

REVIEW

The effects of physical exercise, dance and movement therapy on the immune system during COVID-19 pandemic

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ABSTRACT

Objective: The COVID-19 pandemic has been challenging for everyone since it is confronted with various precautions such as lockdowns. For those who stay healthy and protect themselves from COVID-19, physical exercise and activity might be an effective solution since it has specific impacts on the immune system.

Methods: MEDLINE and SportDiscus data from the US National Library of Medicine were used to search for scientific literature related to this review. The terms "coronavirus", "physical exercise", and "immune system" were used. The relevant literature has also taken its source from the research of relevant articles from reference lists derived from data studies. An additional search for the term "dance and movement therapy" was made in Google Scholar generally because it is considered a proposal to promote well-being and high immunity in a community traumatized by the pandemic. Well-being and immune response were assessed in a separate search with the terms "well-being" and "immune", several additional sources were used to link a multisystem perspective.

Results: The effects of physical exercise and activity have been proven useful in defending the body against COVID-19 by supporting the immune system. Therefore, people should perform daily physical exercises and activities as advised during quarantine. They also should consider various factors such as intensity, duration, and amount of training, with appropriate rest time. Also, exercises such as movement and dance therapy including the type of movement that can engage physiological processes as a way to increase emotional regulation, and activities that potentially become more accessible in quarantine through conscious participation have been considered as a form of physical exercise.

Conclusions: Studies show that physical exercise and activities significantly affect the immune system since they form an immune response to various infections, viruses, etc. In addition, some factors, such as the intensity and duration of exercise, are essential. Dance and movement therapy as a home-based physical training helps counterbalance the destructive physical and mental side effects of COVID-19. Dance and movement therapy exercises that bring people together are beneficial in terms of psychosocial primary care, mood, and physical and mental health.

Keywords: immune system, physical exercise, dance and movement therapy, coronavirus, COVID-19 pandemic

INTRODUCTION

In December 2019, in Wuhan, China, the world started to change, despite being unaware of it at that time, this change would lead to significant transformations in various areas of people's daily lives and lifestyles. This massive change has been caused by a disease, SARS-CoV-2, in other words, Coronavirus Disease-2019 [1], which will be announced as a pandemic by the World Health Organization (WHO) later [2].

According to the studies conducted since the first case, COVID-19 has been known to be a member of β -CoVs [3], containing viruses such as SARS (SARS-CoV) and MERS (MERS-CoV) as well [4]. In addition, so far, the primary and standard modes of transmission of COVID-19 disease have been known as respiratory droplets and surface contact [5]. Cases with COVID-19 show symptoms such as coughing, high fever, difficulty breathing, fatigue, and so on [6]. After transmission, it is possible to discuss certain stages of this virus, which may be categorized into three: Stage I is accepted as an asymptomatic incubation period, and during this stage, the virus might not be detected, whereas, during Stage II, symptomatic period with the existence of virus is observed, however, symptoms generally remain non-severe during this process. Moreover, a high viral load is observed during Stage III, and severe symptoms are experienced, including respiratory symptoms [7]. In addition, it is also noted that cases older

than 60 years old and with chronic health problems such as hypertension, diabetes, cardiovascular, liver, and kidney diseases are more vulnerable to COVID-19, and higher mortality rates are observed [8-10].

On being announced as a pandemic by the WHO, various studies were carried out to take preventive precautions against COVID-19. In light of these studies and the views of a significant number of scientists and doctors from different parts of the world, people are advised to stay at home unless needed, wear medical masks, wash their hands regularly after contact with people or surfaces, do social distancing, and so on. The governments have been trying to find various solutions facing one of the most challenging health problems of all time, such as travel bans [11] and the closure of schools [12] to prevent the increase in cases. Among these solutions, the lockdown has been very effective [13] and has become prevalent worldwide, so human-to-human virus transmission would be somewhat hindered. However, lockdowns have caused significant impacts on people in different aspects, from physical to mental conditions, by restricting almost every sphere of life. The closure of gyms, stadiums, pools, dance and fitness studios, physiotherapy centers, parks, and playgrounds reduced the possibility to practice Physical Activity (PA) in an outdoor setting and, in general, the exercise options [14,15]. As an important example of its effect on physical condition, as a consequence of staying home for a long term, reduced physical

