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PHYSICAL EXERCISE AND COVID-19: MECHANISMS OF ACTION AND STRATEGIES TO COMBAT THE EFFECTS OF SOCIAL ISOLATION

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ABSTRACT

At the end of 2019, a new aggressive infectious respiratory disease was identified as COVID-19 (Coronavirus Disease 2019). The outbreak of COVID-19, which was originated in China, was quickly transmitted to more than 200 countries, which is why the World Health Organization, in the first half of March 2020, classified it as a Pandemic. It is known to the academic community that SARS-COV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), with high transmission speed, represents the type of coronavirus responsible for COVID-19. Although the pathophysiological mechanisms related to SARS-CoV-2 are unknown in their accuracy and complexity, the genomic similarities with SARS-CoV can help explain the inflammatory response in conjunction with a major change in the functioning of the immune system, which can result in the emergence of severe pneumonia, in addition to other pathological changes. This fact has led most countries to take several restrictive actions, such as social isolation, which, to the extent that it promotes a certain control in the development of the pandemic, can lead the individual to sedentarism and to important emotional changes. In this context, the adequate practice of physical exercise, with its well-known immunostimulating and anti-stress effects, can be a considerable component in the fight against Pandemic. Therefore, using the available scientific literature as a basis, this study aims to present characteristics of the new Coronavirus, demonstrate the impacts of COVID-19 and to approach the practice of physical exercises as a non-pharmacological strategy to prevent and avoid the worsening of the disease.

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INTRODUÇÃO

A new acute and aggressive infectious respiratory disease, caused by a new coronavirus initially known as New Coronavirus 2019 or 2019-nCoV (Wu *et al*., 2020) and later as SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), has been identified as Coronavirus Disease 2019 or COVID - 19 (Guo *et al*., 2020). The COVID-19 outbreak, which was originatedin the city of Wuhan in late December 2019, was quickly transmitted to all provinces in China and later to more than 200 countries (Fan *et al*., 2020). Therefore, in a short time, COVID-19 has undoubtedly become the main global concern in the health area. Attesting this feeling of perplexity, by April 18th, 2021, 140.887.145 cases of infections were registered worldwide, with 3.013.280 deaths, among which 13.900.091 cases in Brazil, with 371.678 deaths (JHU, 2021). It is worth mentioning that the World Health Organization (WHO) declared on January 30th, 2020, in Geneva - Switzerland, that the outbreak caused by COVID-19 constituted a Public Health Emergency of International Importance (OPAS, 2020).

Subsequently, on March 11th, 2020, COVID-19 was characterized by WHO as a pandemic (Buss *et al*, 2020). However, it should be noted that since the beginning of the pandemic period, mainly in the segment that encompasses the various health professions, several entities representing this sector, such as the Professional Councils, have mobilized themselves in order to amplify, as much as possible, the technical information to registered professionals, understanding that, in addition to being a new and unknown disease, health professionals would be those who would work professionally on the "front line", that is: they would be the professionals who would spend the longest time in contact with infected subjects. Converging with the reality that appeared at the time, the Regional Council of Physical Education of the State of São Paulo - Brazil (CREF4/SP), aiming to technically subsidize the entire segment of professional performance, especially the Physical Education professional, projected the creation of a "manual" of relevant information, called: *Recomendações da Educação Física frente à Pandemia por COVID -19* (Silva Jr *et al*., 2020). For the development of this project, CREF4/SP invited several academic professionals, including members of our group. Therefore, it is worth emphasizing that since the beginning of the second quarter of 2020, our group has been dedicated to collecting information that relates the practice of Physical Exercise with COVID-19. That said, it

