

# The COVID-19 pandemic and physical activity during intermittent fasting, is it safe? A call for action

**AUTHORS:** Hesam Addin Akbari<sup>1†</sup>, Amine Ghram<sup>1,2,3\*†</sup>, Mohammad Yoosefi<sup>1</sup>, Ross Arena<sup>2,4</sup>, Carl J Lavie<sup>2,5</sup>, Hamdi Chtourou<sup>6,7</sup>, Helmi Ben Saad<sup>8‡</sup>, Karim Chamari<sup>9‡</sup>

<sup>1</sup> Department of Exercise Physiology, Faculty of Physical Education and Sport Sciences, University of Tehran, Tehran, Iran

<sup>2</sup> Healthy Living for Pandemic Event Protection (HL – PIVOT) Network, Chicago, IL, USA

<sup>3</sup> Department of Cardiac Rehabilitation, Tehran Heart Center, Tehran University of Medical Sciences, Tehran, Iran

<sup>4</sup> Department of Physical Therapy, College of Applied Sciences, University of Illinois at Chicago, Chicago, IL, USA

<sup>5</sup> Department of Cardiovascular Diseases, John Ochsner Heart and Vascular Institute, Ochsner Clinical School the University of Queensland School of Medicine, New Orleans, Louisiana, USA

<sup>6</sup> Institut Supérieur du Sport et de l'éducation physique de Sfax, Université de Sfax, Sfax, Tunisia

<sup>7</sup> Activité Physique, Sport et Santé, UR18JS01, Observatoire National du Sport, Tunis, Tunisia

<sup>8</sup> Université de Sousse, Faculté de Médecine de Sousse, Hôpital Farhat HACHED de Sousse, Laboratoire de Recherche «Insuffisance Cardiaque» (LR12SP09), Sousse, Tunisie

<sup>9</sup> Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

† These authors contributed equally to this work as first author

‡ These authors contributed equally to this work as last author

**ABSTRACT:** Intermittent fasting (IF) has recently gained popularity, and has been used for centuries in many religious practices. The Ramadan fasting is a mandatory form of IF practiced by millions of healthy adult Muslims globally for a whole lunar month every year. In Islam, the “Sunna” also encourages Muslims to practice IF all along the year (e.g.; two days a week). The 2019-Coronavirus disease (COVID-19) pandemic in the context of Ramadan has raised the question whether fasting is safe practice during the COVID-19 pandemic health crisis, and what would be the healthy lifestyle behaviors while fasting that would minimize the risk of infection. As COVID-19 lacks a specific therapy, IF and physical activity could help promote human immunity and be part of holistic preventive strategy against COVID-19. In this commentary, the authors focus on this dilemma and provide recommendations to the fasting communities for safely practicing physical activity in time of COVID-19 pandemic.

**CITATION:** Akbari HA, Ghram A, Yoosefi M et al. The COVID-19 pandemic and physical activity during intermittent fasting, is it safe? A call for action. *Biol Sport*. 2021;38(4):729-732.

Received: 2021-04-23; Reviewed: 2021-05-09; Re-submitted: 2021-06-03; Accepted: 2021-08-02; Published: 2021-08-12.

Corresponding author:

**Amine Ghram**

Department of Exercise Physiology, Faculty of Physical Education and Sport Sciences, University of Tehran, Tehran, Iran.

Email: [amineghram.110@ut.ac.ir](mailto:amineghram.110@ut.ac.ir)

**ORCID:**

Hesam Addin Akbari  
0000-0003-4417-0151

Amine Ghram  
0000-0002-2851-0753

Mohammad Yoosefi  
0000-0002-5399-5000

Ross Arena  
0000-0002-6675-1996

Carl J Lavie  
0000-0003-3906-1911

Hamdi Chtourou  
0000-0002-5482-9151

Helmi Ben Saad  
0000-0002-7477-2965

Karim Chamari  
0000-0001-9178-7678

**Key words:**

Exercise Training  
Fasting  
Physical Inactivity  
Ramadan  
SARS-CoV-2  
Sedentary Behavior

