

THE IMMUNE SYSTEM IN THE ERA OF COVID-19

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Abstract

Recently our communities have been placed in peril due to the Covid-19 pandemic without a reliable cure and a lack of vaccines against this new coronavirus strain. We need to strengthen our immune system to cope with the Covid-19 pandemic and other diseases. People with asthma, heart disease, high blood pressure, diabetes or obesity are more vulnerable to becoming severely sick or dying due to this novel coronavirus. In the era of coronavirus it should be stressed that the above listed chronic diseases are mostly preventable. We have excellent programs which should be emphasized more stringently and more prudently implemented before the next wave of the Covid-19 pandemic or other emerging diseases. Just checking blood pressure, monitoring blood glucose level, sticking to a healthy diet, exercising, losing weight are some of the best approaches to enhance immunity. One very important action is to quit smoking and avoid drinking alcohol as much as possible. Other impacts on people's health are the stress that accompanies the lockdown, and poor sleep all of which can negatively contribute to one's immune response to Covid-19.

Key words: Covid-19, immune system, prevention

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Introduction

The immune system is one of the best defences against harmful pathogens. Our bodies are also protected by skin, air ways, gastrointestinal mucosa and membranes which play a significant role as barriers to stop bacteria, viruses, or fungi from entering our bodies. The first innate responder to infection is the immune system, which is composed of cells and chemicals that try to kill and destroy pathogens. When our innate immune system is not able to defeat pathogens that are circulating inside our bodies and they multiply, the adaptive immune system produces antibodies to protect us against these pathogens [1,2]. To support our immunity, we have vaccines which are one of the safest medication with little to no side effects. Unfortunately, sometimes, we endorse commercial promotions to buy supplements to avoid vaccination. There are plenty of diet, vitamins, minerals, antioxidants or probiotics supplements on sale [1], but modern science strongly suggests skipping most of the supplements and engaging rather in physical activity, eating a healthy diet and being vaccinated to boost one's immunity [1-3].

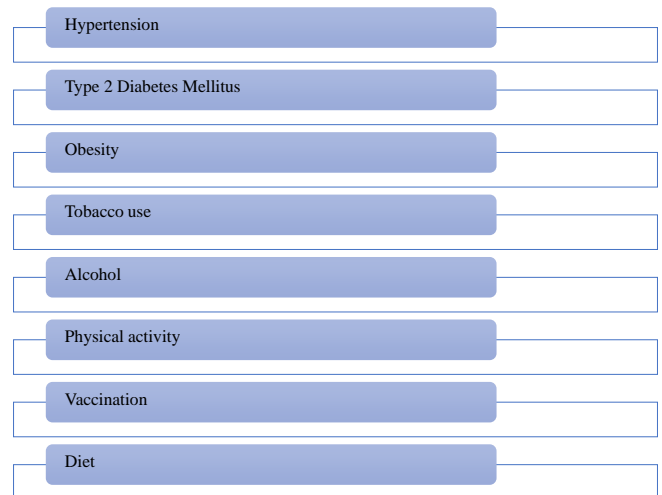


Fig. 1: The diseases and problems which should be maintained in the era of Covid-19.

Hypertension

All over the world, most health problems occur due to cardiovascular diseases, which is mostly affected by hypertension, with 1 billion adults already sick worldwide. Hypertension is one of the modifiable risk factors for cardiovascu-

lar death. Hypertension triggers inflammation and activates immune cells that can further elevate blood pressure [4, 5]. Every year, we should emphasize that seasonal influenza alone causes many more problems for people's cardiovascular systems than respiratory systems. Very frequently, pneumonia caused by influenza when added to hypertension can damage a person's cardiovascular system [3]. Any kind of inflammation in the human body has some negative consequences, such as damaging blood vessels, releasing cytokines, or causing renal impairment. Some of diseases such as influenza, respiratory syncytial virus (RSV), and recently SARS and SARS-Cov-2 [3] can induce temporary or long lasting inflammation issues. However, hypertension alone is able to influence the migration of immune cells, T and B lymphocytes, monocytes, pro-inflammatory cytokines which raise blood pressure and become a risk factor for a heart attack, ischemic stroke or renal damage [6]. An activated immune system when started can cause inflammation in many organs like the central nervous system (CNS) and arteries including peripheral blood vessels [4, 5].

