


The comparison of the lifestyle of vaccinated versus unvaccinated elite athletes during the Covid-19 pandemic: A multi-country comparison

Mahdi Ashouri¹, Morteza Taheri^{1,2*}, Khadijeh Irandoust¹, Masoud Mirmoezzi³

1. Department of Sport Sciences, Faculty of Social Sciences, Imam Khomeini International University, Qazvin, Iran.
2. Department of Behavioral and Cognitive Sciences in Sport, Faculty of Sport Sciences and Health, University of Tehran, Tehran, Iran. (*Corresponding author: ✉ taheri.mortza@ut.ac.ir,  <https://www.orcid.org/0000-0001-8031-3792>)
3. Department of Sport Sciences, Faculty of Physical Education and Sport Science, Islamic Azad University, Tehran, Iran.

Article Info	Abstract
<p>Original Article</p> <p>Article history: Received: 19 July 2021 Revised: 10 August 2021 Accepted: 25 August 2021 Published online: 01 November 2021</p> <p>Keywords: COVID-19, dietary behaviors, elite athletes, sleep quality, vaccination, physical activity.</p>	<p>Background: The COVID-19 pandemic has resulted in global home confinement and quarantine, leading to the vaccination of societies worldwide. However, some elite athletes have negative views toward vaccination.</p> <p>Aim: This study aimed to compare the lifestyle of vaccinated versus unvaccinated international elite athletes during the COVID-19 pandemic.</p> <p>Materials and Methods: From March to October 2021, an online survey was conducted, including socio-individual information of athletes, the International Physical Activity Questionnaire (IPAQ), the Rapid Eating Assessment for Participants (REAP-S), and the Petersburg Sleep Quality Questionnaire (PSQI). A total of 581 elite athletes from 4 continents (Europe, Asia, Africa, and America) and different countries, aged 18-35 years, were voluntarily recruited. Data analysis was performed using U-Mann-Whitney and Wilcoxon signed-rank tests, with the level of significance set at alpha $P < 0.05$.</p> <p>Results: The results indicated that there was a significant difference between the level of physical activity and eating behavior of vaccinated versus unvaccinated elite athletes ($P < 0.001$). However, no significant difference was found between the quality of sleep among vaccinated and unvaccinated elite athletes ($P = 0.270$).</p> <p>Conclusion: It was shown that, despite the unvaccinated status of some elite athletes (49.9%), their physical activity levels were higher than those of vaccinated elite athletes during the COVID-19 pandemic. Additionally, the eating behavior of vaccinated elite athletes was better than that of unvaccinated elite athletes during the COVID-19 pandemic, but there was no significant difference in the quality of sleep between the groups.</p>

Cite this article: Ashouri M, Taheri M, Irandoust Kh, Mirmoezzi M. "The comparison of the lifestyle of vaccinated versus unvaccinated elite athletes during the Covid-19 pandemic: A multi-country comparison". *Sport Sciences and Health Research*. 2022, 14(2): 189-199. doi: [10.22059/SSHR.2023.357170.1082](https://doi.org/10.22059/SSHR.2023.357170.1082).



This is an open access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (CC BY NC), which permits distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.
EISSN: 2717-2422 | Web site: <https://sshr.ut.ac.ir/> | Email: sshr@ut.ac.ir

© The Author(s). Publisher: University of Tehran, Faculty of Sport Sciences and Health

1. Introduction

The first patient infected with coronavirus disease (COVID-19) was reported in Wuhan, Hubei province, China on 12 December 2019. The cause of this disease was a new type of genetically modified virus from of corona virus's family so-called Covid-19 [1, 2]. It is highly contagious pathogenic viral infection which spread rapidly around the whole world less than four months due to onward transmission [3, 4].

Studying the impact of COVID-19 on athletes is crucial for understanding the potential health risks and performance implications of the virus in this population, as well as informing strategies for prevention, management, and safe return to play."Covid-19 home confinement had a negative effect on sports activities [5] and psychological and emotional disorders, as well as sleep quality and nutrition behavior in all people over the world especially in athletes [6]. As a result, sports events at all levels (recreational, professional and elite levels) were all affected by the viral outbreak such as the cancellation and postpone of 2020 Olympics. Regarding the athlete vaccination during the pandemic, there was no definite guideline compared to general population. That's was why most athletes refused to be vaccinated due to its possible side effects [7].

Since, there was a possibility of its side effects (e.g., reduced sporting performance, nutritional and sleep cycle disruption) on sports performance, many athletes refused to inject vaccine [7, 8]. The vital role of nutrition in maintaining and promoting the immune system and the vital role of micronutrients in the optimal functioning of immune system have been well documented [9, 10]. Quarantine has probably affected

the perceived food habits and behaviors of athletes during the pandemic [11]. In this regard, dietary habits are defined as "the habitual decisions of individuals or a group of people regarding what foods they eat" [12].