is important to note that the Pandemic decree made the Brazilian government propose on March 13th, 2020, through the Ministry of Health, several measures to prevent the spread of the disease, guiding state and municipal managers to adapt accordingly. with the local reality. Among the various measures, social distancing stood out with great relevance. Following the guidelines of the Ministry of Health, the Public Power (in all spheres) indicated the closure of several spaces, both public (such as parks and beaches) and private. These measures were implemented in order to promote social distance, a strategy to contain the very rapid proliferation of the disease, which would certainly lead the country's health system to collapse. However, it is undeniable that these measures impacted, among other actions, the worrying decrease in the practice of activity and physical exercise performed by society in general. Ramallo (2018) mentions that, currently, Physical Exercise has been considered an integral and essential part in the procedures performed by multiprofessional teams that work in the treatment of various diseases and acts as one of the most important non-pharmacological resources for health promotion both in aspects biological and psychosocial and in most diverse age groups individuals. Since the beginning of the Pandemic, some studies have been published (Nyenhuis *et al*., 2020; Burtscher *et al*., 2020) pointing out the importance of the practice of regular physical exercises in the prevention and combat of COVID-19, as well as in the consequences of distancing Social. This situation was strongly evidenced by the recent publication of the American College of Sports Medicine (2020a), which positions itself indicating the need to maintain regular physical exercise during Pandemic. Recommendations in general, based on published research on the topic, such as that of Chen *et al*. (2020), indicate, for society as a whole, the practice of exercises with a local effect (with muscle strengthening, flexibility and balance) and a general cardiorespiratory effect (with walking, cycling on bicycles and climbing stairs). Thus, it seems clear the need for greater reflection on the practice of physical exercises, whether performed at home, in gyms or in open environments, to be considered as an essential activity during and after the Pandemic period of COVID-19. Therefore, using the available scientific literature as a basis, the present study aims to present general characteristics of the new Coronavirus, demonstrate the impacts of COVID-19 and address the practice of physical exercise as a preventive and therapeutic strategy against COVID-19.

Coronavirus and Covid-19: General characteristics: Felsenstein together with collaborating researchers, through the study entitled: *COVID-19: Immunology and treatment options*, published in 2020, point out that even the SARS outbreak (2002), during which the coronavirus (CoV) exhibited strong potential for dissemination epidemic and significant pathogenicity in humans, these viruses were known, mainly, to cause mild respiratory and gastrointestinal diseases. The authors mention that in the last two decades, three new coronaviruses entitled: 1. Severe Acute Respiratory Syndrome (SARS) -CoV; 2. Middle East Respiratory Syndrome (MERS) -CoV and 3. SARS-CoV2, crossed the species barrier and promoted significant outbreaks, characterized by high lethality rates in humans. The most recent addition to human pathogenic coronaviruses (hCoVs) is SARS-CoV2, the cause of COVID-19. Sohrabi *et al*. (2020) cite that, although the exact pathophysiological mechanisms underlying the emergence of SARS-CoV-2 are unknown (due to pending laboratory studies), the genomic similarities with SARS-CoV may help explain the inflammatory response that can lead to the onset severe pneumonia. Currently, thousands of coronavirus species are known, although only seven CoVs are recognized as human pathogens (Song *et al*., 2019). CoVs are large viruses enveloped with a positive, non-segmented, single-stranded RNA genome, making it the largest known genome of any RNA virus (Fehr and Perlman, 2015). As RNA viruses, CoVs evolve rapidly through homologous and non-homologous mutation and recombination, which expands their host range and facilitates the crossing of species barriers. The new coronaviruses SARSCoV, MERS-CoV and SARS-CoV2 are comparatively poorly adapted to humans, thus affecting their pathogenic potential (Drexler *et al*., 2014; Corman *et al*., 2018). Coronaviruses are often spherical in shape. Its most striking feature is projections on the virus' surface, known as "spikes". The virus membrane contains four structural components, the Spike (S), the Envelope (E), the Membrane (M) and the Nucleocapsid Protein (N), in addition to the enzyme Hemagglutinin Esterase (HE), as shown in Figure 1. The Spike protein (S) facilitates binding to the ECA2 transmembrane host receptor; the Envelope protein (E) together with the Membrane protein (M) forms the viral envelope and determines its shape; the hemagglutinin esterase enzyme (HE) may be similar to another mechanism for cell entry of new CoVs; the nucleocapsulated protein (N) is linked to the virus's genome RNA to form the nucleocapsulated. Adapted: Felsenstein et al. (2020).