## INTRODUCTION

Ramadan as a model of intermittent fasting (IF), is observed by millions of adults Muslims globally for a whole lunar month every year and is associated by changes in sleeping and activity patterns, as well as circadian rhythms of hormones [1, 2]. Healthy adult Muslims fast from dawn meal “Suhour” until dusk “Iftar” and fasting duration can typically range from 10 to 21 hours, depending on the season and geographical location (Ramadan slides around the year’s calendar on a 33 years’ cycle) [3]. Ramadan IF includes total abstinence from eating and drinking, smoking, and having sexual intercourse amongst others [4]. In 2021, and for the second consecutive year, Muslims worldwide celebrated Ramadan under the shadow of pandemic restrictions fighting deadly consecutive waves of coronavirus fueled by

new variants and, as a result, the Coronavirus disease 2019 (COVID-19) continued to spread in many countries for more than one year [5]. The COVID-19 outbreak has made the 2021 Ramadan IF for more than 2.18 billion Muslims globally more challenging. The practices associated with Ramadan does not appear to have a detrimental effect on COVID-19 outcomes [6]. Furthermore, discovering new Coronavirus mutations associated with increased mortality added to the concerns [7]. Coronavirus vaccination has instilled hope to eradicate COVID-19, but vaccination speed has plodding, especially in Muslim countries. Therefore, at present time, we do not know if Ramadan 2022 will be completely COVID-19 free, encouraging the authors of the present commentary to communicate on the topic.

Given that COVID-19 lockdowns primarily promote a more sedentary and passive lifestyle and could have deleterious effects in older adults [8], patient populations [9], athletes [10], and other specific groups including prisoners, refugees, and asylum seekers [11], the COVID-19 pandemic in the context Ramadan has raised the question whether IF is safe during this health crisis, and what would be the healthy lifestyle behaviors during Ramadan IF that would potentially minimize the risk of infection from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Importantly, Islam's "Sunna" strongly encourages healthy adult Muslims to intermittently fast out of Ramadan. Throughout the year, hundreds of opportunities to fast are there, e.g. two days a week, and/or three consecutive days of IF in the middle of the lunar cycle (full moon, white nights). Ramadan IF is not a cause for concern for healthy people who adopt a healthy diet and drink plenty of fluids during the dark hours, have adequate sleep, and perform regular physical activity (PA). As COVID-19 lacks a specific therapy and home confinement may induce negative impairment in sleep patterns and PA levels [12], Ramadan IF and PA could help sustain humans' immunity and may become part of holistic preventive strategies against COVID-19. Therefore, the present commentary focuses on this possibility and provides recommendations to the different community individuals. Ramadan fasting is a safe dietary pattern similar to IF (e.g., 16/8 hours) where dietary intake is limited to a short window during the day. Ramadan IF has been suggested not to be an appropriate dietary approach for some individuals, including patients with reactive hypoglycemia, kidney pathologies, children, pregnant women, and people performing heavy physical work [4, 13-16]. In addition, Ramadan IF can in certain extreme cases hamper the athlete's ability to train and compete, and discourage the general community to exercise [17]. Although Ramadan IF can lead to health issues such as fatigue, dizziness, sleep deprivation, irritability, and headaches [18], IF may confer cardiac protection, even after a cardiovascular event and optimize circadian rhythms and ketogenesis [19]. Patients with ischemic cardiomyopathy [20] and hemodialysis or peritoneal dialysis [21] should not be encouraged to fast only after consultation with their physician. Therefore, further studies are needed to investigate the safety of this dietary pattern in these patient populations and any ill person shall seek their physician before practicing IF to make appropriate adjustment to the medication dosage [4]. Patients may require further testing and risk assessment before performing regular exercise.

### *Practical recommendation during Ramadan and COVID-19 pandemic*

Research on the impact of regular PA and fasting during the pandemic is still not available. An overwhelming evidence demonstrates that PA plays a positive role in the primary and secondary prevention of several chronic medical conditions. In that regard, a recent study including more than 48,000 participants reported that adults meeting PA guidelines had reduced risk for developing severe COVID-19