On the other hand, it has been reported that production and also the closure of food manufacturing companies during the pandemic has affected people's eating behaviors [13].

There are evidences suggesting that sleep is a major component in cognition [14], learning and memory consolidation [15], well-being [16] cell growth and repair [17], glucose metabolism leptin [18] and ghrelin secretion [19] and immune system function [20]. Apparently, improved quality of sleep in athletes is of utmost importance for recovery and energy conservation objectives [21]. It has been reported that athletes are faced with lower sleep quality and mental health status during the pandemic [22]. Furthermore, it was shown that elevated sleep disturbance was found during the pandemic suggesting the presence of chronobiologic disorder [22]. This disorder would probably increase nutrition behavior and also metabolism [18]. It has been well proven that physical activity is a main neuroprotective and antidepressant factor [23].

During the exercise, stimulation of factors originating in the brain is occurred. It consists of neurotrophic factors derived from the brain and endorphins which potentially have a positive effect on the functioning of the nervous system [24]. Infectious diseases would possibly lead to, increased risk of infarction, heart failure and arrhythmias [25]. As regular exercise improves circulation and breathing processes, it is believed that physical activity is

necessary during the pandemic [24].

The optimal functioning of blood circulation affects improvement of pulmonary functions leading to making anti-inflammatory reactions [26, 27]. The impact of vaccination on global health is well understood. Except for clean water healthy water, no other method has had such a major impact on reducing mortality and population growth [28]. However, some people like elite athletes had refused to inject it due to reasons such as reluctance to receive the vaccine, concern about possible side effects and safety as well as lack of trust in the vaccine production process. Therefore, it was aimed to compare the lifestyle of vaccinated versus unvaccinated elite athletes.

Also, since the outbreak of the Corona virus, there has been no research that examines the lifestyle of vaccinated and unvaccinated elite athletes during the quarantine of this virus. Therefore, the purpose of this study was the comparison of the lifestyle of vaccinated and unvaccinated elite athletes during the Covid-19 pandemic.

2. Materials and Methods

A cross-sectional study design was carried out. A convenience non-probabilistic and snowball sampling method was employed to compare the lifestyle of vaccinated and versus unvaccinated international elite athletes during the covid-19 pandemic.

2.1. Participants

The research participants included 581 elite athletes (athletes whose income is only from sports and participated in the highest level of competitions; 68.67% men, 31.33% women) in 4 different continents, including Turkey (Ankara), Brazil (Sao Paulo, Curitiba and Rio de Janeiro), UAE (Abu

Dhabi), Malaysia (the city of Kuala Lumpur), Tunisia (the city of Tunis) and Iran (the cities of Karaj, Tehran and Qazvin) in 2021. They were surveyed based on convenience and snowball sampling.

The inclusion criteria were as follows: a) Age ≥ 18 years; b) Quarantine experience during the pandemic (at least one week); c) Financial independency from sports. Table 1 shows the demographic characteristics of the participants. The ethical considerations were regarded based on declaration of Helsinki in the research.

2.2. Research instruments

An online survey was conducted from March to October 2021. The questionnaires consisted of socio-individual information of participants including International Physical Activity Questionnaire (IPAQ), Rapid Eating Assessment for Participants (REAPS) and Petersburg Sleep Quality Questionnaire (PSQI). Questionnaires were provided through google doc form to the elite athletes.

2.3. PSQI sleep quality

PSQI examines people's attitude about sleep quality in the last four weeks and has seven points. Each scale of the questionnaire gets a score from zero to three. The internal consistency of the questionnaire using Cronbach's alpha has been measured as 0.83 [29]. In the Iranian version of this questionnaire, validity was 0.86 and reliability was 0.89 [30].

2.4. IPAQ

This questionnaire aims to get information about the physical activities that people do as part of their daily life. Questions will be about the times you were physically active during the past seven days. It takes into account the activities you do at work, or as

part of housework and yard (gardening), going from one place to another, sports training, and activities you do as fun in your free time, which fall into three categories. 1. Style, 2. Moderate, 3. Severe. The validity of this questionnaire is 0.96 within the range of 0.46 and the reliability is $\rho = 0.30$ [31].