Tobacco use

Tobacco use is another global health problem and economic burden. Smoking induces systematic inflammation and immunodeficiency, triggers the release of the pro-inflammatory cytokines, creates low-oxygen condition, and weakens the body's defences against viral or bacterial infection [7]. When Covid-19 makes us sick, first it attacks the respiratory tract. Tobacco use aggravates the dangerous Covid-19 situation. Cigarette smoking causes chronic bronchitis, lung damage, and negatively affects any treatments [7]. Unfortunately, smokeless tobacco is also not safe because it dysregulates the immune system and endothelial function as well as increases blood pressure. Globally, the prevalence of smokeless tobacco is growing rapidly, and it worsens human health [8].

Type 2 Diabetes Mellitus (T2DM)

Our immune system is targeted by chronic inflammation accompanying type 2 diabetes mellitus, which easily increases many kinds of virus or bacterial infections [9, 10]. High blood glucose level dysregulates the innate immune system which makes it less efficient to combat infections, particularly with comorbidities like Covid-19, Human Immunodeficiency Virus and other diseases [9]. When the immune system is partially damaged by chronic inflammation, the secretion of pro-inflammatory macrophages produces more cytokines and creates dysfunctions of natural killer cells (NK), which further heightens the risk of infections [11]. Hyperglycaemia is more frequent among obese people and

Primary

Genetic

Secondary

medications,
malnutrition,
surgery,
trauma,
liver disease,
elderly, newborn,
kidney disease,
sleep/fatigue,
mental health,
thermoregulation,
stress,
nutrition,
infections,
vaccination history,
hygiene,
travel,
air pollution

Fig. 2: Immunodeficiency, multiple risk factors.

smokers where the prevalence of infectious diseases is greater as compared to people with normal weight and who do not smoke [12]. The prediabetes condition is a risk factor for cardiovascular and pulmonary diseases [12]. This chronic inflammation accompanying T2DM creates the risk of greater incidence of the one oldest scourges, tuberculosis. The latent Mycobacterium tuberculosis currently infects one third of the world population [13]. Type 2 diabetes mellitus is on the rise mostly in developed countries and will become the seventh leading cause of death in 2030 [13].

Alcohol consumption

Any amount of alcohol intake could be dangerous for humans and lead to infections of the respiratory system such as pneumonia [14]. Alcohol negatively alters the immune system which becomes too weak to fight pathogens. An impaired innate and adaptive immune system in the younger population creates a more devastating impact on our overall health, mostly for men [15]. People who frequently consume alcohol have slower recovery from infections and their wounds heal more slowly. Alcohol abuse creates the risk of severe lung disease such as Covid-19 and some types of cancer but also has a negative impact on families and crime [15]. In the last decades, alcohol was allowed to be drunk in moderation. As the science progresses, the rules

have changed, and new, comprehensive studies have found compelling evidence to require people to stop consuming alcohol to diminish the spread of cancer and other diseases [14, 15].

Physical activity

Diet and exercise are the most effective factors to improve human health, and many papers support this statement. To be fit, we need about 30 minutes a day to exercise. Physical activity is beneficial to the innate immune system, which protects against infection [16, 17]. If a person is physically active for most days of the week, sufficient recovery is needed particularly from intense exercise which is crucial to avoid injury or fatigue. Proper nutrition, a healthy diet, a minimum of six hours of sleep, vaccinations, no alcohol consumption, and controlling psychological stress are very important. [16, 17]. Overall, the benefits of physical activity are enormous and well defined for everyone to implement. Exercise improves longevity and also the quality of life. Moderately intense physical activity of up to 45 minutes a day lowers chronic inflammation, improves the immune response, and prevents cardiovascular disease, some types of cancer, diabetes, obesity and cognitive impairment [18, 19]. When we are physically active, our sitting time is reduced, and we eat a more healthy diet, and improve lipids and glucose levels [19].