outcomes in case of infection [9]. Accordingly, it seems that performing PA during the COVID-19 pandemic is safe and crucial for immunity and can decrease the risk of COVID-19 infection and many other diseases [8, 22, 23]. The need to develop effective strategies to maintain an optimal level of PA during Ramadan is of high importance [10]; COVID-19 control protocols, by itself, dramatically impacted humans' life patterns (e.g., PA, sedentary time), recreational PA, diet, sleep, weight, and wellbeing [24, 25], especially in the countries that have received the most impact from COVID-19 [26]. Moreover, individuals who fast are less inclined to exercise during Ramadan, which worsens PA levels during this month [27]. Therefore, Ramadan IF and PA could be a potential strategy amid this outbreak to support the immune system. In 2021, Aspetar provided clinical guidelines related to Ramadan IF and exercise for healthy individuals [17]. For athletes, and according to Aspetar guidelines [17], training times during Ramadan can be carried out during two main-time points: i) 1-2 hours before "Iftar": light to moderate technical/tactical sessions with low to moderate cardiovascular load, or, intensive resistance training sessions of relatively short duration; and ii) Starting ~3 hours after "Iftar": high intensity and/or long duration training sessions. For non-athlete healthy individuals, exercising while fasting during COVID-19 lockdown should ideally be performed during two main-time points: just before "Iftar" and/or 2-3 hours after "Iftar". We recommend low to moderate intensity exercise, as a possible safe and feasible activity, such as home-based free weight, bodyweight training, brisk walks, stretching, yoga, and gardening [4, 8, 28, 29]. These activities should be of moderate duration during Ramadan IF, especially at the beginning of the fasting month, when the body is adapting to the new dietary pattern. Subsequently, fasters can gradually increase the intensity and duration of PA. It should be noted that significant health benefits can be gained with adopting PA behaviors below the aforementioned ideal recommendations and, as such, individuals should be encouraged to move more and sit less through any possible means [30].

Regardless of PA timing, appropriate hydration (approximately 200 ml every 30 min) between "Iftar" and "Suhoor" is vital [31]. Exercising while fasting during the day can lead to increase water losses in sweat and from the lungs, which can cause headaches, tiredness, and difficulty of concentration. Thus, fasters should recover their hydration status during Ramadan by increased drinking during the night, in order to prevent the individuals from becoming chronically hypohydrated/dehydrated [18]. In addition, fasters should not skip "Suhoor". They should consume various foods, including many fruits and vegetables (water and fiber-rich foods), which can help prevent constipation while promoting immunity. Consuming low glycemic index foods at "Iftar", especially when they want to exercise after "Iftar" will prevent potential hypoglycemia during intensive exercise [32].

Sleep has been reported to be negatively affected by Ramadan IF [33]. Although sleep is known by its role in promoting immunity, prevalence of sleep disorders could be aggravated during the month

of Ramadan due to the stressful COVID-19 lockdowns. Some recommendations that can improve sleep quality include the following actions: afternoon napping, avoiding/minimizing screen viewing at least one hour before bedtime; avoiding prolonged, vigorous-intensity PA before sleep; and preparing a good sleep environment (comfortable, quite, dark and cool room) [34].

Finally, and most importantly, fasters who want to exercise during the COVID-19 pandemic should follow general healthy practices [35]. Sport and fitness equipment should be cleaned before and after use. Fasters should exercise in well ventilated rooms, use their own towel and supplies and avoid touching their eyes, nose, and mouth. Fasters should avoid exercising in groups to minimize human-to-human contact, maintain physical distance in-between individuals if exercise is performed in groups, and wearing masks in crowded places. Although the transmission risk of SARS-CoV-2 infection appears low in professional team players [36, 37], it is advisable to maintain more than two-meters distance between individuals because close running or cycling can increase the risk to be infected with COVID-19 [38, 39]. Thus, maintaining more extensive distances up to 10 meters is necessary when exercising inside indoor environment [39] even if face masks are used. Although the contradictory results to whether wearing face mask affects exercise performance, wearing face masks while exercising is recommended and can be used to slow the spread of SARS-CoV-2 infection. Face mask use seems safe and might be essential during aerobic activity such as running or cycling because it has been reported that small droplets can spread as far as five meters while walking at a pace of four km/h and 10 meters when running at 14.4 km/h [40]. Heart rate, respiratory rate, blood pressure, oxyhemoglobin saturation and time of exhaustion are not significantly affected by wearing a surgical mask or

N95 respirator during moderate to strenuous aerobic physical activity in healthy non-smoking volunteers [40]. People with lung or heart diseases should consult a physician before attempting physical activity with any mask [40]. In that regard, it has been shown that ventilation, cardiopulmonary exercise capacity and comfort are reduced by surgical masks and highly impaired by FFP2/N95 face masks in healthy individuals [41].

