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A Review on Biological and Co-Morbidity as Potential Factors for COVID 19 Heavy Morbidity and Mortality Among the Elderly and Their Implications on Public Health Scenario in India

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ABSTRACT

Aim of this Article: The main aim of this article is to explain how biological changes in the ageing process and comorbidity (presence of one or more additional conditions) increase the risk of the aged to COVID 19 morbidity and mortality. **Study objectives:** ***Primary objective*** 1. To review publications and other studies associated with biological changes in the ageing process as well as identifying some specific comorbidity among the aged ***Secondary objective*** 1. To develop appropriate health educational programs to protect the aged population on COVID 19 2. To develop an educational strategy on COVID 19 for the aged and the general public. According to Prof Walter Ricciardi, scientific adviser to Italy's Minister of Health, the country's mortality rate is far higher due to demographics - the nation has the second oldest population worldwide. Again, most of the deaths in Italy also have comorbid conditions (presence of more than one disease in one person) from 1 to 3 in addition to Covid 19 and most of these conditions are age related. The conditions range from cardiovascular, diabetes, respiratory disorders and cancers. All these conditions were identified in some studies in Italy and China. In Italy for example 48.5% had 3 conditions in addition to Covid 19, 25.6% had 2 conditions, and 25.1% had 1 condition and 0.8% died from only Covid 19. CDC examined the first 4,200 U.S. cases and found 508 (12%) of patients were hospitalized, and of those, 121 were known to be admitted to an intensive care unit, and 44 patients died. Similar to China, both hospitalization and mortality rates increased with increasing age, though this data indicated 20% of hospitalized patients and 12% of patients admitted to an ICU were ages 20-44. Nine patients age 20-44 died, though in the entire group most deaths were among adults ages 65 and older. It is clear from the above that Covid19 19 has devastating effect on the aged and patients with comorbidity.

INTRODUCTION

A. BIOLOGICAL FACTORS

The biological factors describe structural and functional changes in both the respiratory and the immune systems as they occur in the ageing process.

1.1. Structure and functions of the respiratory system

The human respiratory system is a series of organs responsible for taking in oxygen and expelling carbon dioxide. The primary organs of the respiratory system are the lungs, which carry out this exchange of gases as we breathe. The lungs work with the circulatory system to pump oxygen-rich blood to all cells in the body. The blood then collects carbon dioxide and other waste products and transports them back to the lungs, where they're pumped out of the body when we exhale, according to the (American Lung Association, 2020).

The organs of the respiratory system include the nose, pharynx, larynx, trachea, bronchi lungs alveolar ducts and respiratory muscles such as the diaphragm and intercostal muscles.

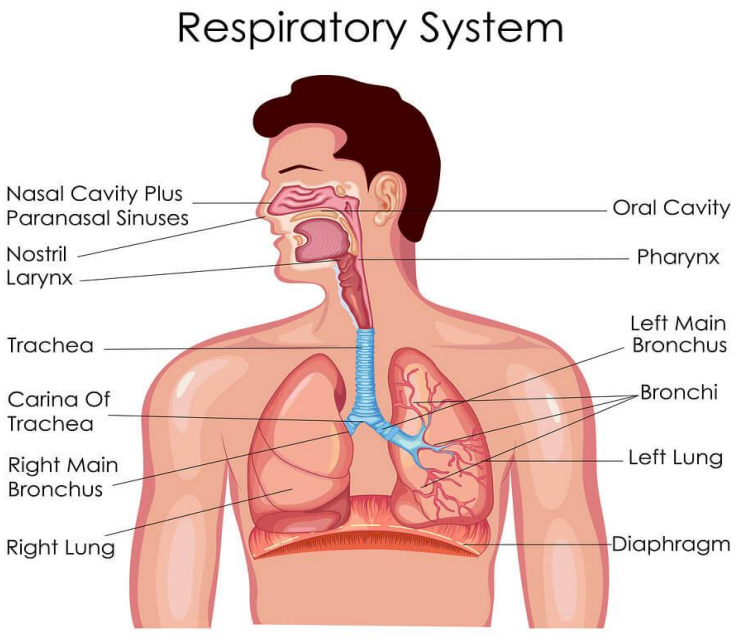

Figure No. 1: Anatomical view of Human respiratory system

The five primary functions of the respiratory system, in order of significance as mentioned (Marieb) 2014, are:

