fibers, and outpocketing alveoli.
Alveolar Macrophages	Microorganisms that crawl freely along the internal alveolar surfaces, keeps the alveolar surface clean.
Alveolar Pores	Connecting adjacent alveoli allow air pressure throughout the lung to be equalized and provide alternate air routes to any alveoli whose bronchi have collapsed due to disease
Alveolar Sacs	Terminal clusters of alveoli
Alveoli	Tiny air sacs at the end of the bronchioles. Oxygen in the air you have inhaled passes through the thin walls of the alveoli into the tiny blood vessels (capillaries) surrounding the alveoli.
Anatomical Dead Space	Some of the inspired air fills the conducting respiratory passageways and never contributes to gas exchange in the alveoli, typically amounts to about 150 ml (The rule of thumb is that the anatomical dead space volume in a healthy young adult is equal to 1 ml per pound of ideal body weight.) This means that if TV is 500 ml, only 350 ml of it is involved in alveolar ventilation. The remaining 150 ml of the tidal breath is in the anatomical dead space.

Anemic hypoxia	Reflects poor O2 delivery resulting from too few RBCs or from RBCs that contain abnormal or too little Hb.
Apex	Top point of the lungs
Apnea	Breathing cessation.
Arytenoid, Cuneiform, and Corniculate cartilages	These form part of the lateral and posterior walls of the larynx.
Asthma	A disease that is characterized by episodes of coughing, dyspnea, wheezing, and chest tightness—alone or in combination.
Atelectasis	Lung collapse.
Atmospheric Pressure	Patm, which is the pressure exerted by the air (gases) surrounding the body.
AVR	Alveolar Ventilation Rate takes into account the volume of air wasted in the dead space and measures the flow of fresh gases in and out of the alveoli during a particular time interval.
Bohr Effect	Oxygen unloading is enhanced where it is most needed.
Bronchial Arteries	Provide oxygenated systemic blood to lung tissue.
Bronchial Tree	Consists of right and left main bronchi, which subdivide within the lungs to form lobar and segmental bronchi and bronchioles. Bronchiolar walls lack cartilage but contain complete layer of smooth muscle. Constriction of this muscle impedes expiration. Air passageways connecting trachea with alveoli; cleans, warms, and moistens incoming air
Bronchi/Bronchioles	The large and small tubes that carry air in and out of the lungs – the airways. Passages smaller than 1 mm in diameter are "little bronchi".
Bronchiectasis	A long-term lung condition where the airways of the lungs become widened, leading to a build-up of excess mucus, which can make the airways of the lungs more vulnerable to infection.
Bronchitis	Acute bronchitis is a chest infection. Chronic bronchitis is a permanent cough, producing phlegm, and is one of the conditions that is called COPD.
Bronchopulmonary Segments	Separated from one another by connective tissue septa. Each segment is served by its own artery and vein and receives air from an individual segmental (tertiary) bronchus. Initially each lung contains ten bronchopulmonary segments arranged in similar (but not identical) patterns
Bronchoscopy	A bronchoscopy is a test whereby a telescope in a flexible narrow tube is passed through the nose into the lungs; this is usually done with sedation. The tube has an eyepiece, so the doctor can see inside to look for anything abnormal and can take cell samples for testing. They can also take photographs of the inside of the airways if necessary.
Carbon Dioxide (CO2)	A waste gas that is sent from the blood to the lungs to be exhaled.
Carbon Dioxide Transport: Blood transports CO2 from the tissue cells to the lungs in three forms	Normally active body cells produce about 200 ml of CO2 each minute—exactly the amount excreted by the lungs.