2.5. REAPS

REAPS is a self-report questionnaire designed to assess the eating behaviors of individuals. The validity and reliability of the REAPS have been evaluated in several studies, with generally positive results. In terms of validity, the REAPS has been found to have good convergent validity, meaning that it correlates well with other measures of eating behaviors and attitudes. The test-retest reliability of the REAPS was acceptable, with an intraclass correlation coefficient of 0.76. Additionally, the REAPS was originally developed for use with college students, so its validity and reliability in other populations may be less well-established [32].

2.6. Statistical analysis

To assess the normality of the sample distribution, the Kolmogorov-Smirnov (K-S) test was employed, and to assess the equality of variance, Levene's test was used., respectively. All the data in tables and text is presented as frequency, percentage, mean, and standard deviation. Independent t-test and chi-square were also used to compare the demographic information of vaccinated versus unvaccinated elite athletes. The Mann Whitney U test was used to compare the physical activity levels between two independent groups of vaccinated and unvaccinated athletes. The Wilcoxon Rank Sum test was used to compare the physical activity levels within one group. These tests

were employed to assess the impact of vaccination status on the physical activity levels of athletes. The level of significance was set at alpha $P < 0.05$. All statistical analyses were computed utilizing SPSS v. 23 (IBM Corporation; Armonk, NY, USA) and Excel spreadsheet (Microsoft Corporation; Redmond, WA).

3. Results

According to the findings, 581 elite athletes were respondents, 182 (31.3%) were female and 399 (68.7%) were male. Among elite athletes, 36% of male are unvaccinated. About 41% of athletes have been infected with Covid-19, of which 59% were not vaccinated. Among the vaccinated athletes, 75.2% had received the first dose of vaccine, 24.4% had received the second doses of vaccine, 21.9% had received the third doses of vaccine, and 0.9% had received the fourth dose of vaccine. 18.1% of vaccinated athletes had side effects after vaccination. Most of the unvaccinated elite athletes believed that vaccination could have a negative effect on their sports performance (10.2%); vaccination increases the risk of injury (9.3%) and has many side effects (6.9%). Most elite athletes have used Sinopharm vaccine in the first (41.5%), second (38.4%) and third (18.8%) doses. 31.8% of unvaccinated elite athletes spent one to two months in home confinement and 28.6% of vaccinated athletes spent only one week in home confinement. 50.4% of elite athletes expressed their activity level as intense active after the corona pandemic, while 63.3% were intense active before the corona pandemic. 37.2% of elite athletes trained at home and 17.2% had access to sports clubs (muscle strengthening/ resistance exercises). 71.3% of elite athletes had no children. 22% of elite athletes considered

the situation somewhat stressful. Individual characteristics of elite athletes are described in more detail in Table 1.

Figure 1 shows the descriptive data relating to the quality of sleep in vaccinated and unvaccinated elite athletes during Covid-19 shown by the sub-scales of the PSQI.

Physical activity level (before and during covid-19) and dietary behavior for vaccinated and unvaccinated elite athletes during the pandemic are shown in Figure 2.

Kolmogorov-Smirnov test indicates that the physical activity level $D(581)=6.84$, $P=0.001$, sleep disorders $D(581)=2.03$, $P<0.001$ and eating behavior $D(581)=3.80$, $P=0.001$ do not follow a normal

distribution. The Mann Whitney U and the Wilcoxon Rank Sum Tests were used for inter-group versus intra-group comparisons of physical activity of vaccinated and unvaccinated athletes, respectively.

Median physical activity level before covid-19 in vaccinated and unvaccinated elite athletes were 212.4 and 371.5; the distributions in the two groups differed significantly (Mann-Whitney $U=19084.5$, $n_1=294$, $n_2=287$, $P<0.001$). Median physical activity level during covid-19 in vaccinated groups and unvaccinated elite athletes were 195.8 and 388.5; The distributions in the two groups differed significantly (Mann-Whitney $U=14207.5$, $n_1=294$, $n_2=287$, $P<0.001$).

Table 1. Individual characteristics of vaccinated and unvaccinated elite athletes