Obesity

Obesity rates have doubled over the past two decades and is on the rise worldwide. This is really a separate pandemic. By 2025, 18 per cent of men and 21 per cent of women on the earth will be obese [20, 21]. It is very important to know that obesity is a preventable disease which further negatively influences cardiovascular diseases, stroke, diabetes, and cancer [20, 21]. Obesity has a negative impact on the immune system as well as dysregulation of endothelial and lymphoid tissue [21, 22]. Obesity facilitates chronic inflammation, so an obese human body is more prone to infections and infectious diseases. Obese children have higher rates of allergies, T2DM and hypertension compared to normal ones [21]. Obesity is related to chronic low-level inflammation and has a negative impact on vaccine efficacy, cholesterol, triglycerides and insulin resistance [20, 22]. Obesity increases the risk of dementia and osteoarthritis that additionally cause health problems which are on the rise, too [20, 22]. A healthy lifestyle (e.g. diet, exercise) can alleviate, to a huge extent, the prevalence of diseases including obesity and diminish the economic burden of obesity [20].

Nutrition, diet

Nutrition plays an important role in life expectancy. Healthy diets have many benefits as they reduce the risk for diabetes, cardiovascular diseases, stroke, some cancers as well as ward off dementia and depression and strengthen the immune systems. A diet such as the Mediterranean diet is a good source of micronutrients and macronutrients, fibres, and polyphenols, and it also has health benefits [23, 24]. Nutrition rich vegetables, grains, seeds, nuts, and fruits have anti-inflammatory properties, which improve the immunity against inflammation [25]. A healthy diet has been associated with a reduced risk of cardiovascular diseases, stroke as well as many cancers, T2DM and obesity [23, 25]. A diet rich in vegetables, grains, fruits and extra-virgin olive oil is a key element in preventing chronic diseases and diseases of the elderly [23, 24]. An immune system combined with aging and an unhealthy diet has a lower number of lymphocytes such as T-cells, B-cells and an enhanced risk of infections [24].

Vaccinations

The body's defence in elderly people is limited as the innate and adaptive immune system deteriorates with age and is compromised by infectious diseases, toxins, and different kinds of illnesses. One of the best boosters of immunity are vaccines, which create herd immunity in the population and save millions of lives. Vaccines stimulate the production of lymphocytes, secreting antibodies, which prevent pathogens from replicating or help to kill them. Mostly, vaccines provide us with long lasting immunological retention against microorganisms that prevent infectious diseases. When we age, we lose a massive number of white cells such as macrophages, B-lymphocytes and T-lymphocytes, which exist to digest germs, produce antibodies to attack the antigens and fight infection [26]. Vaccines stimulate immunity, which improves the body's defence against infections [27]. As long as we are far away from a Covid-19 vaccine, which can take months to be provided to the public, our responsibility is to improve our immune systems just by being vaccinated on a larger scale against influenza and *Streptococcus pneumoniae* which can cause pneumonia. We should have in mind that any pathogen easily compromises the respiratory track and makes the situation much worse when attacked by SARS-CoV-2 [28].

Discussion

Most of experts warn of second Covid-19 wave when the summer ends or earlier. The second surge of the novel coronavirus could be worse, and resemble influenza symptoms and other seasonal respiratory viruses at the beginning. What we know right now is that the immune system

in elderly people is not efficient enough to fight the infection caused by coronaviruses. Most individuals with severe symptoms had extremely low levels of T lymphocytes, called T-cell.

When the innate immunity such as skin, mucous, membranes, body temperature, low pH, and natural killer cells all fail to combat an invading bacteria, viruses, parasite, or fungi, then the adaptive immunity tries to develop and secrete lymphocytes B and T. The number of T-cells could decrease due to aging, environmental factors, medical treatments or malnutrition, and they lose their power to combat pathogens. A decline in immune function creates a gradual immunosenescence of all cells, which triggers pro-inflammatory cytokines. A decreased number of T cells and B cells make the human body prone to infections and reduce the response to germs. Another problem is the higher rate of comorbidities, particularly common in the elderly. Seniors usually take some kind of medications, and many have had surgeries or trauma which worsen their overall health condition.