### CONCLUSION

To June 2021, there has been no currently experimental trial describing the impacts of exercising while fasting as a potential preventive measure to support the immune system in times of COVID-19 infection. This commentary presents an insight into the potential benefits against COVID-19 infection that could be attained through observing Ramadan and simultaneously practicing PA to potentially minimize the risk factors associated with the worst COVID-19 outcomes. In light of the scientific evidence presented here, exercising while observing Ramadan fasting in healthy adults may be safely performed during the COVID-19 pandemic, provided appropriate precautions are followed. However, people with pre-existing conditions should be aware of the potential complications of Ramadan IF. Healthy practices, such as while wearing face mask when exercising in groups, adjusting the exercise intensity, having a balanced nutrition and adequate sleep, are essential during Ramadan IF in order to help support immunity, in times of COVID-19 pandemic.

### Conflict of interests

The authors declare that this commentary in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

### REFERENCES

1. Lessan N, Ali T. Energy Metabolism and Intermittent Fasting: The Ramadan Perspective. *Nutrients*. 2019;11(5). Epub 2019/05/30. doi: 10.3390/nu11051192.
2. Trabelsi K, Bragazzi N, Zlitni S, Khacharem A, Boukhris O, El-Abed K, et al. Observing Ramadan and sleep-wake patterns in athletes: a systematic review, meta-analysis and meta-regression. *Brit J Sport Med*. 2020;54(11):674-680.
3. Chtourou H, Trabelsi K, Boukhris O, Ammar A, Shephard RJ, Bragazzi NL. Effects of Ramadan fasting on physical performances in soccer players: a systematic review. *Tunis Med*. 2019;97(10):1114-131.
4. Ghram A, Ben Saad H, Briki W, Jiménez- Pavón D, Mansoor H, Moalla W, et al. Ramadan Intermittent Fasting, Physical Activity, and COVID-19 Pandemic in Patients with Chronic Diseases. *Amer J Med*. 2021. doi: <https://doi.org/10.1016/j.amjmed.2021.04.035>.
5. Smirmaul BPC, Arena R. The Urgent Need to Sit Less and Move More During the COVID-19 Pandemic. *J Cardiopulm Rehabil Prev*. 2020;40(5):287-9. doi: 10.1097/hcr.0000000000000538.
6. Waqar S, Asaria M, Ghouri N, Suleman M, Begum H, Marmot M. Assessing the impact of Ramadan fasting on COVID-19 mortality in the UK. *J Glob Health*. 2021; 11:03060-. doi: 10.7189/jogh.11.03060.
7. Challen R, Brooks-Pollock E, Read JM, Dyson L, Tsaneva-Atanasova K, Danon L. Risk of mortality in patients infected with SARS-CoV-2 variant of concern 202012/1: matched cohort study. *BMJ*. 2021;372:n579. doi: 10.1136/bmj.n579.
8. Ghram A, Briki W, Mansoor H, Al-Mohannadi AS, Lavie CJ, Chamari K. Home-based exercise can be beneficial for counteracting sedentary behavior and physical inactivity during the COVID-19 pandemic in older adults. *Postgrad Med*. 2020;1-12. doi: 10.1080/00325481.2020.1860394.
9. Sallis R, Young DR, Tartof SY, Sallis JF, Sall J, Li Q, et al. Physical inactivity is associated with a higher risk for severe COVID-19 outcomes: a study in 48 440 adult patients. *Brit J Sport Med*. 2021:bjsports-2021-104080. doi: 10.1136/bjsports-2021-104080.
10. Yousfi N, Bragazzi NL, Briki W, Zmijewski P, Chamari K. The COVID-19 pandemic: how to maintain a healthy immune system during the quarantine - a multidisciplinary approach with special focus on athletes. *Biol Sport*. 2020;37(3):211-216. doi: 10.5114/biolSport.2020.95125.
11. Ghram A, Bragazzi NL, Briki W, Jenab Y, Khaled M, Haddad M, et al. COVID-19 Pandemic and Physical Exercise: Lessons Learnt for Confined Communities. *Front Psychol*. 2021;12(1533). doi: 10.3389/fpsyg.2021.618585.
12. Trabelsi K, Ammar A, Masmoudi L, Boukhris O, Chtourou H, Bouaziz B, et al. Globally altered sleep patterns and physical activity levels by confinement in 5056 individuals: ECLB COVID-19 international online survey. *Biol Sport*. 2021;38(4):495-506.