Individual characteristics		Vaccinated	Unvaccinated	Total	P-value
Frequency (%)		294(50.6)	287(49.4)	581(100)	0.249
Sex (percentage)	Female	17.9	13.4	31.3	
	Male	32.7	36	68.7	
Age (years)		24.5±6.1	30.5±4.7	28.5±5.8	<0.001
Height (cm)		181.3±10.2	177.7±13.9	179.5±21	<0.001
Weight (kg)		75.3±19.9	74.8±10.7	75.1±16	<0.001
Sports history (years)		15.2±5.9	16.1±6.1	15.2±6.5	<0.001
Sport category (%)	Individual sport	26.5	43.7	70.2	<0.001
	Team sport	24.1	5.7	29.8	<0.001
Marital status (%)	Married	12.9	21.7	36.6	<0.001
	Single	37.7	27.7	65.4	<0.001
Education level (%)	No schooling completed	2.2	5.2	7.7	<0.001
	High school graduate	1.7	13.6	15.3	<0.001
	Professional degree	17.6	0.2	17.7	<0.001
	Bachelor's degree	16.2	21.2	37.4	<0.001
	Master's degree	11.2	9.1	20.3	0.021
Doctorate degree		0.5	1.2	1.9	<0.001
Covid-19 infected (%)	Yes	19.6	21.2	40.8	0.604
	No	29.8	29.4	59.2	0.813
Taken all doses (%)	Yes	0.5	37.9	38.4	<0.001
	No	58.2	12.7	61.6	<0.001
Smoking (%)	Yes	48	46	94	0.235
	No	2.6	3.4	6	0.249
Financial security (%)	Very secure	3.8	7.9	11.7	<0.001
	Moderately secure	17.4	15	32.4	<0.001
	Slightly secure	12.7	21.3	34.1	<0.001
	Low secure	9	3.3	12.2	<0.001

	Not at all secure	7.8	1.9	9.6	<0.001
--	-------------------	-----	-----	-----	--------

*p-value (Chi-square independence test or independent t-test) < 0.05.

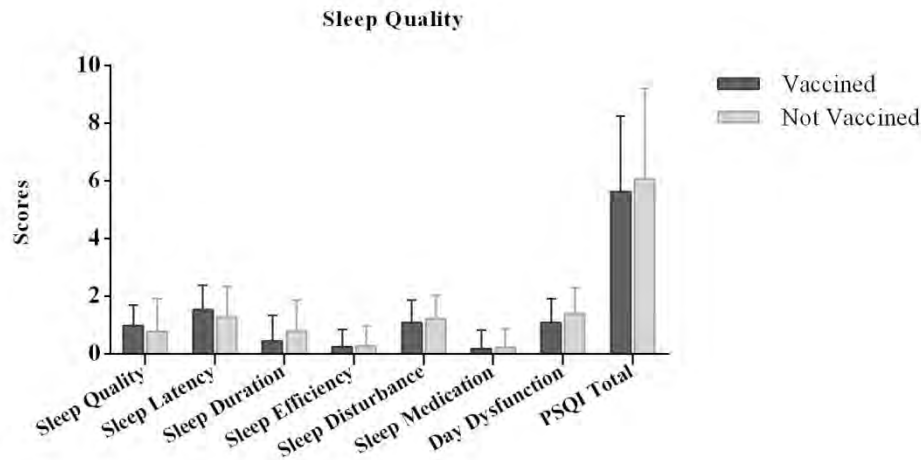


Figure 1. Sleep quality sub-scales of vaccinated and unvaccinated elite athletes during Covid-19

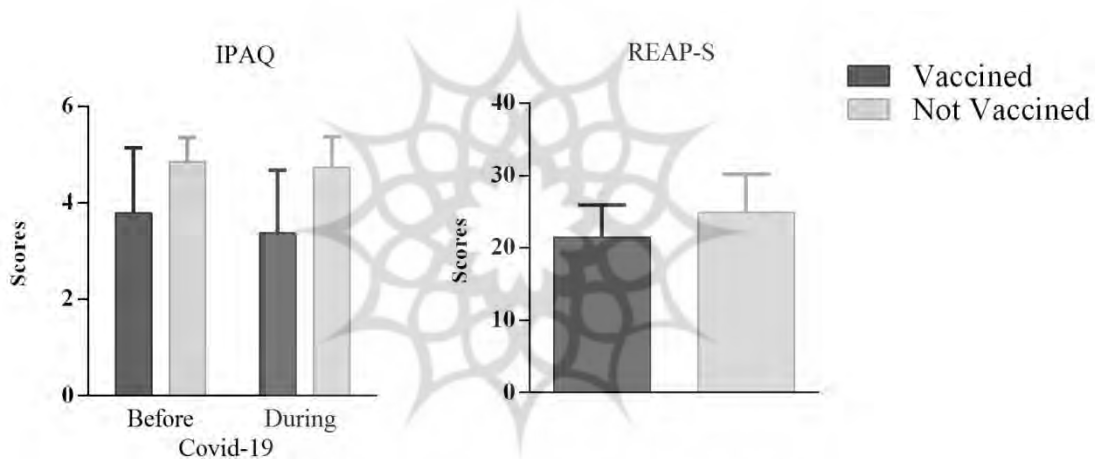


Figure 2. The IPAQ and REAP-S of vaccinated and unvaccinated elite athletes before and during covid-19