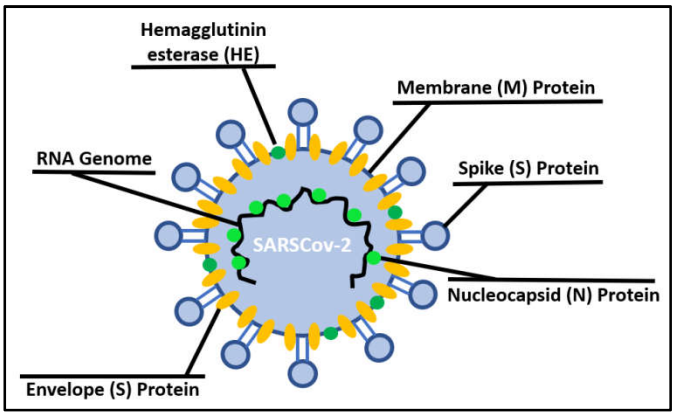

Fig. 1. SARS-CoV2 structure

It is important to note that in SARS-CoV and SARS-CoV2, protein S is the main determinant of host pathogenicity. Therefore, this protein becomes the main objective of the action of neutralizing antibodies and is of great interest in terms of the immune response and the design of possible vaccines (Hulswit et al., 2016). Walls et al. (2019), mention that the structure of protein S is formed by two subunits: S1, which forms the part involved in the recognition of receptors and S2, which anchors the protein in the viral membrane and facilitates viral fusion. The S1 contains a very variable loop that differs greatly between coronaviruses, both in size and in sequence. Viral entry requires proteolysis of protein S at two sites, a process that uses host proteases and results in irreversible conformational changes in protein S. According to Ou et al. (2020), the amino acid sequence of SARS-CoV2 receptor binding sites is 74% homologous to SARS-CoV, suggesting that the mechanisms of entry into cells are similar or even identical for both viruses. Tortorici and Veesler (2019), mention that SARS-CoV and SARS-CoV2 use Angiotensin-Converting Enzyme 2 (ACE-2) as a host receptor. However, the enzyme activity itself is not necessary for successful binding and fusion. The binding affinity between SARS-CoV2 protein S and ECA-2 is high. ACE-2 receptors are used by the virus to enter host cells (Letko et al., 2020). ACE-2 expression is detected in tissues found in the type I and II alveolar epithelium, upper respiratory system, heart, renal tubular epithelium, pancreas, endothelial cells and enterocytes. Thus, the external peak protein determines the infectious nature and host specificity of SARS-CoV-2. Host cells allow the virus to enter through a process called endocytosis (Dariya and Nagaraju, 2020). Zeng et al. (2008), mention that the coronaviruses present another structural protein, the hemagglutinin-esterase (HE) enzyme, present in the hCoVs envelope. HE is a marker of the evolution of hCoVs and the influenza virus. HE mediates reversible binding to O-acetylated sialic acids on cell surfaces. This link seems to optimize the virus' ability to invade the surfaces of host cells, constituting a virulence factor in new hCoVs.