13. Abdelrahim D, Faris ME, Hassanein M, Shakir AZ, Yusuf AM, Almeneessier AS, et al. Impact of Ramadan Diurnal Intermittent Fasting on Hypoglycemic Events in Patients With Type 2 Diabetes: A Systematic Review of Randomized Controlled Trials and Observational Studies. *Front Endocrinol (Lausanne)*. 2021;12(39). doi: 10.3389/fendo.2021.624423.
14. Malinowski B, Zalewska K, Węsierska A, Sokotowska MM, Socha M, Liczner G, et al. Intermittent Fasting in Cardiovascular Disorders—An Overview. *Nutrients*. 2019;11(3):673..
15. Ganesan K, Habboush Y, Sultan S. Intermittent Fasting: The Choice for a Healthier Lifestyle. *Cureus*. 2018;10(7):e2947. Epub 2018/09/12. doi: 10.7759/cureus.2947.
16. Fenneni MA, Latiri I, Aloui A, Rouatbi S, Chamari K, Ben Saad H. Critical analysis of the published literature about the effects of Ramadan intermittent fasting on healthy children's physical capacities. *LJM*. 2015;10:28351. Epub 2015/06/11. doi: 10.3402/ljm.v10.28351.
17. Aspetar Clinical Guideline: Ramadan Fasting and Exercise for Healthy Individuals. Available from this link: [https://www.aspetar.com/AspetarFILEUPLOAD/UploadCenter/637556398121737163\\_Aspetar%20clinical%20guideline%20for%20Ramadan.pdf](https://www.aspetar.com/AspetarFILEUPLOAD/UploadCenter/637556398121737163_Aspetar%20clinical%20guideline%20for%20Ramadan.pdf). (last visit: June 3rd 2021). Qatar: Aspetar Orthopedic and Sports Medicine Hospital; 2021.
18. Leiper JB. Effects on health of fluid restriction during fasting in Ramadan. *Eur J Clin Nutr*. 2003;57:S30-S8. doi: 10.1038/sj.ejcn.1601899.
19. Dong TA, Sandesara PB, Dhindsa DS, Mehta A, Arneson LC, Dollar AL, et al. Intermittent Fasting: A Heart Healthy Dietary Pattern? *Amer J Med*. 2020;133(8):901-7.
20. Salim I, Al Suwaidi J, Ghadban W, Alkilani H, Salam AM. Impact of religious Ramadan fasting on cardiovascular disease: a systematic review of the literature. *Curr Med Res Opin*. 2013;29(4):343-54.
21. Ahmad S, Chowdhury TA. Fasting during Ramadan in people with chronic kidney disease: a review of the literature. *Ther Adv Endocrinol Metab*. 2019;10:2042018819889019..
22. Filgueira TO, Castoldi A, Santos LER, de Amorim GJ, de Sousa Fernandes MS, Anastácio WdLdN, et al. The Relevance of a Physical Active Lifestyle and Physical Fitness on Immune Defense: Mitigating Disease Burden, With Focus on COVID-19 Consequences. *Front Immunol*. 2021;12:150.
23. Laddu DR, Lavie CJ, Phillips SA, Arena R. Physical activity for immunity protection: Inoculating populations with healthy living medicine in preparation for the next pandemic. *Prog Cardiovasc Dis*. 2020;S0033-620(20)30078-5. doi: 10.1016/j.pcad.2020.04.006.
24. Curtis RG, Olds T, Ferguson T, Fraysse F, Dumuid D, Esterman A, et al. Changes in diet, activity, weight, and wellbeing of parents during COVID-19 lockdown. *PLoS one*. 2021;16(3):e0248008. doi: 10.1371/journal.pone.0248008.
25. Ammar A, Trabelsi K, Brach M, Chtourou H, Boukhris O, Masmoudi L, et al. Effects of home confinement on mental health and lifestyle behaviours during the COVID-19 outbreak: Insight from the ECLB-COVID19 multicenter study. *Biol Sport*. 2021;38(1):9-21. doi: 10.5114/biolport.2020.96857.
26. Tison GH, Avram R, Kuhar P, Abreau S, Marcus GM, Pletcher MJ, et al. Worldwide Effect of COVID-19 on Physical Activity: A Descriptive Study. *Ann Intern Med*. 2020;173(9):767-70. Epub 06/29. doi: 10.7326/M20-2665.
27. Alghamdi AS, Alghamdi KA, Jenkins RO, Alghamdi MN, Haris PI. Impact of Ramadan on Physical Activity and Sleeping Patterns in Individuals with Type 2 Diabetes: The First Study Using Fitbit Device. *Diabetes Ther*. 2020;11(6):1331-46.