1. The inhalation and exhalation of air or **Breathing**. This involves the nasal and oral cavities, the pharynx, the larynx, the trachea and the lungs. Also involved are the diaphragm, the intercostal muscles, and the rib cage to pull in air for inhalation and push it out for exhalation.

2. **Gas exchange** between the lungs and the bloodstream (*External Respiration*). This involves the passage of oxygen from the air in the *alveoli* (tiny sacs at the end of the *bronchioles* in the lungs) through the alveolar and capillary walls to the blood in the capillaries, as well as the passage of carbon dioxide from the bloodstream to the alveoli.

3. **Gas exchange** between the bloodstream and the body tissues (*Internal Respiration*). This involves the transport of oxygenated blood from the heart to all parts of the body, where the oxygen is delivered to tissues and cells for energy and metabolism, while carbon dioxide, as a waste product, is absorbed by the blood.

4. Vibration of the vocal cords in the larynx to produce **Sound**. This is a more specialised function in which air passing over the vocal cords is modulated by laryngeal muscles pushing the vocal cords together so that they vibrate when air passes over them, creating sound.

5. The sense of **Smell**. *Olfaction*, or the sense of smell, occurs when air passes over olfactory fibres in the nasal cavities that sense certain chemicals in the inhaled air that bind to them and transmit a signal to the brain which is then identified.

1.2. Defense Mechanisms of the Respiratory System

Dezube, (2019) described the respiratory defense mechanism as follows; The average person who is moderately active during the daytime breathes about 20,000 liters (more than 5,000 gallons) of air every 24 hours. Inevitably, this air (which would weigh more than 20 kilograms [44 pounds]) contains potentially harmful particles and gases. Particles, such as dust and soot, mold, fungi, bacteria, and viruses deposit on airway and alveolar surfaces. Fortunately, the respiratory system has defense mechanisms to clean and protect itself. Only extremely small particles, less than 3 to 5 microns (0.000118 to 0.000196 inches) in diameter, penetrate to the deep lung. **Cilia,** tiny muscular, hair-like projections on the cells that line the airway, are one of the respiratory system's defense mechanisms. Cilia propel a liquid layer of mucus that covers the airways. The **mucus layer** traps pathogens (potentially infectious microorganisms) and other particles, preventing them from reaching the lungs.

Cilia beat more than 1,000 times a minute, moving the mucus that lines the trachea upwards about 0.5 to 1 centimeter per minute (0.197 to 0.4 inch per minute). Pathogens and particles that are trapped on the mucus layer are coughed out or moved to the mouth and swallowed. **Alveolar macrophages,** a type of white blood cell on the surface of alveoli, are another defense mechanism for the lungs. Because of the requirements of gas exchange, alveoli are not protected by mucus and cilia—mucus is too thick and would slow movement of oxygen and carbon dioxide. Instead, alveolar macrophages seek out deposited particles, bind to them, ingest them, kill any that are living, and digest them. When the lungs are exposed to serious threats, additional white blood cells in the circulation, especially neutrophils, can be recruited to help ingest and kill pathogens. For example, when the person inhales a great deal of dust or is fighting a respiratory infection, more macrophages are produced and neutrophils are recruited.