	1. Dissolved in plasma (7–10%). The smallest amount of CO2 is transported simply dissolved in plasma.
	2. Chemically bound to hemoglobin (just over 20%). In this form, dissolved CO2 is bound and carried in the RBCs as carbaminohemoglobin
	3. As bicarbonate ion in plasma (about 70%). Most carbon dioxide molecules entering the plasma quickly enter the RBCs, where most of the reactions that prepare carbon dioxide for transport as bicarbonate ions
Carbon Monoxide Poisoning	A unique type of hypoxemic hypoxia, and a leading cause of death from fire. Carbon monoxide (CO) is an odorless, colorless gas that competes vigorously with O2 for heme binding sites. Moreover, because Hb's affinity for CO is more than 200 times greater than its affinity for oxygen, CO is a highly successful competitor. Even at minuscule partial pressures, carbon monoxide can displace oxygen.
Carbonic Acid–Bicarbonate Buffer System	Very important in resisting shifts in blood pH, as shown in the equation in point 3 concerning CO2 transport. For example, if the hydrogen ion concentration in blood begins to rise, excess is removed by combining with HCO3 – to form carbonic acid (a weak acid). If H concentration drops below desirable levels in blood, carbonic acid dissociates, releasing hydrogen ions and lowering the pH again.
Carbonic Anhydrase	An enzyme that reversibly catalyzes the conversion of carbon dioxide and water to carbonic acid.
Cardiac Notch	A concavity in the medial aspect of the left lung.
Carina	The last tracheal cartilage is expanded, and a spar of cartilage, projects posteriorly from its inner face, marking the point where the trachea into the two main bronchi.
Central Chemoreceptors	Receptors that are located throughout the brain stem, including the ventrolateral medulla.
Chemoreceptors	Sensors responding to such chemical fluctuations.
Chloride Shift	An ion exchange process which occurs via facilitated diffusion through a RBC membrane protein.
Chronic Bronchitis	Inhaled irritants lead to chronic excessive mucus production by the mucosa of the lower respiratory passageways and to inflammation and fibrosis of that mucosa. These responses obstruct the airways and severely impair lung ventilation and gas exchange.
Chronic Obstructive Pulmonary Diseases (COPD)	A disease that is exemplified best by emphysema and chronic bronchitis which are major causes of death and disability in North America. The key physiological feature of these diseases is an irreversible decrease in the ability to force air out of the lungs.
Composition of Alveolar Gas	The gaseous makeup of the atmosphere is quite different from that in the alveoli. The atmosphere is almost entirely O2 and N2; the alveoli contain more CO2 and water vapor and much less O2.
These differences reflect the effects of	(1) gas exchanges occurring in the lungs (O2 diffuses from the alveoli into the pulmonary blood and CO2 diffuses in the opposite direction)
	(2) humidification of air by conducting passages,

	(3) the mixing of alveolar gas that occurs with each breath.
Conducting Zone	Respiratory passageways which provide fairly rigid conduits for air to reach the gas exchange sites.
Costal Surface	Anterior, lateral, and posterior lung surfaces lie in close contact with the ribs.
Cough	Taking a deep breath, closing glottis, and forcing air superiorly from lungs against glottis; glottis opens suddenly and a blast of air rushes upward. Can dislodge foreign particles or mucus from lower respiratory tract and propel such substances superiorly.
Cricoid Cartilage	Inferior to the thyroid cartilage, ring-shaped, perched atop and anchored to the trachea inferiorly.
Crying	Inspiration followed by release of air in a number of short expirations. Primarily an emotionally induced mechanism.
CT Scan	Similar to an X-ray, a CT (computerized tomography) scan can provide a sharper and more detailed image of the lungs to help a specialist reach a diagnosis.
Cystic Fibrosis (CF)	CF affects internal organs, especially the lungs and digestive system by causing sticky mucus to be produced which clogs up the systems making it hard to breathe and digest food.
Dalton's Law of Partial Pressures	States that the total pressure exerted by a mixture of gases is the sum of the pressures exerted independently by each gas in the mixture.
Deoxyhemoglobin	Reduced hemoglobin.
Diaphragm	A large muscle under the lungs. The diaphragm moves up and down during breathing.
Dorsal Respiratory Group (DRG)	(DRG) integrates peripheral sensory input and modifies the rhythms generated by the VRG.
Duration	How long to do an activity.