28. Chtourou H, Trabelsi K, H'mida C, Boukhris O, Glenn JM, Brach M, et al. Staying Physically Active During the Quarantine and Self-Isolation Period for Controlling and Mitigating the COVID-19 Pandemic: A Systematic Overview of the Literature. *Front Psychol*. 2020;11(1708). doi: 10.3389/fpsyg.2020.01708.
29. Bentlage E, Ammar A, How D, Ahmed M, Trabelsi K, Chtourou H, et al. Practical Recommendations for Maintaining Active Lifestyle during the COVID-19 Pandemic: A Systematic Literature Review. *Int J Environ Res Public Health*. 2020;17(17):6265.
30. Arena R, McNeil A, Street S, Bond S, Laddu DR, Lavie CJ, et al. Let Us Talk About Moving: Reframing the Exercise and Physical Activity Discussion. *Curr Probl Cardiol*. 2018;43(4):154-79.
31. Aloui A, Baklouti H, Souissi N, Chtourou H. Effects of Ramadan fasting on body composition in athletes: a systematic review. *Tunis Med*. 2019;97(10):1087-94.
32. Chamari K, Roussi M, Bragazzi NL, Chaouachi A, Abdul RA. Optimizing training and competition during the month of Ramadan: Recommendations for a holistic and personalized approach for the fasting athletes. *Tunis Med*. 2019;97(10):1095-103.
33. Trabelsi K, Ammar A, Zlitni S, Boukhris O, Khacharem A, El-Abed K, et al. Practical recommendations to improve sleep during Ramadan observance in healthy practitioners of physical activity. *Tunis Med*. 2019;97(10):1077-86.
34. Romdhani M, Souissi N, Chaabouni Y, Mahdouani K, Driss T, Chamari K, et al. Improved Physical Performance and Decreased Muscular and Oxidative Damage With Postlunch Napping After Partial Sleep Deprivation in Athletes. *Int J Sports Physiol Perform*. 2020;15(6):874-83.
35. Aspetar clinical guideline: Safe return to sport during the Covid-19 pandemic. Available from this URL: [https://www.aspetar.com/AspetarFILEUPLOAD/UploadCenter/637532352577633336\\_Aspetar%20Clinical%20Guideline%20-%20Safe%20return%20to%20sport%20during%20the%20COVID-19%20pandemic%20Version%202.0.pdf](https://www.aspetar.com/AspetarFILEUPLOAD/UploadCenter/637532352577633336_Aspetar%20Clinical%20Guideline%20-%20Safe%20return%20to%20sport%20during%20the%20COVID-19%20pandemic%20Version%202.0.pdf) (last visit: June 3rd 2021). Qatar: Aspetar Orthopedic and Sports Medicine Hospital; 2021.
36. Schumacher YO, Tabben M, Hassoun K, Al Marwani A, Al Hussein I, Coyle P, et al. Resuming professional football (soccer) during the COVID-19 pandemic in a country with high infection rates: a prospective cohort study. *Brit J Sport Med*. 2021:bjsports-2020-103724. doi: 10.1136/bjsports-2020-103724.
37. Jones B, Phillips G, Kemp S, Payne B, Hart B, Cross M, et al. SARS-CoV-2 transmission during rugby league matches: do players become infected after participating with SARS-CoV-2 positive players? *Brit J Sport Med*. 2021:bjsports-2020-103714. doi: 10.1136/bjsports-2020-103714.
38. Arias FJ. Are Runners More Prone to Become Infected with COVID-19? An Approach from the Raindrop Collisional Model. *J Sci Sport Exercise*. 2020;1-4. doi: 10.1007/s42978-020-00071-4.
39. Setti L, Passarini F, De Gennaro G, Barbieri P, Perrone MG, Borelli M, et al. Airborne Transmission Route of COVID-19: Why 2 Meters/6 Feet of Inter-Personal Distance Could Not Be Enough. *Int J Environ Res Public Health*. 2020;17(8). doi: 10.3390/ijerph17082932.
40. Epstein D, Korytny A, Isenberg Y, Marcusohn E, Zukermann R, Bishop B, et al. Return to training in the COVID-19 era: The physiological effects of face masks during exercise. *Scand J Med Sci Sports* 2021;31(1):70-5. doi: 10.1111/sms.13832.
41. Fikenzer S, Uhe T, Lavall D, Rudolph U, Falz R, Busse M, et al. Effects of surgical and FFP2/N95 face masks on cardiopulmonary exercise capacity. *Clin Res Cardiol*. 2020;109(12):1522-30. doi: 10.1007/s00392-020-01704-y.