1.3 Respiratory system changes with ageing.

On the changes in the respiratory system, the respiratory muscles, like all skeletal muscles, weaken with age. Lung tissue loses its elasticity and alveoli are lost as their walls deteriorate. All of this results in decreased ventilation and lung capacity, but the remaining capacity is usually sufficient for ordinary activities (Scanlon and sanders, 2018). The cilia of the respiratory mucosa deteriorate with age, and the alveolar macrophages are not as efficient, which make elderly people more prone to pneumonia, a serious pulmonary infection (Guyton and Hall, 2012). Chronic alveolar hypoxia from diseases such as emphysema or chronic bronchitis may lead to pulmonary hypertension, which in turn overworks the right ventricle of the heart. Systemic hypertension often weakens the left ventricle of the heart, leading to congestive heart failure and pulmonary edema, in which excess tissue fluid collects in the alveoli and decreases gas exchange. Though true at any age, the interdependence of the respiratory and circulatory systems is particularly apparent in elderly people. Scanlon and sanders (2018) then suggested that the most important way to help your respiratory system age gracefully is not to smoke. In the absence of chemical assault, respiratory function does diminish but usually remains adequate. With these structural and functional changes in the respiratory system of the aged, it is evidence that the gradual deterioration could be aggravated by COVID 19 which also has devastating effect on the respiration system as it could cause severe pneumonia with associated complication and death among the aged.

2.1. Structure and functions of the immune system

Our immune system is essential for our survival. Without an immune system, our bodies would be open to attack from bacteria, viruses, parasites, and more. It is our immune system that keeps us healthy as we drift through a sea of pathogens. This vast network of cells and tissues is constantly on the lookout for invaders, and once an enemy is spotted, a complex attack is mounted. The immune system is spread throughout the body and involves many types of cells, organs, proteins, and tissues. Crucially, it can distinguish our tissue from foreign tissue — self from non-self. Dead and faulty cells are also recognized and cleared away by the immune system. If the immune system encounters a pathogen, for instance, a bacterium, virus, or parasite, it mounts a so-called immune response. Later, we will explain how this works, but first, we will introduce some of the main characters in the immune system (Delves, 2019).

2.2 Immune system changes with ageing

The immune system is the body's defense against foreign or dangerous invaders. Such invaders include microorganisms (commonly called germs, such as bacteria, viruses, and fungi) Parasites (such as worms), cancer cells and transplanted organs and tissues (Delves, 2019).

The immune system changes throughout life. As people age, the immune system becomes less effective in the following ways: The immune system becomes less able to distinguish self from nonself (that is, to identify foreign antigens). As a result, autoimmune disorders become more common. Delves, (2019) continued that Macrophages (which ingest bacteria and other foreign cells) destroy bacteria, cancer cells, and other antigens more slowly. This slowdown may be one reason that cancer is more common among older people.T- cells (which remember antigens they have previously encountered) respond less quickly to the antigens like virus. There are fewer white blood cells capable of responding to new antigens. Thus, when older people encounter a new antigen, the body is less able to remember and defend against it. Delves (2019) again explained that older people have smaller amounts of complement proteins and do not produce as many of these proteins as younger people do in response to bacterial infections. Although the amount of antibody produced in response to an antigen remains about the same overall, the antibodies become less able to attach to the antigen. This change may partly explain why pneumonia,

influenza, and tetanus are more common among older people and result in death more often. These changes may also partly explain why vaccines are less effective in older people and thus why it is important for older people to get booster shots (which are available for some vaccines). These changes in immune function may contribute to the greater susceptibility of older people to some infections and cancers hence the high mortality and mortality with COVID 19 among the aged. In his report to find out why are the death rates different from COVID 19 in other countries, Heise (2020) mentioned the average age of a population could play a role here. He continued that older people are at high risk of contracting the coronavirus as they often have pre-existing health conditions. That can make it easier for a virus to overcome a person's immune system — certainly easier than is with otherwise healthy people, who are often also young. He concluded that our immune defenses weaken as we get older, our immune systems become less effective, and that puts us at risk.

B. COMORBIDITY

One important factor that could also increase the morbidity and mortality of aged to COVID 19 is the issue of comorbidity as confirmed by several studies. In medicine, comorbidity is the presence of one or more additional conditions co-occurring with (that is, concomitant or concurrent with) a primary condition; in the countable sense of the term, a comorbidity is each additional condition. The additional condition may also be an infectious disease like COVID 19.