Coronavirus and Covid-19: Mechanisms of action: As already discussed, SARS-CoV2 is the coronavirus that is most closely related to SARS-CoV. Both viruses use an angiotensin-converting enzyme (ACE-2) related receptor to gain access to cells. This receptor, as also already reported, is widely expressed in several organic tissues, as well as in some hematopoietic cells, including monocytes (later, macrophages). An important feature of COVID-19 infection is lymphopenia (low blood lymphocyte count), which correlates with clinical severity (Yang et al., 2020). In a recent publication in the

journal Science, researchers John B. Moore and Carl H. June (2020) cite that SARS-CoV efficiently infects primary human monocytes/macrophages and dendritic cells, and it is quite possible that SARSCoV-2 also infects these cells. As a result of the possible dysfunction of dendritic cells, apoptosis and exhaustion of T cells occurs, contributing to the immunopathology of COVID-19. However, the authors point out that lymphopenia, as a biomarker of bad prognosis for COVID-19, is not considered specific, since it has also shown to be a biomarker of high correlation with fatality in the influenza A (H1N1) pandemic, in the year of 2009. In addition, the authors still cite that Cytokine Release Syndrome (CRS), also called Cytokine Storm, was considered the main cause of morbidity in patients infected with SARS-CoV and MERS-CoV. Therefore, high serum concentrations of cytokines such as interleukin-6 (IL-6) and other inflammatory cytokines are characteristic of severe infections by MERS-CoV. SLC is common in patients with COVID-19, and the elevation of serum IL-6 is correlated with the Acute Respiratory Distress Syndrome (ARDS) and with adverse clinical results. Infection in monocytes, macrophages and dendritic cells by the coronavirus results in increased activation and secretion of IL-6 and other inflammatory cytokines (Fig. 2).

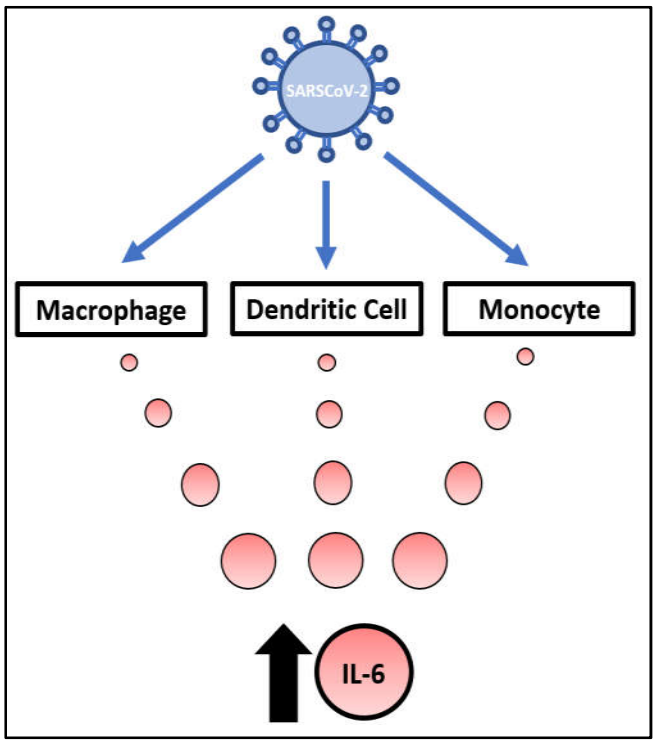

Fig. 2. Pathwaysleadingtocytokine release syndrome (CRS) orcytokinestorm. Coronavirusinfectionresults in the activation of monocytes, macrophagesanddendriticcells, increasingthe release of Interleuk in 6 (IL-6). Adapted: Moore and June 2020

IL-6 has prominent proinflammatory properties and can signal through two main pathways, called *cis* or *trans* signaling (Fig. 3). From these signals, it is worth mentioning, among several important ones, the control of the expression of an Acute Phase Protein (APP) secreted in the liver, called C-Reactive Protein (CRP). According to Aguiar et al. (2013), CRP was identified in 1930 and received this name because it reacted with pneumococcal C-polysaccharide in the acute phase of pneumococcal pneumonia. The measurement of CRP is, therefore, a direct determination of a APP and in the presence of inflammatory conditions, its serum concentrations change more rapidly and its variation is wider than that of the erythrocyte sedimentation rate (ESR). Moore & June (2020) cite that a high serum concentration of C-reactive protein (CRP), can also be considered a biomarker of severe coronavirus infection.