Elasticity	The ability of the alveoli to stretch and get smaller with breathing.
Emphysema	A chronic lung disease distinguished by permanent enlargement of the alveoli, accompanied by destruction of the alveolar walls. Invariably the lungs lose their elasticity.
This has three important consequences	(1) Accessory muscles must be enlisted to breathe, and victims are perpetually exhausted because breathing requires 15–20% of their total body energy supply (as opposed to 5% in healthy individuals).
	(2) For complex reasons, the bronchioles open during inspiration but collapse during expiration, trapping huge volumes of air in the alveoli. This hyperinflation leads to development of a permanently expanded "barrel chest" and flattens the diaphragm, thus reducing ventilation efficiency.
	(3) Damage to the pulmonary capillaries as the alveolar walls disintegrate increases resistance in the pulmonary circuit, forcing the right ventricle to overwork and consequently become enlarged.
Endurance Exercise	Activity to increase one's ability to sustain an activity.

Epiglottis	("above the glottis"), is composed of elastic cartilage and is almost entirely covered by a taste bud–containing mucosa.
Esophagus	The tube that connects the mouth and stomach.
Eupnea	Normal respiratory rate and rhythm.
Exacerbation	When symptoms get temporarily worse in lung conditions.
Exhaled Carbon Monoxide Test	This test measures the amount of carbon monoxide a person exhales. Carbon monoxide is increased if a cigarette has recently been smoked.
Expiration	Air leaving the lungs.
Expiratory Reserve Volume	(ERV) is the amount of air—normally 1000 to 1200 ml—that can be evacuated from the lungs after a tidal expiration.
External Respiration	Movement of oxygen from the lungs to the blood and of carbon dioxide from the blood to the lungs.
External Respiration	During external respiration (pulmonary gas exchange) dark red blood flowing through the pulmonary circuit is transformed into the scarlet river that is returned to the heart for distribution by systemic arteries to all body tissues.
The following three factors influence the movement of oxygen and carbon dioxide across the respiratory membrane:	1. Partial pressure gradients and gas solubilities
	2. Matching of alveolar ventilation and pulmonary blood perfusion
	3. Structural characteristics of the respiratory membrane
Fatigue	Feeling weak or tired.
FEV	Forced expiratory volume that determines the amount of air expelled during specific time intervals of the FVC test.
Flexibility	Exercises to stretch muscles increasing blood flow to the muscle. The ability of a muscle or joint to move through a full range of motion without discomfort or pain.
Forced Expiration	An active process produced by contraction of abdominal wall muscles, primarily the oblique and transversus muscles.
Function of the Respiratory System	Supply the body with oxygen and dispose of carbon dioxide
Functional Residual Capacity	(FRC) represents the amount of air remaining in the lungs after a tidal expiration and is the combined RV and ERV.
Frequency	How often one performs an activity throughout the week.
FVC	Forced vital capacity that measures the amount of gas expelled when a subject takes a deep breath and then forcefully exhales maximally and as rapidly as possible.
Glottis	Vocal folds and the medial opening between them through which air passes.

Hard Palate	Where the palate is supported by the palatine bones and processes of the maxillary bones.
Heimlich Maneuver	A procedure in which air in the victim's lungs is used to "pop out,"or expel, an obstructing piece of food, has saved many people from becoming victims of "café coronaries."
Henry's Law	When a gas is in contact with a liquid, that gas will dissolve in the liquid in proportion to its partial pressure. Accordingly, the greater the concentration of a particular gas in the gas phase, the more and the faster that gas will go into solution in the liquid.
Hiccups	Sudden inspirations resulting from spasms of diaphragm; believed to be initiated by irritation of diaphragm or phrenic nerves, which serve diaphragm. Sound occurs when inspired air hits vocal folds of closing glottis.
Hilum	An indentation on the mediastinal surface of each lung.
Histotoxic Hypoxia	Occurs when body cells are unable to use O2 even though adequate amounts are delivered. This variety of hypoxia is the consequence of metabolic poisons, such as cyanide.
