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PHYSICAL ACTIVITY IN THE TIME OF COVID-19 PANDEMIC

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ABSTRACT. On 31 January 2020, the World Health Organization (WHO) declared a global state of public health threat following the outbreak of a new coronavirus responsible for COVID-19 infection. To prevent spreading of the disease, various measures such as closing institutions, curfews, locking the country, and targeted quarantine for suspects and infected people are implemented in different countries. Physical inactivity caused by long-term quarantine measures may reduce the regulatory capacity of organ systems to resist viral infections, such as the coronavirus SARS-CoV-2. This article aims to advise on how the physical population should exercise physical activity and athletes who are quarantined or, as a result of the measures, are unable to fully exercise in public facilities. As a solution to the lack of physical activity, taking into account the limitations of this time, we proposed a movement program, which we want to contribute to the prevention of disease in COVID-19 and to better manage the current pandemic situation.

Key words: *COVID-19, physical activity, physical program, upper respiratory tract infection, pandemic*

Introduction

COVID-19 is an infectious disease caused by the coronavirus SARS-CoV- 2. It was first identified in patients with severe respiratory disease in December 2019 in Wu-chan, China. In particular, COVID-19 infects the respiratory system, in severe cases causes severe pneumonia and can often lead to severe systemic failure and death of the patient (Bergendi, 2021 Yuki et al, 2020). On 30 January 2020, the World Health Organization (WHO) declared the outbreak of the

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disease to be a "public health emergency of international concern" and described it as a pandemic on March 11, 2020 (WHO, 2021). The COVID-19 pandemic caused by SARS-CoV-2 results in a devastating threat to human society in terms of health, economy and lifestyle. The new coronavirus COVID-19 currently accounts for more than 118 million confirmed cases, and more than 2.6 million people have died worldwide from complications related to the disease (WHO, 2021).

The viral infection is transmitted by droplets of secretion during coughing, sneezing and talking. It endangers persons who are in close or prolonged contact with the infected person. The infection is also transmitted through contaminated objects (Bergendiová, 2021). Recent findings show that a "bubble" with a diameter of 2 m can no longer be considered safe during movement, so we appeal to increased vigilance during physical activity. When running or cycling, a stream of dirty air is created behind the athlete, and it is therefore necessary for the person following the infected person to keep a distance of at least 5 to 20 meters and should not move in a straight line behind the person (Blocken, 2020).

Restriction of movement due to long-term quarantine also reduces social contact between people, which negatively affects the human body's ability to resist viral infections, resulting in an increased risk of damage to individual organ systems of the human body (Woods, et al., 2020). Public health recommendations for the prevention of the spread of COVID-19 tend to negatively affect the daily dose of physical activity. However, these findings need to be considered, as daily exercise of appropriate intensity can help fight disease by strengthening our immune system and suppressing some of the co-morbid conditions such as obesity, diabetes, hypertension and severe heart disease, which make us more susceptible to severe COVID-19 (Siordia, 2020).

Positive physical activity during the COVID-19 pandemic

At present, the issue of the influence of physical fitness on the course of SARS-CoV-2 infection is addressed by a lack of studies. However, it is documented that adaptations induced by regular physical activity lead to an improvement in the body's defenses, the actual level of which could affect the course of SARS-CoV-2 infection (Krüger, et al., 2016). According to Bergendi (2021), the immune system and immunity against viruses and bacteria are affected by various factors, including physical activity. Recreational sports or appropriate short-term physical exercise 3 to 4 times a week lasting 15-60 minutes at 40-60% of the intensity of maximum oxygen consumption (VO2 max) has stimulating effects on the immune system, or does not significantly affect its activity. This is also confirmed by experiments on animals given influenza viruses. They have shown

that even low physical activity and strength training, which patients performed before or after the disease, reduces the symptoms of viral load, morbidity and mortality from infection (Kohut, et al. 2009; Lowder, et al., 2005).