activity which had been inevitable for many people, ultimately leading to a sedentary lifestyle such as sitting, spending a long time in front of the screen, lying down and so on [16]. “Space limits mean short-sighted horizons with a restricted perspective and reduced ability to perceive distance, affecting life quality and vision functioning. The body adapts to a standstill position and boredom, falling into hypokinesia. Psychophysical disorders appear, compromising all senses, increasing damages to cardiovascular and pulmonary systems, stimulating diabetes.” [17]. In a stark warning to countries where health services are already creaking, the World Health Organization said the cost of failing to get people moving more would be about \$27bn (£24bn) a year [18]. Therefore, many professionals and health institutions have recommended physical activities and exercises at home, which are proven beneficial for the human body to be protected against COVID-

19 and to have positive effects on the immune system, which will be discussed in this study.

It is acknowledged that against COVID-19 the immune system helps the human body defend against pathogens such as viruses, bacteria, and so on [19]. In 1994, Nieman proposed the *J-shaped curve* (Figure 1) which demonstrated an interaction between physical exercise and the immune system by claiming that people performing moderate-intensity exercises confront a lower risk of contracting URTI and flu. On the other hand, people performing high-intensity exercises may also have a higher chance of URTI and other respiratory illnesses [20]. This concept sets a fine example to understand the correlation between physical activity and the immune system, although it is formed for URTI. Besides, it has been widely accepted and supported by many scholars and professionals since it was first proposed.

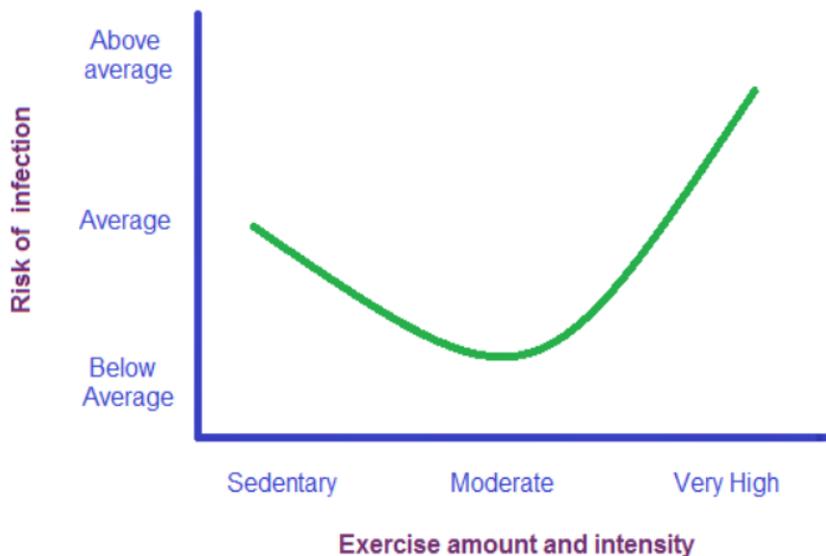


Figure 1. J-Curve Model proposed by Nieman. It is demonstrated that people with a sedentary lifestyle have an average risk of URTI, while people performing moderate exercise have a lower risk. On the other hand, people performing very high intensity and amount of exercise have a higher risk compared to people with a sedentary life [21].