Hypercapnia	As PCO2 levels rise in the blood CO2 accumulates in the brain.
Hyperventilation	An increase in the rate and depth of breathing that exceeds the body's need to remove CO2. A person experiencing an anxiety attack may hyperventilate involuntarily to the point where he or she becomes dizzy or faints.
Hypoxemic Hypoxia	Indicated by reduced arterial PO2. Possible causes include disordered or abnormal ventilation perfusion coupling, pulmonary diseases that impair ventilation, and breathing air containing scant amounts of O2.
Hypoxia	Inadequate oxygen delivery to body tissues.
Idiopathic	This means the cause is unknown.
Idiopathic Pulmonary Disease (IPF)	IPF is caused by repeated injury to small areas of the lungs resulting in inflammation and scarring.
Infant Respiratory Distress Syndrome	(IRDS), a condition peculiar to premature babies. When too little surfactant is present, surface tension forces can collapse the alveoli. Once this happens, the alveoli must be completely reflated during each inspiration, an effort that uses tremendous amounts of energy.
Inflation Reflex, or Hering	Breuer reflex - As the lungs recoil, the stretch receptors become quiet, and inspiration is initiated once again.
Inhaler	A device which gives a dose of medication to breathe in.
Inspiration	Taking air into the lungs.
Inspiratory Capacity	(IC) is the total amount of air that can be inspired after a tidal expiration, so it is the sum of TV and IRV.
Inspiratory Reserve Volume	(IRV) The amount of air that can be inspired forcibly beyond the tidal volume (2100 to 3200 ml)
Intensity	How hard and how many reps of each type of activity to do. Intensity can be measured using Rating Perceived Exertion Scale.
Internal Respiration	movement of oxygen from blood to the tissue cells and of carbon dioxide from tissue cells to blood.

Interstitial Lung Disease (ILD)	A group of lung disorders that cause scarring of the lung tissue, making it difficult to get enough oxygen into the body; around a third of people with interstitial lung disease may have pulmonary hypertension.
Intrapulmonary Pressure	Intra-alveolar Ppul is the pressure in the alveoli. Intrapulmonary pressure rises and falls with the phases of breathing, but it always eventually equalizes with the atmospheric pressure.
Ischemic (stagnant) Hypoxia	Results when blood circulation is impaired or blocked. Congestive heart failure may cause body wide ischemic hypoxia, whereas emboli or thrombi block oxygen delivery only to tissues distal to the obstruction.
Laryngeal Prominence	The midline of the thyroid cartilage (adams apple).
Laryngopharynx	Subdivision of the pharynx which serves as a passageway for food and air and is lined with a stratified squamous epithelium. It lies directly posterior to the upright epiglottis and extends to the larynx, where the respiratory and digestive pathways diverge.
Larynx	Connects pharynx to trachea. Has framework of cartilage and dense connective tissue. Opening (glottis) can be closed by epiglottis or vocal folds. Air passageway; prevents food from entering lower respiratory tract Houses vocal folds (true vocal cords). Voice production
Laughing	Essentially same as crying in terms of air movements produced. Also an emotionally induced response.
Layers of trachea	Mucosa, submucosa, and adventitia—plus a layer of hyaline cartilage.
Lobar (secondary) Bronchi	The subdivision of the main bronchi, three on the right and two on the left—each supplying one lung lobe.
Lobes of the Lungs	The left lung is subdivided into superior and inferior lobes by the oblique fissure, whereas the right lung is partitioned into superior, middle, and inferior lobes by the oblique and horizontal fissures.
Lung Compliance	Healthy lungs are unbelievably stretchy
Lungs	Paired composite organs that flank mediastinum in thorax. Composed primarily of alveoli and respiratory passageways. Stroma is fibrous elastic connective tissue, allowing lungs to recoil passively during expiration. House respiratory passages smaller than the main bronchi
Lymphangioleiomyomatosis (LAM)	A rare disorder which affects women only. The condition mainly affects the lungs and causes an overgrowth of the smooth muscle cell around the airways, blood vessels and lymph vessels that drain the excess fluid from the lungs. This leads to cysts developing in the lung and some patients also have a non-malignant tumor or tumors in the kidneys that can cause bleeding. LAM patients generally develop the onset of their symptoms in their 30s.