Physical activity acts as a modulator of the immune system. During and after exercise, pro- and anti-inflammatory cytokines are released and lymphocyte circulation increases. Such an approach has an effect on the lower incidence, intensity of symptoms and mortality from viral infections observed in people who regularly exercise. However, its proper implementation needs to be considered to avoid damaging the immune system (Da Silveira, et al., 2021). Other available scientific evidence suggests that regular exercise is beneficial to the immune system and reduces the risk of infection with certain types of infections, such as upper respiratory tract infections (Fondell, et al. 2011; Nieman, 1997). In this regard, several studies have revealed that mild or intense exercise results in several positive changes in the immune system (Nieman, 2000; Nieman, et al., 2005). Immunoglobulin A (IgA) is the predominant antibody contained in the secretions of the mucosal immune system, one of the body's first lines of defense against attack by upper respiratory tract pathogens (Yousfi, et al., 2020). Klentrou et al. (2002) reported that IgA concentration and excretion rate at rest were significantly increased in individuals with regular moderate physical activity.

Movement exercises performed with medium intensity have proven to be the most suitable for increasing the immunity of the human body (Li, et al. 2020). A large observational study lasting 8 years found that a group of people who performed 15 minutes of daily physical activity 6 days a week of low volume activity reduced overall mortality by 14%, cancer mortality by 10% and cardiovascular mortality by 20% compared to individuals in the inactive group (Wen, et al., 2011).

Negatives of physical activity during the COVID-19 pandemic

Nevertheless, pilot studies have confirmed the relationship between intense exercise and increased morbidity and susceptibility to viral respiratory infections (Murphy, et al., 2008). Prolonged and intense training, which is part of the top or performance sport more than 5 times a week at more than 80% VO2 max without sufficient regeneration, can weaken the immune system and cause reduced immunity of the individual (Bergendiová, 2021). The acute and chronic effects of physical activity on the immune response have been extensively studied in athletes (Jesus, 2021; Nieman, Wentz, 2019). Various epidemiological studies confirm that athletes who participate in races such as marathons or other endurance races have been at increased risk of upper

respiratory tract infections (Nieman, Wentz, 2019; Svendsen, et al. 2015; Gleeson, et al. 2013; Matthews, et al., 2002). For example, in a large group of 2,311 endurance runners, nearly 13.0% reported disease within a week of the Los Angeles Marathon compared to 2.2% of control runners (Nieman, et al., 1990). A one-year retrospective study of 852 German athletes showed that the risk of upper respiratory tract infection was highest in endurance athletes who simultaneously reported severe stress and sleep deprivation (König, et al. 2000). These studies have suggested that the risk of disease may increase when an athlete participates in competitive events, repeatedly undergoes unusually high load cycles, or experiences other stressors affecting the immune system, such as sleep deprivation or mental stress (Nieman, Wentz, 2019).

Excessive exercise is an intense exercise associated with an increased risk of disease attributed to immune dysfunction. After intense and long-term exercise, increased inflammatory biomarkers and an increased risk of upper respiratory tract infections have been observed in athletes. In the post-competition period, the increased risk of disease correlated with suppressed salivary IgA release, decreased activity of innate immune cells, and decreased T- and B-cell function (Jesus, 2021; Nieman, Wentz, 2019; Sharman, et al., 2019). After strenuous physical activity, there is a short-term transition period of reduced immune resistance (the so-called immunosuppressive window), which can last depending on the length and intensity of the exercise for about 3-12 hours (eg in endurance days). The period after intense exercise leading to increased inflammation, muscle damage, and a higher risk of infections may tend to expose the athlete to an increased risk of COVID-19 infection and subsequent slower recovery after infection. Therefore, close monitoring of respiratory and cardiac symptoms after overcoming COVID-19 infection is important (Bergendi, 2021).

The negative of the COVID-19 viral disease is also probably damage to the heart and its failure during physical activity, these conditions can occur even after overcoming the infection. Physical activity is not recommended during systemic viral disease (Inciardi, 2020; Yang, Jin, 2020). With COVID-19, there are concerns about the increased risk of complications after returning to sport, and we are slowly showing the possible short-term and long-term consequences of overcoming COVID-19. The consequences can range from heart problems to lifelong lung damage, and for many, returning to "normalcy" in everyday life can be a challenge, and sometimes it is necessary to take a break from sports in this case. Even after the asymptomatic COVID-19 infection, it is recommended to temporarily reduce the frequency and intensity of training focused on maintaining fitness for at least 2-4 weeks (Bergendiová, 2021).