There are three types of immunity: **innate** immunity, **adaptive** immunity, and **passive** immunity [22]. Among these, adaptive immunity plays an essential role in the clearance of viral-infected cells, reducing the spread and replication of the virus by giving a response in the case of COVID-19, for example, with the activation of T cells, production of proinflammatory cytokines and CD4 and CD8+ T cells [22,23]. There are many steps to take, such as physical exercise, to support the function of the immune system. For instance, regular moderate-intensity exercise positively impacts a decreased number of exhausted T-cells [24], elevated levels of T-cell proliferation

[25], reduced degrees of circulating inflammatory cytokines [26], increased neutrophil phagocytic activity [27], and high levels of NK-cell cytotoxic activity [28]. In addition, an increase in plasma levels of IL-7 might be expected with the prolongation of thymic activity [29]. Furthermore, releasing IL-15 from skeletal muscles, activated by physical exercise [30], may also support the immune system. It grasps the importance of all these effects of physical exercise and activities on the immune system against COVID-19; the chart (Figure 2) demonstrated below sets a good summary in this sense [31].

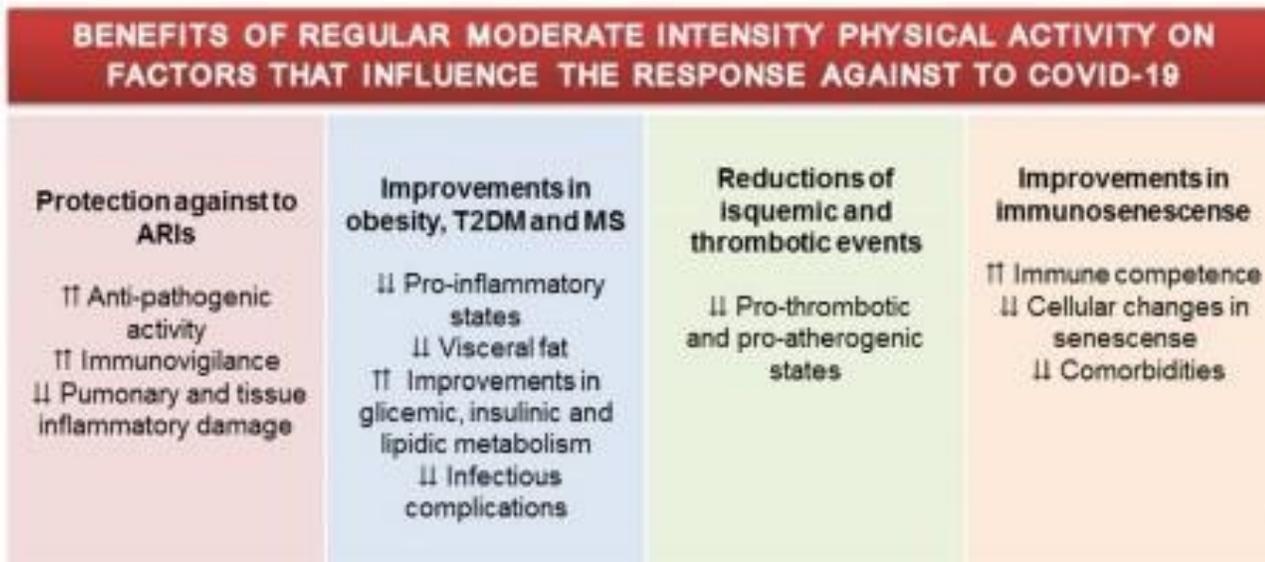
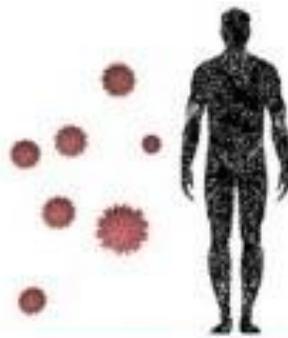


Figure 2. Chart for benefits of regular moderate-intensity physical activity on factors influencing the immune response against COVID-19 [31].

Besides, according to various studies, physical activity and exercise have also proved to be very effective mentally and physically, for instance, for patients with chronic diseases [32-34]. Therefore, the WHO recommends several physician practices and activities during this period that are easy to do at home [35]. These exercises might be even minor daily activities such as walking in the house, climbing stairs, carrying shopping bags [36-38], attending yoga [39] and dance/movement therapy [40] via online sessions, and moves that might be done even while watching television. Besides, to complete these exercises and stimulate their benefits for supporting the immune system. There are various tools, including media platforms such as social media, mobile phones, apps, computers, and so on.