Lysozyme	Antibacterial enzyme.
Main (primary) Bronchi	The trachea divides into left and right subdivisions.

Medical Device	Medical devices may be classified as Class I, Class IIa, IIb and III, with Class III covering the highest risk products. Classification of a medical device will depend upon a series of factors, including: how long the device is intended to be in continuous use, whether or not the device is invasive or surgically invasive, whether the device is implantable or active, whether or not the device contains a substance, which in its own right is considered to be a medicinal substance and has action supplementary to that of the device.
Methacholine Test	This test measures how sensitive the airways are to methacholine (a substance that causes the airways to narrow). Lung function is checked first (see "Spirometry") and then nebulized saline (salt water) is inhaled; lung function is measured again. This test can check whether a breathing problem is asthma.
Minute Ventilation	The total amount of gas that flows into or out of the respiratory tract in 1 minute. During normal quiet breathing, the minute ventilation in healthy people is about 6 L/min (500 ml per breath multiplied by 12 breaths per minute). During vigorous exercise, the minute ventilation may reach 200 L/min.
Mucus	A sticky fluid found in the airways which protects against particles moving down into the lungs and causing damage.
Nares	Nostrils
Nasal Septum	Formed anteriorly by the septal cartilage and posteriorly by the vomer bone and perpendicular plate of the ethmoid bone.
Nasal Vestibule	The part of the nasal cavity just superior to the nostrils, lined with skin containing sebaceous and sweat glands and numerous hair follicles.
Nasopharynx	Subdivision of the pharynx which lies above the point where food enters the body, it serves only as an air passageway.
Nebulizer	This is a machine that delivers medication as a mist.
Nose	Jutting external portion is supported by bone and cartilage. Internal nasal cavity is divided by midline nasal septum and lined with mucosa. Produces mucus; filters, warms, and moistens incoming air; resonance chamber for speech.
Oropharynx	Subdivision of the pharynx that lies posterior to the oral cavity and is continuous with it through an archway called the isthmus of the fauces.
Oximetry	A test that monitors the amount of oxygen in your blood, using a small device often placed on the finger or earlobe.
Oxygen	A colorless, odorless and tasteless gas needed for life. After air is inhaled, oxygen is sent to the blood and to the cells for energy.
Oxygen Saturation	If an individual has lung disease or other types of medical conditions, fewer red blood cells carry their usual load of oxygen and the oxygen "saturation" will be lower than 95%. The blood oxygen level can be measured in two ways; with a clip that fits onto the finger or through an arterial blood gas.

Oxygen Toxicity	Develops rapidly when PO2 is greater than 2.5–3 atm. excessively high O2 concentrations generate huge amounts of harmful free radicals, resulting in profound CNS disturbances, coma, and death.
Oxygen Hemoglobin Dissociation Curve	Between the degree of hemoglobin saturation and the PO2 of blood is not linear, because the affinity of hemoglobin for O2 changes with O2 binding, as we just described.
Oxyhemoglobin	Hemoglobin-oxygen combination
Palatine Tonsils	Structures that lie embedded in the oropharyngeal mucosa of the lateral walls of the fauces.
Paranasal Sinuses	Mucosa-lined, air-filled cavities in cranial bones surrounding nasal cavity. Same as for nasal cavity; also lighten skull.
Peripheral Chemoreceptors	Found in the aortic arch and carotid arteries.
Pharyngeal Tonsil	Traps and destroys pathogens entering the nasopharynx in air. Also known as adenoids.
Pharynx	Passageway connecting nasal cavity to larynx and oral cavity to esophagus. Three subdivisions: nasopharynx, oropharynx, and laryngopharynx. Passageway for air and food Houses tonsils (lymphoid tissue masses involved in protection against pathogens). Facilitates exposure of immune system to inhaled antigens
Philtrum	A shallow vertical groove just inferior to the apex of the nose
Phlegm	Thick mucus.