Furthermore, the Wilcoxon Test indicated that the physical activity level in pre-pandemic period was higher than the pandemic in vaccinated ($P<0.001$) and unvaccinated athletes ($P<0.001$). Median sleep disorders in pre-pandemic in vaccinated group and unvaccinated groups were 283.5 and 298.7 respectively; the distributions in the two groups differed significantly (Mann–Whitney $U= 39976.5$, $n_1= 294$, $n_2= 287$, $P=0.270$). Nevertheless, median eating behavior before covid-19 in vaccinated and unvaccinated groups were 283.5 and 298.7; The distributions in the

two groups differed significantly (Mann–Whitney $U= 25371.5$, $n_1= 294$, $n_2= 287$, $P<0.001$).

4. Discussion

The Covid-19 pandemic has highlighted the importance of implementing effective strategies in critical situations. Given this urgency, it is essential to conduct investigations to identify the most effective strategies. Therefore, it is necessary to consider the impact of the pandemic on elite athletes, who may have unique challenges and needs in this situation. By

understanding the specific challenges faced by elite athletes during the pandemic, effective strategies can be developed to support their health and well-being, and to ensure their continued participation in sports. Hence, we sought to compare the lifestyle of vaccinated versus unvaccinated elite athletes during the Covid-19 pandemic. The results suggested that there was a significant difference between the dietary behavior and physical activity level of vaccinated and unvaccinated elite athletes and there is no significant difference between the quality of sleep of vaccinated and non-vaccinated elite athletes. The results showed that the level of physical activity of non-vaccinated elite athletes was higher than the vaccinated and the nutritional behavior of vaccinated athletes was better.

It was also indicated that there was no significant difference between the quality of sleep between vaccinated and unvaccinated elite athletes. The results suggest that the level of physical activity of two groups of vaccinated and unvaccinated elite athletes were decreased during the pandemic compared to pre pandemic condition. Also, the level of physical activity of unvaccinated elite athletes during the Covid-19 was higher than that of vaccinated elite athletes. One of the possible reasons for the higher rate of physical activity of unvaccinated athletes compared to vaccinated athletes is related to psychological fear. Since, those athletes who have fear of getting infected try to follow the principles of social distancing and not being involved in outdoor activities. Obviously, it's logical to have low rate of physical activity during the pandemic. Additionally, their vaccination was also another reason for their caution, but those

athletes who had not been vaccinated did not have this psychological fear.

The reason for the difference in the eating behavior of vaccinated versus unvaccinated elite athletes would be attributed to the values of optimal nutrition considered by vaccinated athletes. Li et al. (2022) found that nutritional sufficiency would increase immune responses to vaccine against infection [33].

It seems that elite athletes suffered from sleep problems during the Covid-19 pandemic. There is no research on the difference in quality of sleep between vaccinated and unvaccinated elite athletes, but research shows that having optimal sleep behavior (quality; duration) in the early days after the vaccine would increase the effectiveness of the vaccine [34].

In general, the results of this research are in line with the results of Frank et al. (2020) [35] and Newbury et al. (2022) [36]. Frank et al. (2020) suggested that eight weeks of detraining leads to a significant decrease in maximal oxygen consumption (VO_{2max}), endurance capacity, and muscle strength with accompanying decrease which is similar to the consequences of covid-19 [35].

Newbury et al. (2022) analyzed the nutritional intake of adolescent elite swimmers at three different time points: a) before Covid-19, b) during the national quarantine, c) during limited training after the quarantine [36].

A key finding of the research was that adolescent swimmers changed their nutrition based on their modified training needs. Their energy, carbohydrate, protein and fat intakes all were decreased during quarantine conditions and was consequently increased by resuming swimming training. However, reduced

dietary intake during quarantine resulted in lower micronutrients intakes compared to Reference Nutrient Intake recommended for British adolescents (15-18 years) [36].

On the other hand, the results of the present study are inconsistent with the results of Woodford and Bussey (2021) [37], and da Silva Santos et al. (2021) [38]. Woodford and Bussey (2021) stated that quarantine provides athletes with a resting period allowing them to reflect on their sports participation and make the necessary changes in their lives that will protect their health during and after quarantine periods [37].

da Silva Santos et al. (2021) suggested that no significant changes were found in the sleep quality of athletes during quarantine [39].

The study limitations were as follows: The small size of the study samples, the lack of accurate assessment” instead of “control”, over the sleep status, eating behavior, and sports behavior of the participants. Also, climatic, geographical and time differences would have an effect on the lifestyle of elite athletes.

5. Conclusion

According to the obtained results, the amount of physical activity of elite athletes has been decreased during the pandemic compared to before the pandemic conditions.