On the other hand, to form an immune response, factors like regularity, intensity, and duration of an exercise are crucial as they might even lead to undesirable results. For instance, as stated before, high-intensity exercise, for an extended period, with improper rest time, might stimulate reduced cellular immunity, which may lead to an increased risk for infectious diseases [41]. “Physiological complications due to the pandemic have been reported to be severe in immune-compromised people including the obese, overweight, elderly, or subjects with metabolic syndrome or underlying pathologies. Similarly, anxiety and depression, the two major psychological complications reported during the COVID-19 pandemic are influenced by inflammatory pathways and neurotransmitters that are activated by an imbalance of the immune system” [42]. The

beneficial role of physical activity in disease prevention, as an adjuvant treatment in chronic diseases with a protective effect on the immune system, whose optimal status is crucial to respond adequately to the threat of COVID-19 [43].

In this sense, it is possible to state that physical exercise and activities positively impact the immune system to defend the body against COVID-19. Therefore, people should follow the advice of authorized institutions, doctors, and scholars related to physical exercise and activities during this period.

DISCUSSION

Throughout life, the brain balances activation and rest, stimulation and integration, via the biodynamics of the body [44,45]. Together, a neural network of structures regulates motor/sensory functioning and emotional states while coordinating arousal levels, the balance of neurotransmitters, and the focus of attention [46]. Their neural interconnections penetrate all parts of the brain and are linked to biochemical processes throughout the body such as hormone levels and the immune system [46,47]. In an epidemiologic study carried out by Fondell *et al.* on 1509 female and male adults, whose ages vary between 20 and 60 years old, participants were followed for four months, and their levels of physical activities were also determined with a questionnaire. In addition, their biological activities were assessed every three weeks. As a result of the study, it was found that for participants engaging in high physical activity,

a 18% decreased risk of illnesses, such as URTI, is observed compared to the participants who engage in lower physical activity levels [48]. Concerning epidemiology, exploration of movement with a social dimension such as assessment and analysis of folk dances can be reflected. Considering the importance of these continual activity branches in society, it has been emphasized that folk dances have a positive effect on sportive, pedagogical, physical, and spiritual development and therefore their importance in terms of public health [49].

In another study, a group of 22 marathon runners who had at least completed seven marathons and a controlled group of 18 sedentary participants were compared. It was found that the measured NK-cell activities of the two groups were significantly different. It was higher in marathoners, showing that they better protect against viruses [50].

In a study conducted by Nieman *et al.* on 1002 male and female adults aged between 18-85 years old, participants were followed for 12 weeks. Their physical activity levels were assessed with a questionnaire, and it was found that participants whose physical activity levels were higher had a decrease at the rate of 46% in total days with an illness [51].

Besides, two different exercise programs were adopted in a randomized controlled study by Nieman *et al.* related to moderate intensity exercise on 91 obese women for 12 weeks. One group performed a walking program for 45 minutes a day and five

days a week, while the control group performed a stretching program for 45 minutes a day and four days a week. As a result, fewer days with illness symptoms were reported in walkers compared to the control group [52].

CONCLUSION

During the days of COVID-19 and lockdown, in the light of these studies related to the benefits of physical exercise and activities on the immune system, an awareness of this subject should be raised among people, and they should be motivated to engage in physical practices and actions much more. Yoga, movement therapy, or dance, as forms of culture that unite communities in an age when life allows for virtual togetherness, should also be considered as opportunities to increase physical activity. However, while performing exercises and activities, one should consider that factors such as duration, intensity, and amount of exercise also play a critical role in its benefits on the immune system and, as a result, protection against COVID-19 pandemics.

Acknowledgments

We would like to express our special thanks of gratitude to Evangelia STAVROPOULOU for

her very successful contribution to the literature research process and unique academic

support in the publication during the process of this review article.

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