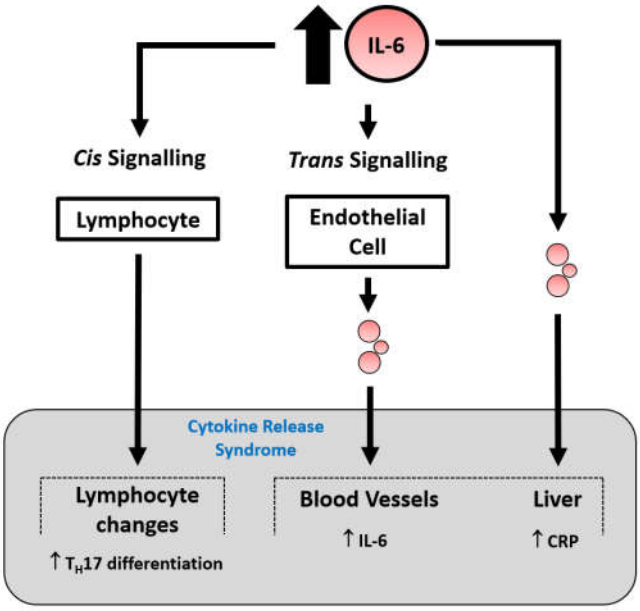

Fig. 3. The release of IL-6 activates a cascadeofeventsthatresults in cis signalingwith Th17 differentiation, amongotherlymphocytechanges, and trans signaling for manytypesofcells, such as endothelialcells. The increase in systemiccy to kine production contributes to the pathophysiology of severe COVID-19, including hypotension and acuterespiratory distresssyndrome (ARDS), whichcanbetreatedwith IL-6 antagonists. Adapted: Moore &June, 2020

Specifically considering the possible action of CoV on macrophages, an important cell of the immune system, Felsenstein et al. (2020), point out in a recent review that SARS-CoV and SARS-CoV2 use ACE-2 as a host cell receptor to establish infection (as already mentioned), although, according to the authors, ACE-2 is expressed in lesser amount in these cells. The host response and the elimination of viral infections strongly depend on the expression of Interferon type I (IFN-1). IFN-1 expression modulates cellular responses and reprograms cells to an "antiviral state", further promoting infection control and pathogen release. Several stages of molecular integration occur in this process, as elucidated in figure 4, published in the study by Felsenstein et al. (2020).

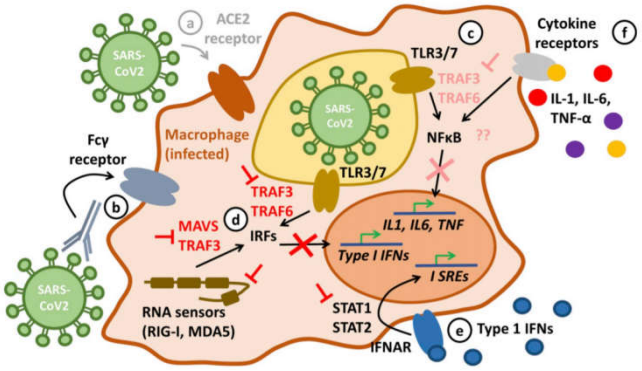

Fig. 4. Tissue macrophages express ECA2 to a significantly lesser extent, making infection by this path less likely (a). However, immune complexes consisting of ineffective antibodies against seasonal CoVs, in addition to virus particles, can be absorbed by macrophages through Fcγ receptors, resulting in infection (b). In a process known as Antibody Directed Enhancement (ADE), the viruses in question inhibit IFN-1 signaling in infected macrophages, allowing pro-inflammatory expression of IL-1, IL-6 and TNF-α, which can contribute to hyperinflammation and Cytokine Release Syndrome (c, d). The inhibited IFN-1 signaling suppresses antiviral programs (e), while the increased expression of IL-1, IL-6 and TNF-α is amplified through positive feedback cycles (f). Source: Felsenstein et al. (2020)