Phrenic and Intercostal nerves	Excites the diaphragm and external intercostal muscles, respectively a result, the thorax expands and air rushes into the lungs. When the VRG's expiratory neurons fire, the output stops, and expiration occurs passively as the inspiratory muscles relax and the lungs recoil.
Pleurae	Serous membranes. Parietal pleura lines thoracic cavity; visceral pleura covers external lung surfaces. Produce lubricating fluid and compartmentalize lungs
Pleurisy	Inflammation of the pleurae often results from pneumonia. Inflamed pleurae become rough, resulting in friction and stabbing pain with each breath. As the disease progresses, the pleurae may produce an excessive amount of fluid. This increased fluid relieves the pain caused by pleural surfaces rubbing together but may exert pressure on the lungs and hinder breathing movements.
Pneumothorax	The presence of air in the pleural cavity
Pontine Respiratory Centers	Interact with the medullary respiratory centers to smooth the respiratory pattern.
PPI	Patient and Public Involvement.
Preventer	A medication that is designed to prevent airways inflammation.
Pulmonary	To do with the lungs.
Pulmonary Arteries	Delivers systemic venous blood that is to be oxygenated in the lungs.
Pulmonary Capillary Networks	Surrounding the alveoli
Pulmonary Hypertension	This is high pressure inside the pulmonary arteries, which are the vessels carrying blood from the right-hand side of the heart to the lungs.

Pulmonary Plexus	The lungs are innervated by parasympathetic and sympathetic motor fibers, and visceral sensory fibers. These nerve fibers enter each lung through the pulmonary plexus on the lung root and run along the bronchial tubes and blood vessels in the lungs. Parasympathetic fibers constrict the air tubes, whereas the sympathetic nervous system dilates them.
Pulmonary Rehabilitation	A course of exercise and education which helps some people with lung conditions to become more active.
Pulmonary Veins	Veins that deliver freshly oxygenated blood from the lungs to the heart.
Pulmonary Ventilation	Movement of air into and out of the lungs so that the gases there are continuously changed and refreshed-breathing.
Pulmonologist	A doctor who specializes in respiratory disease. Also known as a chest medicine specialist, a respiratory medicine specialist, a respirologist or a thoracic medicine specialist.
Pulmonology	The study of respiratory disease.
Rating Perceived Exertion Scale	A measure of the intensity of an activity. Intensity will vary on a scale of 1 (very easy) to 10 (maximal).
Residual Volume	(RV) after the most strenuous expiration, about 1200 ml of air remains in the lungs; which helps to keep the alveoli patent (open) and to prevent lung collapse.
Respiratory	To do with breathing and the chest.
Respiratory Membrane	The walls of the alveoli are composed primarily of a single layer of squamous epithelial cells, called type I cells.
Respiratory Mucosa	A pseudostratified ciliated columnar epithelium, containing scattered goblet cells, that rests on a lamina propria richly supplied with mucous and serous glands. (Mucous cells secrete mucus, and serous cells secrete a watery fluid containing enzymes.
Respiratory Questionnaire	A questionnaire that gains background information about an individual’s respiratory details.
Respiratory System	Nose, nasal cavity, and paranasal sinuses; the pharynx; the larynx; the trachea; the bronchi and their smaller branches; and the lungs, which contain the terminal air sacs, or alveoli.
Respiratory Zone	The actual site of gas exchange which is composed of the respiratory bronchioles, alveolar ducts, and alveoli, all microscopic structures.
Rhinitis	Inflammation of the nasal mucosa accompanied by excessive mucus production, nasal congestion, and postnasal drip, caused by Cold viruses, streptococcal bacteria, and various allergens.
Segmental (tertiary) Bronchi	Third-order bronchi.
Sinusitis	Inflamed sinuses.