Also, the amount of physical activity of unvaccinated elite athletes during the pandemic was higher than that of vaccinated elite athletes. In addition, it was concluded that the nutritional behavior of vaccinated elite athletes during the pandemic was better than that of unvaccinated elite athletes, and quality of sleep was also decreased in some athletes. As a result, the level of physical activity,

quality of sleep and eating behavior of these athletes should be considered in order to prevent the injury of elite athletes.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

Ethical considerations

The authors have completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Acknowledgment

This paper was taken from the Master's thesis of Imam Khomeini International University.

References

- [1] Wu J, Li J, Zhu G, Zhang Y, Bi Z, Yu Y, Huang B, Fu S, Tan Y, Sun J, Li X. “Clinical features of maintenance hemodialysis patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China”. *Clin J Am Soc Nephrol*. 2020; 15(8): 1139-1145. doi: 10.2215/CJN.04160320. Epub: 2020 May 22. PMID: 32444393; PMCID: PMC7409740.
- [2] Kosendiak AA, Adameczak B, Kontek S, Kuźnik Z, Roman M,-Gostkowski M, Niedziółka A. “Level of physical activity, sleep quality and use

- of personal protective equipment of students at Wrocław Medical University during the COVID-19 pandemic". *Int J Environ Res Public Health*. 2023; 20(3): 2406. doi: 10.3390/ijerph20032406. PMID: 36767774. PMCID: PMC9915195.
- [3] Zangrillo A, Beretta L, Silvani P, Colombo S, Scandroglio AM, Dell'Acqua A, et.al. "Fast reshaping of intensive care unit facilities in a large metropolitan hospital in Milan, Italy: facing the COVID-19 pandemic emergency". *Crit Care Resusc*. 2020; 22(2): 91-94. Epub ahead of print. PMID: 32227819.
- [4] Remuzzi A, Remuzzi G. "COVID-19 and Italy: what next?". *Lancet*. 2020; 395(10231): 1225-1228. doi: 10.1016/S0140-6736(20)30627-9. Epub 2020 Mar 13. PMID: 32178769; PMCID: PMC7102589.
- [5] Hossain MM, Sultana A, Purohit N. "Mental health outcomes of quarantine and isolation for infection prevention: a systematic umbrella review of the global evidence". *Epidemiol Health*. 2020; 42: e2020038. doi: 10.4178/epih.e2020038. Epub 2020 Jun 2. PMID: 32512661; PMCID: PMC7644933.
- [6] Ammar A, Chtourou H, Boukhris O, Trabelsi K, Masmoudi L, Brach M, Bouaziz B, et.al. "COVID-19 home confinement negatively impacts social participation and life satisfaction: A worldwide multicenter study". *Int J Environ Res Public Health*. 2020; 17(17): 6237. doi: 10.3390/ijerph17176237. PMID: 32867287. PMCID: PMC7503681.
- [7] Hull JH, Wootten M, Moghal M, Heron N, Martin R, Walsted ES, Biswas A, Loosemore M, Elliott N, Ranson C. "Clinical patterns, recovery time and prolonged impact of COVID-19 illness in international athletes: The UK experience". *Br J Sports Med*. 2022; 56(1): 4-11. doi: 10.1136/bjsports-2021-104392. Epub 2021 Aug 2. PMID: 34340972; PMCID: PMC8331321.
- [8] Kim DS, Lee YH, Bae KS, Baek GH, Lee SY, Shim H, On MG, Rhie SJY. "PyeongChang 2018 Winter Olympic Games and athletes' usage of 'polyclinic' medical services". *BMJ Open Sport Exerc Med*. 2019; 5(1): e000548. doi: 10.1136/bmjsem-2019-000548. PMID: 31548900. PMCID: PMC6733333.
- [9] Kozloff N, Mulsant BH, Stergiopoulos V, Voineskos AN. "The COVID-19 global pandemic: Implications for people with schizophrenia and related disorders". *Schizophr Bull*. 2020; 46(4): 752-757. doi: 10.1093/schbul/sbaa051. PMID: 32343342. PMCID: PMC7197583.
- [10] 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. doi: 10.5114/biolSport.2021.101605. Epub 2020 Dec 23. PMID: 34937958. PMCID: PMC8670812.
- [11] Ammar A, Mueller P, Trabelsi K, Chtourou H, Boukhris O, Masmoudi L, et.al. "ECLB-COVID19 consortium. Psychological consequences of COVID-19 home confinement: The ECLB-COVID19 multicenter study". *PLoS One*. 2020; 15(11): e0240204. doi: 10.1371/journal.pone.0240204. PMID: 33152030. PMCID: PMC7643949.
- [12] Preedy VR, Watson RR. *Handbook of Disease Burdens and Quality of Life Measures*. Springer. 2010.
- [13] Cena H, Calder PC. "Defining a healthy diet: Evidence for the role of contemporary dietary patterns in health and disease". *Nutrients*. 2020; 12(2): 334. doi: 10.3390/nu12020334. PMID: 32012681. PMCID: PMC7071223.
- [14] Belenky G, Wesensten NJ, Thorne DR, Thomas ML, Sing HC, Redmond DP, et al. "Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: A sleep dose response study".- *Journal of Sleep Research*. 2003; 12(1): 1-12. <https://doi.org/10.1046/j.1365-2869.2003.00337.x>
- [15] Walker MP, Stickgold R. "It's practice, with sleep, that makes perfect: implications of sleep-dependent learning and plasticity for skill performance"- *Clinics in Sports Medicine*. 2005; 24(2): 301-17. <https://doi.org/10.1016/j.csm.2004.11.002>.
- [16] Haack M, Mullington JM. "Sustained sleep restriction reduces emotional and physical well-being". *Pain*. 2005; 119(1-3): 56-64. doi: 10.1016/j.pain.2005.09.011. Epub 2005 Nov 16. PMID: 16297554.
- [17] Czeisler CA, Klerman EB. "Circadian and sleep-dependent regulation of hormone release in humans". *Recent Prog Horm Res*. 1999; 54: 97-130. discussion 130-2. PMID: 10548874.
- [18] Spiegel K, Leproult R, Van Cauter E. "Impact of sleep debt on metabolic and endocrine function". *Lancet*. 1999; 354(9188): 1435-9. doi:

