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The impact of aerobic exercise on overall health, chronic disease management and COVID-19 outcomes – a literature review

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Abstract

Introduction and purpose

Physical activity and aerobic exercise have long been recognized as foundational to maintaining good health. Insufficient activity is linked to be a factor contributing to many chronic diseases, as well as a worse prognosis for COVID-19 infection. This review aims to present the current state of knowledge regarding aerobic exercise and physical activity – and to present this information to doctors and other medical staff, as well as to those who seek help in our healthcare system.

State of knowledge

Currently, there is a common understanding that, without physical activity, the human body begins to experience physiological changes. This is manifested in deteriorating health and a greater risk of falling into disorders such as cardiovascular disease, mental health problems, and metabolic syndrome.

With the outbreak of the COVID-19 pandemic, it was also understood that individuals with a worse state of overall health (with many risk factors) have a greater risk of severe cases of this infection and more serious complications.

Conclusions

Despite all the knowledge, there is still room to improve our understanding of this topic, creating clearer guidelines, and educating healthcare professionals and patients on the importance of physical activity. Therefore, it is important to investigate further the root causes and mechanisms behind both the positive effects of increasing physical activity and the negative effects of inactivity.

Keywords: aerobic exercise; COVID-19; chronic disease; mental health; endurance training

1. Introduction

Aerobic exercise has long been known to be a keystone of a healthy lifestyle and good quality of life [1,2,3,4,7,10,13]. However, it is still somewhat overlooked by a significant amount of the general population and healthcare professionals. Sometimes doctor's prescription of exercise for healthy and not-so-healthy individuals is limited to "move more, sit less". Thus, it is essential to advance our understanding of this topic in relation to overall health, mental well-being and prevention of chronic conditions, such as cardiovascular diseases and type 2 diabetes. The COVID-19 pandemic highlighted the critical importance of maintaining both physical (including immune system function) and mental health to better withstand unexpected and potentially deadly infectious diseases. Educating of both patients and their physicians about the value of regular, well-structured programmed workouts is essential for improving overall well-being, further delaying onset of chronic diseases and building resilience against future health challenges.

Aerobic training is defined as physical activities relying on moving large muscles in a rhythmic manner for a sustained period of time [5]. This type of effort causes an increase in breathing and heart rate and is described as moderate (50-70% of maximum heart rate - HRmax) to vigorous (70-85% HRmax) intensity exercise [6]. Examples of such activities include brisk walking, swimming, uphill walking, running, rowing, gardening, swimming and participating in team sports, depending on the fitness level of a particular individual [8].

There is an enormous amount of evidence of the health benefits of aerobic exercise. Examples of these benefits include: improving cardiovascular health [11], mental health, and cognition [14,15], improving cell metabolism, promoting weight loss, reducing blood pressure [12], and reducing risk of many chronic conditions such as type 2 diabetes, osteoporosis [9] and various types of cancer [16,17].

Current guidelines provided by World Health Organization (WHO) state that adults aged 18-64 should do, per week, at least 150-300 minutes of moderate-intensity aerobic exercise or at least 75-150 minutes of vigorous-intensity aerobic exercise (or an equivalent combination), and also do muscle-strengthening activities for at least 2 days a week. It is emphasized that any activity is better than none – coming from sedentary lifestyle person should gradually increase the amount of exercise until meeting guidelines [18]. The next interesting aspect of aerobic exercise is its influence on metabolic health, specifically - mitochondrial function. The role of mitochondria in metabolism is of great interest of the scientific community. Role of these organelles is to provide energy needed for cells in order to function properly [19]. Decline in their function is associated with many health problems such as metabolic [21], cardiovascular [20,36] and neurodegenerative disease [37,38], and most recently – COVID-19 [32,33,34,35]. Exercise and especially endurance training, is proven to be a powerful factor in improving mitochondrial activity and efficiency [22,23,24] and also in a process called mitophagy (clearance of mitochondria) [25,26]. These facts further underscore the connection between exercise and its role in preventing and managing diseases prevalent in our society.

2. Cardiovascular disease

Cardiovascular diseases (CVDs) consist of disorders such as acute coronary syndromes, stroke, hypertension, and atrial fibrillation. CVDs are the leading cause of death worldwide, surpassing both cancer and respiratory diseases [39]. They are usually caused by dysfunction of the vascular endothelium, build-up of fat deposits, and calcification occurring in blood vessels [40,41]. One of the primary behavioral interventions in people with risk factors or with already diagnosed problems is physical activity [42]. Mechanisms, in which activity prevents CVDs is improving insulin sensitivity, levels of blood lipids, improving cardiac output, improving blood pressure control and also enhancing quality of life, factor that must not be overlooked [62]. Studies show that all adults should implement training in their daily routine, as per guidelines for CVDs prevention [43]. There is also evidence that physical activity interventions were also beneficial in people without any detected risk factors [44].