Some transcription factors, such as Nuclear Factor kappa-B (NFkB), play an important role as mediators of immunity and inflammation. NFkB mediates the effect of inflammatory cytokines, particularly

theTumor Necrosis Factor-α (TNF-α) which, when expressed in other cells such as skeletal muscle fiber, stimulates a large proteolytic process, promoting mass loss muscle and cachexia (Lima, 2017), characteristics associated with some Chronic Noncommunicable Diseases (CNCD) studied by some members of our group, such as Cancer (Nogueira & Lima, 2018; Lira et al., 2010). Moccia et al. (2020), in a recent review study, mention that, although COVID-19 is a respiratory disease and may progress towards adult respiratory distress syndrome (ARDS), one third of patients with more severe COVID-19 have conjunctivitis , gastrointestinal symptoms (nausea, vomiting or diarrhea) and acute multiple organ failure (for example: kidney, liver and heart), which can even lead to death.

Coronavirus and Covid-19: relationship with physical exercise and social isolation

The contemporary adaptations observed in society show that people started to move less and remain seated longer. The consequence of less movement is the decrease in people's energy expenditure. This reduction has contributed significantly to the increased risk of the appearance of CNCD, such as obesity, dyslipidemia, type II diabetes and some forms of cancer (Garber et al., 2011). On the other hand, the World Health Organization (2010) points to the benefits of regular physical exercise, which go far beyond the aesthetic condition, highlighting the improvement in cardiorespiratory fitness, muscle strength and endurance, flexibility, body composition control, decreased risk of metabolic and cardiovascular diseases, improved responses related to symptoms of anxiety, stress and depression, in addition to improving mood and stimulating social interaction. Therefore, it seems that combating physical inactivity is fundamental to avoid health problems arising from hypokinesia. These benefits are demonstrated for all age groups and for the many goals presented by the performers. The practice of Physical Exercises will collaborate for a better adaptation of aesthetic conditions, better sports performance, maintenance of health, prevention of injuries or illnesses and rehabilitation when, for some reason, health is impaired (Charro et al., 2018). For children, the routine practice of physical exercise is of great importance, as this collaborates with the process of growth and development, in which the different stages of maturation are associated with changes in the level of physical fitness, physical activity and performance of the individuals. In addition to the benefits offered to growth and development, another very important reason for the regular practice of physical exercises to be stimulated in children and teenagers is increasing the possibility of becoming active adults (Figueira Jr, 2018). The reports made available on a regular basis by the various World Government Agencies show a lower propensity for children to present the most serious forms of COVID-19 infection.

In the recent publication *COVID-19, Exercise, Children and their Developing Immune System* (2020), Dr Shlomit Radom-Aizik, a member of the American College of Sports Medicine, indicates that children appear to be less likely to develop the 'cytokine storm' , which as noted earlier, is a dangerous immune response. The Pediatric Committee of Exercise is Medicine, linked to this same institution, points out in its booklet *Keeping Children Active during the Coronavirus Pandemic* (2020b) that during this Pandemic, physical activity can provide immediate benefits, such as stress relief, reduction of behavioral problems, increased concentration and improved immune system. In the adult population, the proposal to perform physical exercises followed, for many years, the recommendations of the US Department of Health and Human Services (2018), the Centers for Disease Control and Prevention (2020) or the American College of Sports Medicine (2014), which indicated the accumulation of thirty minutes of moderate physical activity on most days of the week to avoid metabolic and cardiovascular problems. However, in a recent publication called *Guidelines on Physical Activity and Sedentary Behavior* (2020), the World Health Organization (WHO) proposed significant changes in these recommendations, indicated as a weekly goal to be reached by the adult population, the time from 75 to 150 minutes, if the exercise practiced is of vigorous intensity, or from 150 to 300 minutes, if the exercise practiced is of moderate intensity. These guidelines also mention the indication of physical activity for children and adolescents: 60 minutes daily, with the recommendation of physical activities with vigorous intensity to be practiced for at least 3 days a week.