Recommended physical activity during the COVID-19 pandemic

The above-mentioned studies document that intensive training or long-term intense physical activity can lead to a reduction in the body's defenses. It is not recommended to start an intensive exercise program unless the individual is adapted to these activities and has completed a professional examination. It is recommended to start the activity in low intensity and short load time and gradually increase the intensity. The World Health Organization recommends that physical activity be performed for 150 minutes of moderate-intensity physical activity per week. Bergendi (2021) recommends starting physical activity gradually and slowly and performing it according to her health condition. He considers it appropriate to set his movement routine with an easier exercise strengthening the stabilization system (so-called core), or exercises focused on flexibility - stretching or yoga. In addition, strength training should be included in the training, but should not exceed 60 minutes. For those who have health problems, it is recommended to consult their general practitioner before starting the exercise program. Before continuing the intensive training process, a thorough medical examination - preventive physical education and medical examination - should be performed.

Based on the many studies and recommendations mentioned above, we propose to perform physical activity through the first part of a comprehensive physical training program focused on the development of mobility. The program is primarily intended for professional soldiers, but with minor individual adjustments, we consider it a suitable physical activity for the general public. The exercise program can be used within the current temporal, spatial and material constraints caused by the pandemic situation. This program was scientifically verified in the field of increasing physical performance by Markovic (2018a, b). Comprehensive exercise program - the development of mobility consists of three parts. The first part consists of imitation exercises, which are performed as preparatory exercises for physical activity, which are performed at low or medium load intensity. These exercises are described in more detail in his article Markovič (2019). The second part consists of open palm blows to activate the muscles with a predominance of phasic tasks, but also as a means of increasing resistance to painful stimuli. The intensity of the strokes is determined by the instructor himself. The third part consists of compensatory exercises aimed at stretching the often shortened muscle parts with a predominance of tonic tasks and strengthening the muscle parts with a predominance of phasic tasks, which tend to weaken. Stretching is performed by the method of postisometric relaxation and strengthening in an isometric way (Markovič, 2020). Based on previous findings, we recommend performing this exercise 4 times a week for 20 minutes. For the more fit, we recommend a 10-minute supplement (a total of 30 minutes of exercise). We recommend maintaining a low to medium intensity, which you regulate individually based on the interval of exercise and rest.

Interval 20s + 10s	Description	COMPLEX MOVEMENT PROGRAM - DEVELOPMENT OF MOBILITY MONDAY, THURSDAY	
30	APNEA in breath to 20s, ventilation from 10s	eye gymnastics - eye movements to shape +	Markovič (2019)
1		athletic alphabet - low skipping	
1:30		athletic alphabet - medium skipping	
2		athletic alphabet - high skipping on the place	
2:30		athletic alphabet - trip over on the place	
3		athletic alphabet - active on-site kick-off	
3:30		imitation climbing - leg out scrunch on the place	
4		imitation swim - free style legs	
4:30		imitation swim - breaststroke legs	
5		imitation cross-country skiing - classic style	
5:30		imitation cross-country skiing - classic style	
6		imitation close-combat - kick knee / rope skipping - basic	
6:30		imitation close-combat - straightforward kicking / rope skipping - bell	
7		imitation close-combat - direct kick swing / rope skipping - skier	
7:30		imitation close-combat - side kick / rope skipping - one leg	
8		imitation close-combat - back kick / rope skipping - one leg	
8:30	punches with open palm (30s)	the area of abdominal muscles	Markovič, Šimonek (2020)
9		the area of gluteal muscle	
9:30		the outer and inner sides of the thighs	
10		the area of the tibia	
10:30	exercise 20s, rest 10s, **PNF / PIR stretching,** isometric strengthening	**stretching the hip flexors**	Markovič (2020)
11		**stretching the hip flexors**	
11:30		strengthening the gluteal muscle	
12		strengthening the gluteal muscle	
12:30		**stretching the hip flexors**	
13		**stretching the hip flexors**	
13:30		strengthening the gluteal muscle	
14		strengthening the gluteal muscle	
14:30		**stretching the lumbar erector**	
15		**stretching the lumbar erector**	
15:30		**strengthening abdominal muscles**	
16		strengthening abdominal muscles	
16:30		stretching the lumbar erector	
17		stretching the lumbar erector	
17:30		**strengthening abdominal muscles**	
18		**strengthening abdominal muscles**	
18:30		stretching muscles back of the lower limb	
19		stretching muscles back of the lower limb	
19:30		**Strengthening the front of the lower leg muscles and leg muscles**	
20		**Strengthening the front of the lower leg muscles and leg muscles**	
20:30	imitation of animal movement for 20s, rest 10s	**"crocodile" movement imitation**	SUPPLEMENT
21		**"crocodile" movement imitation**	
21:30		"kangaroo" movement imitation	
22		"kangaroo" movement imitation	
22:30		**"crab" movement imitation**	
23		**"crab" movement imitation**	
23:30		"cat" movement imitation	
24		"cat" movement imitation	
24:30		**"gorilla" movement imitation**	
25		**"gorilla" movement imitation**	
25:30		"monkey" movement imitation	
26		"monkey" movement imitation	
26:30		**"frog" movement imitation**	
27		**"frog" movement imitation**	
27:30		"bear" movement imitation	
28		"bear" movement imitation	
28:30		**burpee**	
29		**burpee**	
29:30		Jacik´s test	
30		Jacik´s test	