Small Cell Carcinoma	A disease which contains round lymphocyte-sized cells that originate in the main bronchi and grow aggressively in small grapelike clusters within the mediastinum. (20% of cases)
Sneeze	Similar to a cough, except that expelled air is directed through nasal cavities as well as through oral cavity; depressed uvula routes air

	upward through nasal cavities. Sneezes clear upper respiratory passages.
Spacer	A chamber used with an inhaler to increase the amount of medication reaching the smaller airways.
Spirometry	A breathing test which measures the amount of air that can be blown out of the lungs (pulmonary or lung function). The test is performed by blowing into a machine at least 3 times to make sure the results are consistent. It cannot provide a specific diagnosis, but it can distinguish between obstructive pulmonary disease involving increased airway resistance (such as chronic bronchitis) and restrictive disorders involving a reduction in total lung capacity resulting from structural or functional changes in the lungs.
Sputum	Mucus or phlegm coughed up from the airways.
Sputum Induction Test	This test involves producing a fresh sample of sputum to be analyzed in the laboratory, to find any inflammatory cells or chemicals that may present and causing a problem. This procedure involves inhaling mildly salty water for 5 minutes to loosen the mucus on the chest so that it can be coughed up, producing a sputum sample.
Squamous Cell Carcinoma	A disease which arises in the epithelium of the bronchi or their larger subdivisions and tends to form masses that may cavitate (hollow out) and bleed. (25-30% of cases)
Steroids	Medication which reduces inflammation. Steroids for the lungs can be taken from an inhaler or as tablets; they are not the same as the steroids that some body-builders use.
Strength and Muscular Endurance	Exercise using weights or other equipment to apply resistance to different movements. Muscular Endurance is the ability of a muscle to contract repeatedly over a period of time or the ability of a muscle to sustain an amount of weight over a period of time. Muscular Strength is the maximal amount of effort or force that a muscle can exert one time or within one rep.
Surface Tension	The unequal attraction which produces a state of tension at the liquid surface.
Surfactant	A detergent-like complex of lipids and proteins produced by the type II alveolar cells. Surfactant decreases the cohesiveness of water molecules much the way a laundry detergent reduces the attraction of water for water, allowing water to interact with and pass through fabric. As a result, the surface tension of alveolar fluid is reduced, and less energy is needed to overcome those forces to expand the lungs and discourage alveolar collapse.
Terminal bronchioles	The smallest of bronchioles less than 0.5 mm in diameter.
The Haldane Effect	The amount of carbon dioxide transported in blood is markedly affected by the degree of oxygenation of the blood. The lower the PO_2 and the lower the extent of Hb saturation with oxygen, the more CO_2 that can be carried in the blood.
The Intrapleural Pressure	Pip The pressure in the pleural cavity.
The lungs' natural tendency to recoil	Because of their elasticity, lungs always assume the smallest size possible.

The surface tension of the alveolar fluid	The molecules of the fluid lining the alveoli attract each other and this produces surface tension that constantly acts to draw the alveoli to their smallest possible dimension.
Thyroid Cartilage	Large, shield-shaped, covers the front of the larynx.
Tidal volume (TV)	During normal quiet breathing, about 500 ml of air moves into and then out of the lungs with each breath
Total Dead Space	Anatomical Dead Space + Alveolar Dead Space
Total Lung Capacity	(TLC) is the sum of all lung volumes and is normally around 6000 ml.
Trachea	Flexible tube running from larynx and dividing inferiorly into two main bronchi. Walls contain C-shaped cartilages that are incomplete posteriorly where connected by trachealis muscle. Air passageway; cleans, warms, and moistens incoming air. Primarily it's the tube that connects the nose and mouth to the lungs.
Transport of Respiratory Gases	Transport of oxygen from the lungs to the tissue cells of the body, and of carbon dioxide from the tissue cells to the lungs. This transport is accomplished by the cardiovascular system using blood as the transporting fluid.
Transpulmonary Pressure	The difference between the intrapulmonary and intrapleural pressures (Ppul – Pip) that keeps the air spaces of the lungs open or keeps the lungs from collapsing.