However, as the adult population usually has well-established goals, but they are not always similar, it is important to understand that the best training prescription is the individualized one. Therefore, equating the volume, intensity, weekly frequency and duration of training is of fundamental importance to achieve the goals of both healthy individuals and those with some pathology (Pitanga, 2019). These recommendations are for people of all ages, but it is undeniable that special attention should be directed to the elderly, as in addition to being listed as a “risk group” for COVID-19, regular physical exercise is considered essential to slow the deleterious effects of aging, preserving and improving physical and functional condition, preventing and controlling diseases, benefiting the subjective perception of well-being (ACSM, 2020a; Machado et al., 2019; Simpson, 2020), as well as abolishing, even partially, the effects of immunosenescence and preventing a sharp decline in the functions of the immune system in this population (ACSM, 2020a; Simpson, 2020; Lima, 2018; Jiménez-Pavón et al., 2020). It should be noted that the COVID-19 pandemic imposed unprecedented restrictions on physical activity and the population's lifestyle. It is an undisputed fact that these restrictions aimed at minimizing the risk of local transmission of SARS-CoV-2 undoubtedly promote a reduction in the practice of activity and physical exercise, giving rise to a sedentary lifestyle. Pitanga, who organized and wrote, together with several researchers, the work *Orientações para Avaliação e Prescrição de Exercícios Físicos direcionados à Saúde* (2019), report the unquestionable adaptations that the practice of physical exercise, especially chronic, promotes in minimizing the symptoms of anxiety and depression, in controlling body weight and in the prevention and treatment of chronic non-communicable diseases, present in a large part of the population.

Among the various adapted body physiological systems, the immune system is highly responsive to the practice of activity and physical exercise. In their review study, Nieman & Wentz (2019) report a series of mechanisms associated with the immune system that are optimized by chronic practice of moderate-intensity physical exercise. Fallon (2020), points out that moderate intensity physical training is associated with a lower incidence, as well as a reduction in the duration and severity of upper respiratory tract infections (predominantly viral). Several epidemiological studies, according to Fallon (2020), suggest that the practice of regular physical activity and exercise are associated with a decrease in the incidence and mortality from influenza and pneumonia. Although, currently, there are no scientific data reporting direct effects of exercise on the prevention and treatment of coronavirus, especially SARS-CoV2, Kasapis & Thompson (2005), they indicate that the chronic practice of moderate physical exercise promotes, by adapting to the training at rest, decreased serum concentrations of IL-6, with a consequent decrease in CRP. It is worth remembering, as previously discussed, that IL-6, when stimulated in its release by dendritic cells and monocyte / macrophages infected by SARS-CoV2, induces a high production of several pro-inflammatory factors, such as CRP. Therefore, the chronic practice of physical exercise, by promoting a decrease in the secretion of IL-6 and, consequently, of CRP, seems to have an important effect on the functional optimization of the immune system, in particular, attenuating one of the pathways most stimulated by the infection. of SARS-CoV2.

However, specifically regarding the relationship between PCR and physical exercise, part of our research group developed a study, which aimed to evaluate the responses of blood concentrations of C-reactive protein ([PCR]) in university futsal athletes who participated in a session acute training. According to the results obtained, it was observed that an acute Futsal training session, consisting of exercises to improve strength, speed and develop technical and tactical aspects, does not constitute sufficient stimulus to alter, 48 hours after the end