Figure 1. Scheme of a complex movement program - development of mobility 1 (Markovič, 2020)

Interval 20s + 10s	Description	COMPLEX MOVEMENT PROGRAM - DEVELOPMENT OF MOBILITY TUESDAY, FRIDAY	
30	APNEA in breath to 20s, ventilation from 10s	eye gymnastics - eye accomodation	Markovič (2019)
1		imitation climbing - upper body movements	
1:30		imitation of swimming - slow hand movement in freestyle	
2		imitation of swimming - slow hand movement in backstroke style	
2:30		imitation of swimming - slow hand movement in breaststroke style	
3		imitation of close combat - front + rear direct punch	
3:30		imitation of close combat - front + rear side punch (hook)	
4		imitation of close combat - front + rear bottom punch (uppercuts)	
4:30		imitation of close combat - front + back side elbow punch	
5		imitation of close combat - block against direct punch	
5:30		imitation of close combat - block against direct punch	
6		imitation of close combat - block against side punch	
6:30		imitation of close combat - block against direct kick	
7		imitation rope climb	
7:30		imitation throwing - left hand	
8		imitation throwing - right hand	
8:30	punches with open palm (30s)	the area of head	Markovič, Šimonek (2020)
9		the area of the bottom ribs and the lower fixators of the scapula	
9:30		the area of right upper limb	
10		the area of left upper limb	
10:30	exercise 20s, rest 10s, PNF / PIR stretching, isometric strengthening	**stretching of paravertebral muscles in the sagittal plane**	Markovič (2020)
11		**stretching of paravertebral muscles in the sagittal plane**	
11:30		strengthening the deep muscles of the torso	
12		strengthening the deep muscles of the torso	
12:30		**torso rotation -** in a kneeling position rotation of the spine on the right (left)	
13		**torso rotation -** in a kneeling position rotation of the spine on the right (left)	
13:30		spinal torsion exercise	
14		spinal torsion exercise	
14:30		**stretching the upper fixators of the scapula**	
15		**stretching the upper fixators of the scapula**	
15:30		**stretching the upper fixators of the scapula**	
16		strengthening the deep flexors of the head and neck	
16:30		strengthening the deep flexors of the head and neck	
17		strengthening the deep flexors of the head and neck	
17:30		**stretching the pectoral muscles**	
18		**stretching the pectoral muscles**	
18:30		strengthening the lower fixators of the scapula	
19		strengthening the lower fixators of the scapula	
19:30		**push-ups**	
20		**push-ups**	

Figure 2. Scheme of a complex movement program - development of mobility 2 (Markovič, 2020)

CONCLUSION

The global pandemic of COVID-19 in recent months has had a major strain on all spheres of human life and has not bypassed physical activity and sport. The recommended anti-pandemic measures have not demonstrated a 100% ability to reduce the growth of infected individuals. Currently, the most effective public health measure available is vaccination in combination with other anti-pandemic measures, which also include appropriately selected low- or medium-intensity physical activity, which contributes to strengthening the immune system and a healthier lifestyle. Strengthening the immune system is essential in such a period of restricted exercise. Adherence to the above recommendations can help people cope with the special situation that this situation brings, and we believe that they will contribute to improving the quality of life of the population and help to return to normal as soon as possible. We should not forget the prevention, which is a long-term result of continuous and systematic building of the immune system, which would make it easier for the body to overcome respiratory diseases. It is assumed that COVID-19 will not disappear from the population and new infectious diseases will emerge, which we will have to fight as a population, therefore preventive strengthening of the immune system in the form of appropriately selected physical activity is one of the effective forms of protection. Further research is needed to elucidate the greater implications associated with physical activity and COVID-19 disease, which will demonstrate clearer insights in this area.

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