Tuberculosis (TB)	The infectious disease caused by the bacterium Mycobacterium tuberculosis, is spread by coughing and primarily enters the body in inhaled air. TB mostly affects the lungs but can spread through the lymphatics to affect other organs. a massive inflammatory and immune response usually contains the primary infection in fibrous, or calcified, nodules (tubercles) in the lungs.
Type II Cells	Secrete a fluid containing a detergent-like substance called surfactant that coats the gas exposed alveolar surfaces. Prevents the alveoli from collapsing during expiration.
Uvula	Also known as "little grape"...during swallowing (along with the soft palate) moves superiorly, an action that closes off the nasopharynx and prevents food from entering the nasal cavity.
Valsalva's Maneuver	Under certain conditions, the vocal folds act as a sphincter that prevents air passage. During abdominal straining associated with defecation, the glottis closes to prevent exhalation and the abdominal muscles contract, causing the intra-abdominal pressure to rise. Help empty the rectum and can also splint (stabilize) the body trunk when one lifts a heavy load.
Ventilation	Perfusion Coupling - For gas exchange to be efficient, there must be a close match, or coupling, between the amount of gas reaching the alveoli, known as ventilation, and the blood flow in pulmonary capillaries, known as perfusion.
Ventilation-Perfusion Coupling	For gas exchange to be efficient, there must be a close match, or coupling, between the amount of gas reaching the alveoli, known as ventilation, and the blood flow in pulmonary capillaries, known as perfusion.
Ventral Respiratory Group	(VRG) contains rhythm generators whose output drives respiration.

Vestibular Folds	Also known as false vocal cords. These play no direct part in sound production but help to close the glottis when we swallow.
Vibrissae	Nose hairs that filter coarse particles (dust, pollen) from inspired air.
Vital Capacity	(VC) is the total amount of exchangeable air. It is the sum of TV, IRV, and ERV. In healthy young males VC is approximately 4800 ml.
Vocal Folds	Tissues that vibrate, producing sounds as air rushes up from the lungs.
Vocal Ligaments	These ligaments attach the arytenoid cartilages to the thyroid cartilage. These ligaments, composed largely of elastic fibers, form the core of mucosal folds called the vocal folds, or true vocal cords, which appear pearly white because they lack blood vessels.
Wheeze	A squeaking or whistling sound when breathing out.
Yawn	Very deep inspiration, taken with jaws wide open; not believed to be triggered by levels of oxygen or carbon dioxide in blood. Ventilates all alveoli (not the case in normal quiet breathing).

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About the Author

Known as the trainer's trainer, CarolAnn, has become one of the country's leading fitness educators, authors, and national presenters. Combining a Master's degree in Exercise Science/Health Promotion with several fitness certifications/memberships, she has been actively involved in the fitness industry for over 3 decades presenting at FiTOUR, NASM OPTIMA, CanFit Pro, Club Industry, MedFit Network Tour, and SCW Manias. As one of the leading experts, she has served on several health advisory boards, performed as a wellness fitness director, owned her own private studio, and operated several gyms. She moved her programming online as the creator and star of The Steel Physique Fitness on Demand series (www.CarolAnn.Fitness). She authored the book *Chiseled Faith: Your Motivational and Survival Bible to Achieving Your Greatest Health & Fitness Potential*, a plug-n-play faith-based health and fitness program for church communities. She is currently the Lead Instructor and Master Trainer at Club Pilates Athens, GA as well as a Program Specialist for Barre Above. As a consultant and contributor, she develops health & fitness educational content for various companies and organizations such as IDEA, Personal Fitness Professional (PFP), FiTOUR, MedFit Network, PT Global, eHOW.com, and LiveStrong.com. She had been named National Fitness Hall of Fame Fitness Superstar for 2019-2021 and is currently a Pro-to-Know. CarolAnn is dedicated to helping other health/fitness professionals and business owners develop, grow, and thrive in their dreams and endeavors.