- 10.1016/S0140-6736(99)01376-8. PMID: 10543671.
- [19] Spiegel K, Tasali E, Penev P, Van Cauter E. "Brief communication: Sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite". *Ann Intern Med.* 2004; 141(11): 846-50. doi: 10.7326/0003-4819-141-11-200412070-00008. PMID: 15583226.
- [20] Cohen S, Doyle WJ, Alper CM, Janicki-Deverts D, Turner RB. "Sleep habits and susceptibility to the common cold". *Arch Intern Med.* 2009; 169(1): 62-7. doi: 10.1001/archinternmed.2008.505. PMID: 19139325. PMCID: PMC2629403.
- [21] Fullagar HH, Skorski S, Duffield R, Hammes D, Coutts AJ, Meyer T. "Sleep and athletic performance: the effects of sleep loss on exercise performance, and physiological and cognitive responses to exercise". *Sports Med.* 2015; 45(2): 161-86. doi: 10.1007/s40279-014-0260-0. PMID: 25315456.
- [22] Facer-Childs ER, Hoffman D, Tran JN, Drummond SPA, Rajaratnam SMW. "Sleep and mental health in athletes during COVID-19 lockdown". *Sleep.* 2021; 44(5): zsaa261. doi: 10.1093/sleep/zsaa261. PMID: 33535229. PMCID: PMC7928674.
- [23] Irandoust K, Taheri M, Chtourou H, Nikolaidis PT, Rosemann T, Knechtle B. "Effect of time-of-day-exercise in group settings on level of mood and depression of former elite male athletes". *Int J Environ Res Public Health.* 2019; 16(19): 3541. doi: 10.3390/ijerph16193541. PMID: 31546685. PMCID: PMC6801561.
- [24] Woods JA, Hutchinson NT, Powers SK, Roberts WO, Gomez-Cabrera MC, Radak Z, Berkes I, Boros A, Boldogh I, Leeuwenburgh C, Coelho-Júnior HJ, Marzetti E, Cheng Y, Liu J, Durstine JL, Sun J, Ji LL. "The COVID-19 pandemic and physical activity". *Sports Med Health Sci.* 2020; 2(2): 55-64. doi: 10.1016/j.smhs.2020.05.006. Epub 2020 May 30. PMID: 34189484. PMCID: PMC7261095.
- [25] Inciardi RM, Lupi L, Zaccone G, Italia L, Raffo M, Tomasoni D, Cani DS, Cerini M, Farina D, Gavazzi E, Maroldi R, Adamo M, Ammirati E, Sinagra G, Lombardi CM, Metra M. "Cardiac involvement in a patient with coronavirus disease 2019 (COVID-19)". *JAMA Cardiol.* 2020; 5(7): 819-824. doi: 10.1001/jamacardio.2020.1096. PMID: 32219357. PMCID: PMC7364333.
- [26] Filgueira TO, Castoldi A, Santos LER, de Amorim GJ, de Sousa Fernandes MS, Anastácio WLDN, Campos EZ, Santos TM, Souto FO. "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: 587146. doi: 10.3389/fimmu.2021.587146. PMID: 33613573. PMCID: PMC7892446.
- [27] Irandoust K, Taheri M. "The effect of aquatic exercises on inflammatory markers of cardiovascular disease in obese women". *International Archives of Health Sciences.* 2018; 5(4): 145. <https://doi.org/10.4103/iahs.iahs.40.18>.
- [28] Rodrigues CMC, Plotkin SA. "Impact of vaccines; Health, economic and social perspectives". *Front Microbiol.* 2020; 11: 1526. doi: 10.3389/fmicb.2020.01526. PMID: 32760367. PMCID: PMC7371956.
- [29] Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. "The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research". *Psychiatry Res.* 1989; 28(2): 193-213. doi: 10.1016/0165-1781(89)90047-4. PMID: 2748771.
- [30] Kakoui H, Zare M, Akhlaghi M, Panahi R. "Investigation of sleep quality among professional drivers in the intercity terminals: a case study in Tehran". *Traffic Management Studies.* 2010; 16(5): 1-10.
- [31] Kim Y, Park I, Kang M. "Convergent validity of the international physical activity questionnaire (IPAQ): meta-analysis". *Public Health Nutr.* 2013; 16(3): 440-52. doi: 10.1017/S1368980012002996. Epub 2012 Jul 2. PMID: 22874087. PMCID: PMC10271683.
- [32] Segal-Isaacson CJ, Wylie-Rosett J, Gans KM. "Validation of a short dietary assessment questionnaire: the Rapid Eating and Activity Assessment for Participants short version (REAP-S)". *Diabetes Educ.* 2004; 30(5): 774, 776, 778 passim. doi: 10.1177/014572170403000512. PMID: 15510530.
- [33] Li Z, Ma Y, Huo S, Ke Y, Zhao A. "Impact of COVID-19 vaccination status and confidence on dietary practices among Chinese residents". *Foods.* 2022; 11(9): 1365. doi: 10.3390/foods11091365. PMID: 35564088. PMCID: PMC9104347.
- [34] Schmitz NC, van der Werf YD, Lammers-van der Holst HM. "The importance of sleep and circadian rhythms for vaccination success and