3. Type 2 diabetes

In the roots of type 2 diabetes lies inability to effectively use the pancreatic hormone – insulin. Primary role of insulin is to control blood glucose levels. Physical activity is linked with improved insulin sensitivity, better function of pancreatic cells and blood vessels. Another mechanism is enhancing mitochondrial function [60], as stated in the introduction. Physical activity and aerobic training also improve function of cells in terms of glucose uptake caused, among other factors, by the activation of GLUT-4 protein and other pathways non-dependent on insulin production. It also enhances the storage of glycogen in muscle [61].

Diabetes is a leading contributor to cardiovascular diseases, blindness and kidney disorders. [45,46]. Aerobic training has been shown to enhance overall health, improve glycemic control in individuals with type 2 diabetes, and also promote weight loss. [47,48,49,50]. Many randomized trials tell us that increased activity can prevent or delay the onset of diabetes [48].

4. COVID-19

COVID-19 is a respiratory infectious disease which potentially leads to a range of other health complications in patients. So-called "long COVID-19" is associated with causing multiorgan disorders [31]. Because of that, it is essential to find ways of preventing severe cases and also mitigating effects in people who already have been through tough instances of this disease. One such intervention is physical activity [30,31].

Studies have shown that moderate-intensity exercise had a positive impact on reducing the severity and progression of COVID-19, there were also no severe side effects of such exercise regime in those patients [28,29]. One of the mechanisms that explain positive effect of physical activity in COVID-19 patients is enhancing immunity. It is achieved by increase in number of immune system cells and reducing inflammation. Another mechanism is better function of respiratory muscles – this can be crucial in mitigating the effects of severe cases of many upper respiratory tract infections, such as COVID-19 infection [58]. Studies suggest that physical activity is a useful predictor of all-cause mortality [59], including mortality connected to COVID-19. Some recommendations suggested that COVID-19 patients should follow a program consisting of aerobic exercise – moderate intensity for 20-60min, ideally 2-3 times a week [27].

5. Mental health

As COVID-19 pandemic showed, need for addressing mental health in every age group is a must. WHO states that mental health is more than absence of mental disorders – there is a wellbeing component that enables people to live a full and meaningful life [51]. Without improving mental health and with delaying or preventing onset of other chronic diseases we would be "healthy", but not according to a modern standard and common sense.

Physical activity shows effects in many mental disorders – depression, anxiety, alcoholism, and substance abuse [52,53,54]. It also causes improvements in cognition [55] and overall mood [56,57]. Possible reasons that attribute to these effects are psychosocial mechanisms, including changes in self-esteem – physical activity caused improvements in how people see themselves [63].

6. What can we do about this?

What we have already presented has many practical implications. Logically, some exercise is better than none. But what should we be doing and teaching our patients?

The first task is to educate ourselves and our patients. It is a crucial part of the equation. When we will understand the importance of physical activity and its underlying mechanisms, it will be easier to convince patients and ourselves that it is an obligatory part of our lives. There are many sources of knowledge and tools to do that, including WHO guidelines, articles, books and websites [68,69,70].

Secondly, it is important to not go all-out immediately – studies show that the risk of injury, and in consequence inactivity in the future, is significant in people starting a new exercise routine [64]. We should start with something easier, walking for example, and progress with time and adaptation of tissues. We also can encourage people to visit a physiotherapist to do an evaluation of their mobility (e.g. FMS), current level of fitness, and potential problems ahead of starting new exercise routine [65]. Easy start and prevention of injuries is particularly important in patients with obesity – their tissues and joints will be subjected to a much larger loads, and therefore a greater risk of damage [66,67].

Definition of aerobic training

As stated in the introduction aerobic training is described as moderate (50-70% HRmax) to vigorous (70-85% HRmax) intensity exercise sustained over long periods [6]. We can calculate HRmax by subtracting our age from 220 (e.g. if your age is 50, your HRmax will be around 170BPM; moderate intensity heart rate, HR, will be 85-119BPM, vigorous intensity HR will be 119-145BPM). Other tools that can be used to tell if we are in the correct zone are talk test and perceived exertion. Talk test is really simple – with moderate intensity exercise you will be able to talk in full sentences, but it would be challenging. With vigorous intensity exercise you won't be able to say more than a few words without pausing for a breath [71]. Perceived exertion is your subjective evaluation of exercise difficulty on a scale of 0-10. Moderate intensity exercise is usually a 5 or 6, vigorous intensity exercise is about a 7 or 8 [18].