1.1. Comorbidity in Ageing

"Comorbidity" and "multimorbidity" are often used as interchangeable terms. However, in recent years, *comorbidity* more often describes the combined effects of additional diseases in reference to an index disease (eg, comorbidity in cancer). Meanwhile, *multimorbidity* is more often meant to describe simultaneous occurrence of 2 or more diseases that may or may not share a causal link in an individual patient (Van den Akker M, 1996). Elisa Fabbri, (2015) explained that aging is characterized by rising susceptibility to development of multiple chronic diseases and, therefore, represents the major risk factor for multimorbidity. The (Elisa Fabbri, 2015) findings continued that from a gerontological perspective, the progressive accumulation of multiple diseases, which significantly accelerates at older ages, is a milestone for progressive loss of resilience and age-related multisystem homeostatic

dysregulation. Because it is most likely that the same mechanisms that drive aging also drive multiple age-related chronic diseases, addressing those mechanisms may reduce the development of multimorbidity. According to Elisa (2015) studying multimorbidity may help to understand the biology of aging and, at the same time, understanding the underpinnings of aging may help to develop strategies to prevent or delay the burden of multimorbidity. As a consequence, we believe that it is time to build connections and dialogue between the clinical experience of general practitioners and geriatricians and the scientists who study aging, so as to stimulate innovative research projects to improve the management and the treatment of older patients with multiple morbidities. Elisa et al, (2015) concluded that ageing is the risk factor for multimorbidity.

1.2 Comorbidity with COVID 19

According to Hong-lei Yin et al (2017), comorbid conditions including cardiovascular and cerebrovascular diseases, endocrine and metabolic disorders, psychiatric and neurological disorders, gastrointestinal diseases, musculoskeletal disorders, non-COPD respiratory conditions, and cancer were significantly higher in patients suffering from COPD than in comparison the non-COPD control patients. Management of comorbidities should be an important part of COPD control strategies that can improve overall outcomes. Yang J et al, (2020) assessed the prevalence of comorbidities in the COVID-19 infection patients and found underlying disease, including hypertension, respiratory system disease and cardiovascular, may be a risk factor for severe patients compared with Non-severe patients. On the part of Li B et al (2020) Patients with previous cardiovascular metabolic diseases may face a greater risk of developing into the severe condition and the comorbidities can also greatly affect the prognosis of the COVID-19. On the other hand, COVID-19 can, in turn, aggravate the damage to the heart. Zhonghua Xin (2020) COVID-19 can significantly affect the heart function and lead to myocardial injury. The past medical history of CHD and increased level of cardiac troponin (cTnI) are two independent determinants of clinical disease status in patients with COVID-19. Guo T (2020) Myocardial injury is significantly associated with fatal outcome of COVID-19, while the prognosis of patients with underlying CVD but without myocardial injury is relatively favorable. Myocardial injury is associated with cardiac dysfunction and arrhythmias. Inflammation may be a potential mechanism for myocardial injury. Aggressive treatment may be considered for patients at high risk of myocardial injury.

CONCLUSION

In inclusion, it is obvious from the above literature review that COVID 19 has devastating effect on the aged due to usual biological deterioration process of the respiratory and the immune system. These biological changes in the ageing process make the aged vulnerable to the COVID 19. Available literatures further review that comorbidity is strong determinant of increase in morbidity and mortality of the aged to COVID 19. Also, the literature reviews suggest that there are not much research studies on the above subject areas especially in India and base on the findings from the above literature, it will be appropriate for some further works to be done that will direct some special health educational program targeted at the elderly or the aged.

Recommendations

1. It is recommended that some further research be done locally on COVID 19 to increase the knowledge on this subject in India.

2. It is also recommended that an appropriate health educational strategy be developed to create awareness among the aged population.

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