Obesity in developed countries is constantly rising, and it also deteriorates the immune system, activates production of cytokines and white blood cells, which predisposes a person to T2DM. Obesity causes chronic inflammation, increases the risk of infectious disease, and weakens the response to vaccines [21,22]. Similarly, alcohol impairs and weakens the immune system, and it makes human body more susceptible to infection such as pneumonia, sepsis and others ailments. Consumption of even a small amount of alcohol increases the risk of infections, including Covid-19 [15].

The immune system can and should be improved during a person's lifetime. Waiting for a vaccine against Covid-19, we need more emphasis on improving our health. The novel coronavirus can strike again in the few upcoming months or years, and the course of it could be much worse than the first one [25]. Diets such as the Mediterranean diet and physical activity are the best approaches to boost the immune system. Antioxidants and phytochemicals (e.g. grains, vegetables, fruits) should improve the function of the immune system also in combination with high intensity exercise. It was proved that physical activity plays an important role in gradually maintaining immunity, improving the immune system, and lowering chronic inflammation. One of the most important roles of exercise is its ability to reduce the risk for influenza and pneumonia. Probably, the best form of exercise is the moderate physical activity, on a daily basis, about half an hour a day. It improves the response to vaccinations and lowers the risk for respiratory diseases [16,17,18,19].

Hypertension alone impairs vascular relaxation, which makes negative structural changes in the vessels, which cause severe inflammation in the arteries, central nervous system and in other organs like the kidneys. Cytokines are

increased in a dysregulated immune system, and they elevate the blood pressure. In the developed world, a high salt diet is frequently consumed by individuals, so B cells, T cells and macrophages are producing more pro-inflammatory cytokines which worsen existing diseases, enhance inflammation and cause an increase in blood pressure [4,5,6].

A healthy lifestyle should be taken seriously by everybody but mostly by vulnerable individuals with underlying diseases such as metabolic diseases. Smokers are another group of people who are easily compromised by infectious diseases. Tobacco is the main culprit which consequently damages the human respiratory system [7]. Most researchers pointed out that the high severity of Covid-19 in smokers is due to irreversible lung damage [7]. Smoking induces chronic obstructive pulmonary disease, which is the fourth leading cause of morbidity and mortality. Cigarette smoking impairs the immune system which produces higher levels of cytokines and induces chronic inflammation. Smokers are more prone to infectious diseases and fight bacterial or virus infections less efficiently [7,8].

In the last decade, less people endorse vaccination programmes. Additionally, when our immune systems are compromised by aging, impaired vaccination response is observed making the vaccines less efficient to protect humans against infectious disease. That is why at this time the need to be vaccinated against influenza and pneumococcus before the next wave of Covid-19 cases matters the most. The less we became sick from the flu and its complication the less potential damage from SARS-CoV-2 [28]. Vaccines are the safest drugs, which create a defence against many pathogens. After vaccination, the immune system starts to produce antibodies and T-lymphocytes, which prevent pathogens from replicating or eradicate them [26,27].

Air pollution also creates health problems and increases the risk for many diseases, such as cardiovascular disease, pulmonary diseases, cognitive decline or dementia. Particulate matter and nitrogen oxide infiltrate the entire body, which causes inflammation and an excessive oxidative stress, and it compromises human health [22].

Conclusion

The body defence against infections is the immune system. The innate and adaptive immune systems should be fortified in different ways to protect a human body's immunity against diseases. Hypertension and obesity are preventable. We should lose weight if needed. Hypertension is most modifiable risk factor of death from cardiovascular disease. Obesity alone creates an economic burden equalling the cost of smoking, armed conflicts and terrorism combined. Our hope is that people entirely embrace a new vaccine against Covid-19 to create herd immunity, exercise regularly, eat an appropriate diet, stop drinking alcohol and

stop smoking cigarettes permanently. The methods to implement such a healthy lifestyle should be carried out on a larger scale. Not only health personnel, particularly experts in infectious diseases, but many famous, well-known people like actors, athletes, locally or globally popular people, or even people in local communities could be involved in the implementation such programs to reduce the burden of diseases.

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