Recommended quantity

According to WHO guidelines, children and adolescents (aged 5-17) should engage in an average of at least 60 minutes of moderate- to vigorous-intensity physical activity per day, primarily aerobic, with muscle- and bone-strengthening activities included at least three times per week.

Adults (aged 18-64) should engage in 150 to 300 minutes of moderate-intensity aerobic exercise or 75 to 150 minutes of vigorous-intensity aerobic exercise (or an equivalent combination) per week, along with muscle-strengthening activities on at least two days each week.

Older adults (aged 65 or above) should engage in 150 to 300 minutes of moderate-intensity aerobic exercise or 75 to 150 minutes of vigorous-intensity aerobic exercise (or an equivalent combination) per week, along with muscle-strengthening activities on at least two days each week. Additionally people aged 65 or older should, at least 3 days a week, engage in training that emphasizes functional balance and strength in order to enhance functional capacity and to prevent falls [18].

It is also stated that, across all age groups, there is potential benefits of engaging in even more exercise than stated above throughout a week.

What should first "prescription" look like?

If the person is beginning to be more active after a considerable period of sedentary lifestyle, first goals should be quite easy and achievable. It could be a 10-15 minutes walks once a day at a reasonable pace (about 3-5 on perceived exertion scale), followed by some easy stretching. With improvements in fitness level, time and intensity of the activity should be increased. It is also important to incorporate some muscle strengthening exercises 2-3 times a week with prior education on good technique, weight progression etc. [18,69,70].

Assessing the benefits

Another important aspect of engaging in a new exercise routine is assessing the changes that appear overtime. Psychological and physical benefits can be a strong motivator for continuing healthy behaviors, therefore it is crucial to monitor and discuss these improvements with our patients [72,73]. Highlighting the immediate benefits of exercise, such as improved mood and boosted energy levels, can enhance motivation and encourage patients to continue their engagement in an exercise routine.

This strategy suggests that focusing on short-term positive effects may be more effective in fostering exercise adherence than emphasizing long-term health advantages [74].

Role of strength and balance training

Despite focusing on aerobic training in our paper, we also want to emphasize the importance of two other aspects of a solid exercise routine – strength (physical activity and exercise that increase skeletal muscle strength, power, endurance, and mass) and balance (or stability) training (static and dynamic exercises that are designed to improve an individual's ability to withstand challenges from postural sway or destabilizing stimuli caused by self-motion, the environment, or other objects) [18].

Many studies provide evidence of an important role of these elements to enhance physical function, prevent injuries, lower risk of various diseases and improve overall health across various age groups [75,76]. Adults lose about 3-8% of their muscle mass per decade which can lead to sarcopenia and worse health outcomes as we age [77]. Therefore it is really important to include strength training as a way to mitigate that problem [78]. Another factor, as previously mentioned, is stability or balance. It gains more importance with age – deterioration in stability is linked with, among other problems, fall risk [79]. According to CDC, falls contributed to as many as over 38,000 in 2021 in adults aged 65 or older (making it leading cause of injury death for that group) [80]. It is widely accepted that balance or stability training can prevent many of that cases, increase level of physical activity and also positively impact overall quality of life [81,82].

8. Conclusions

Physical activity and aerobic exercise are long known to be a foundation of health and good quality of life. It's an element of treatment and prevention of many chronic diseases that cause significant social and economic burdens. Nevertheless, our knowledge and use of it regarding exercise is insufficient. In the process of medical education information about aerobic training and how to implement it in a patient's daily routine is scarce.

This article discusses the link between aerobic exercise, physical activity, overall and metabolic health. Disorders, such as cardiovascular disease, type 2 diabetes and mental disorders are leading causes of death and disability in today's world. Also, the COVID-19 pandemic caused healthcare planners to look more closely at the subject of insufficient activity and mentioned diseases as it resulted in far worse outcomes in SARS-CoV-2 infected patients. Current guidelines show promise in increasing activity by providing much-needed information for the average person.

There is a need for further research into the effects of aerobic activity, its link to chronic diseases, role in maintaining overall and metabolic health. There is also a need for more studies addressing the optimal amount of aerobic training for a healthy population, as well as for people with various conditions. Another crucial element is increasing awareness among healthcare professionals because of their role in providing the best care and information for patients.

Disclosure

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