- susceptibility to viral infections”. *Clocks & Sleep*. 2022; 4(1): 66-79. <https://doi.org/10.3390/clockssleep4010008>.
- [35] Frank A, Fatke B, Frank W, Förstl H, Hölzle P. “Depression, dependence and prices of the COVID-19-crisis”. *Brain Behav Immun*. 2020; 87:99. doi: 10.1016/j.bbi.2020.04.068. Epub 2020 Apr 29. PMID: 32360604. PMCID: PMC7189841.
- [36] Newbury JW, Foo WL, Cole M, Kelly AL, Chessor RJ, Sparks SA, Faghy MA, Gough HC, Gough LA. “Nutritional intakes of highly trained adolescent swimmers before, during, and after a national lockdown in the COVID-19 pandemic”. *PLoS One*. 2022; 17(4): e0266238. doi: 10.1371/journal.pone.0266238. PMID: 35381043. PMCID: PMC8982883.
- [37] Woodford L, Bussey L. “Exploring the perceived impact of the COVID-19 pandemic social distancing measures on athlete wellbeing: A qualitative study utilising photo-elicitation”. *Front Psychol*. 2021; 12: 624023. doi: 10.3389/fpsyg.2021.624023. PMID: 34322049. PMCID: PMC8311490.
- [38] da Silva Santos AM, Rossi FE, Dos Santos Nunes de Moura HP, de Sousa Junior AVM, Machado DCD, Neves LM, Brito AS, Moura P, Monteiro PA, Freitas Junior IF, Dos Santos MAP, Ribeiro SLG. “COVID-19 pandemic impacts physical activity levels and sedentary time but not sleep quality in young badminton athletes”. *Sport Sci Health*. 2021; 17(4): 969-977. doi: 10.1007/s11332-021-00763-6. Epub 2021 Apr 21. PMID: 33903803; PMCID: PMC8059427.
- [39] Lopes Soares L, Bernardes Leite L, Quintão Guilherme L, Teixeira Rezende LM, Noce F, DE Azambuja Pussieldi G. “Anxiety, sleep quality and mood in elite athletes during the COVID-19 pandemic: a preliminary study”. *J Sports Med Phys Fitness*. 2022; 62(6): 867-872. doi: 10.23736/S0022-4707.21.12276-5. Epub 2021 Apr 19. PMID: 33871245.