of this session, the [PCR] in university athletes at the beginning of the competitive training phase (Nogueira, 2021 submitted). In addition, Dr. Richard J Simpson, another member of the American College of Sports Medicine, in a recent document entitled *Exercise, Immunity and the COVID-19 Pandemic* (2020), mentions that each physical training session, particularly the one consisting of exercises cardiorespiratory, rapidly mobilizes billions of immune cells, especially those that are capable of performing effector functions, such as recognizing and killing virus-infected cells. These immune cells, mobilized by exercise, are prepared to 'seek a fight', which, in theory, makes the individual more resistant to infection and more willing to deal with any infectious agent that has affected him. Exercise also releases several proteins that can help maintain immunity, especially muscle-derived cytokines, such as IL-7 and IL-15. The document also mentions that the cytokine IL-7 can stimulate the production of new T-Lymphocytes, while IL-15 would help in the maintenance of already existing peripheral T cells and NK (Natural Killer) cells, resulting in important actions in increasing resistance possible infections. The researcher also points out that, related to COVID-19, the practice of physical exercise does not seem to prevent the practitioner from being infected, if he is exposed to the virus. However, it is likely that the fact that an individual remains physically active, would improve the functioning of his immune system with consequent minimization of the deleterious effects of the virus, would alleviate the symptoms of the disease, accelerate the recovery times and decrease the probability of transmission to others people.

Another important mechanism, verified through an in vitro study with human subcutaneous adipocytes, indicates a positive effect of the hormone irisin together with the expression of multiple genes related to SARS-CoV-2 viral infection, an effect that can be translated into other tissues and organs targeted by the new coronavirus and therefore presents promising approaches for the treatment of COVID-19 infection as a therapeutic strategy to decrease ACE2 regulatory genes (Oliveira et al., 2020). It is worth remembering that irisin, a hormone identified less than a decade ago (Boström et al, 2012), is characterized by a myocin secreted primarily in the skeletal muscle tissue in response to muscle contraction. That said, it remains clear that the practice of different forms of physical exercise represents an important stimulus for the increase in irisin secretion (Nygaard et al., 2015; Tsuchiya et al., 2018) and, consequently, a non-pharmacological strategy to increase the serum concentration of irisin in the body, a fact that could be relevant to prevent or avoid the worsening of COVID-19. On the other hand, a recent study published by researchers linked to the University of São Paulo, on the *medRxiv* prepress platform, containing a sample of 200 subjects aged 55 years old, mostly with comorbidities and with different levels of physical fitness, points out that the regular practice of physical activity is not a determining factor to prevent the worsening of covid-19 (Pinto et al., 2020). Finally, it is worth emphasizing the recent position published by the American College of Sportts Medicine (2020a), which strongly indicates, during the pandemic period, the routine practice of activity and physical exercise for the general population, as a strategy to improve the functioning of the immune system, reduction of feelings of stress and anxiety and prevention of various pathologies, including viral ones, which can affect subjects who practice social isolation, probably in momentary sedentary conditions.

CONCLUSION

Although the pathophysiological mechanisms inherent to the emergence of SARS-CoV-2 are still unknown in its accuracy, the genomic similarities that it presents with SARS-CoV allowed the academic community to explain, even partially, its inflammatory response. In addition, it is worth mentioning that, as with any viral disease, an immunostimulatory condition will always be beneficial in combating pathologies of this nature. In this sense, the academic literature presents a consensus on the thesis that deals with the adequate practice of physical exercise, promoting adaptations that stimulate a better functioning of the immune system. Therefore, it is possible to hypothesize that the physically active individual has a greater chance of presenting, if affected by the virus, a milder symptomatology, although the academic literature does not present robust evidence to confirm this hypothesis. Specifically in the case of COVID-19, due to the implemented measures of social distancing used as a strategy to combat the pandemic, the practice of physical exercise presents itself as a non-pharmacological resource to, in addition to promoting immunostimulation, also reducing feelings of stress and anxiety, extremely recurring during this period.

Authors' contributions:WPL had the idea; WPL, MAC and VAPL searched the literature; WPL wrote the manuscript; MAC and VAPL read, analyzed and collaborated with the content of the manuscript; WPL edited the final document and responded to the reviewers. All authors read and approved the final manuscript.

Conflicts of interest: The authors declare no conflicts of interest.

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