

INFLUENCE OF COVID 19 ON MORPHOLOGICAL AND CARDIOVASCULAR STATUS OF PROFESSIONAL HANDBALL PLAYERS

UTICAJ COVID 19 NA MORFOLOŠKI I KARDIOVASKULARNI STATUS PROFESIONALNIH RUKOMETAŠA

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ABSTRACT

Handball is one of the very popular sports games in the world. The current COVID 19 pandemic directly affects handball players in the training and competition processes from all age categories but professional players seem to be at a higher risk of contracting the disease. This study aimed to assess morphological and cardiovascular status of 20 participants, professional handball players who compete at elite competition rank, and therewith to adjust their training process and to test the differences between COVID 19 positive and COVID 19 negative participants. Testing included measurements of basic morphological parameters while the function of the cardiovascular system (CVS) was assessed at rest and effort - exercise stress test with Vita Maxima protocol. The results of t-test did not show a statistically significant difference in morphological and cardiovascular characteristics of participants who had COVID 19 infection (with a positive PCR test), who had symptoms of infection but no PCR test for the virus, and those who did not contract COVID 19.

Keywords: COVID 19, handball players, exercise stress test, cardiopulmonary performance

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INTRODUCTION

Handball is an international sport and as such it is one of the very popular sports games in the world. Global events with COVID 19 pandemic directly affect the handball players in the quality of the training and competition process from all age categories. Some authors have created exercise programs at home for elite handball players for keeping their aerobic capacity and jumping performance during lockdown period due to the COVID 19 pandemic (Font, Iruiria, Gutierrez, Salas, Vila, & Carmona, 2021). Those authors have confirmed that that program can contribute to the preserving of the jumping performance but it proved to be inefficient in terms of aerobic capacity in elite handball players. Handball is a sport with frequent contact between the players which directly exposes them to the higher potential risk of the infection. On the other hand, considering the health issues in post COVID 19 period, there is growing evidence in the literature that changes in the heart in symptomatic and asymptomatic individuals after COVID 19 infection may be a critical factor (Tahir, Bin Arif, Ahmed, Malik, & Khalid, 2019). Elite athletes may be at increased risk of sudden cardiac death due to myocarditis during COVID 19 infection as a result of their higher level of physical activity (Verwoert, de Vries,

Bijsterveld Willems, Vd Borgh, Jongman, Kemps, Snoek, Rienks, & Jorstad, 2020). The screening strategy for the myocardial effects of COVID 19 on elite athletes has not yet been confirmed.

The results obtained by spiroergometry testing did not prove useful and sufficient for the evaluation after COVID 19 (Stöbe, Richter, Seige, Stehr, Laufs, & Hagendorff, 2020). Also in an MRI (magnetic resonance imaging) study that included 26 athletes with and without symptoms, signs of myocarditis were confirmed in 4 cases. Eight athletes showed late MRI improvement (McKinney Connelly, Dorian, Fournier, Goodman, Grubic, Isserow, Moulson, Philippon, Pipe, Poirier, Taylor, Thornton, Wilkinson, & Johri, 2021). Another study identified significant number of athletes with persistent symptoms characteristic of this virus for weeks and months after COVID 19 infection (Phelan, Kim, Elliott, Wasfy, Cremer, Johri, Emery, Sengupta, Sharma, Martinez, & La Gerche, 2020). A cohort study of 1,597 athletes at the American Football Conference identified 37 athletes (2.3%) with signs of clinical or subclinical myocarditis (Stöbe, Richter, Seige, Stehr, Laufs, & Hagendorff, 2020).

Therefore, MRI of the heart is a sufficiently sensitive method, but the problem arises in the

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unavailability of this testing procedure for athletes around the world due to the economic reasons, i.e. diagnostic costs. In the study where both methods, MRI and spiroergometry, were used, a new conclusion was reached (Fikenzer, Kogel, Pietsch, Lavall, Stöbe, Rudolph, Laufs, Hepp, & Hagendorff, 2021). Namely, those authors have confirmed significant decrease in VO₂max and respiratory minute volume in athletes with a history of COVID 19 infection ($p < 0.05$), while all these parameters remained

METHODS

The sample of participants consisted of 20 senior handball players who competed in the Serbian Handball Super League in season 2020-2021. During the regular medical checkup, after the first part of the season, two groups of players were identified. The first group of 12 players was labeled as COVID 19 positive (four players recovered from COVID 19 and eight players had COVID 19 symptoms but negative PCR test), and the second group of eight players was asymptomatic and negative COVID 19 group. The symptoms present in the first group of eight players were typical for COVID 19 with different degrees of alterations from one participant to another: elevated temperature, weakness, loss of smell, coughing. The recovery from COVID 19 was confirmed by

unchanged in handball players who were not infected. Having in mind the magnitude of the current COVID 19 pandemic, and its endangerment of the professional athletes, the main aim of the present study was to assess the morphological and cardiovascular status of 20 participants who professionally play handball at the elite level in order to adjust their training process, and to examine the differences between the participants who were COVID 19 positive and negative.

medical checkup and it followed general recommendations from the WHO of 14 days from the first symptoms and positive PCR test. The study was conducted six months after the disease diagnosis since that was considered a sufficient period for the recovery, low risk, and uneventful exercise stress testing. Furthermore, this period was decided since the participants did not undergo MRI scan during the COVID 19 diagnostic procedures.

Body height, body weight and body fat percentage were the basic morphological variables and it included measurement of these parameters in clinical environment with following procedure: body height was determined by Seca stadiometer (unit of measure is 1 cm). The Tanita® BC-418MA

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bioimpedance method was used to determine body weight (kg) and body fat percentage - FAT%.

The function of the cardiovascular system (CVS) was assessed at rest and effort – measuring the blood pressure, heart rate, ECG monitoring and exercise stress test of the first clinic of the sports medicine in Serbia, Vita Maxima (modified STEEP protocol, Northridge, Grant, Ford, Christie, McLenachan, Connelly, McMurray, Ray, Henderson, & Dargie,1990). Before the exercise stress test, the participants underwent basic medical checkup (blood pressure, heart rate, auscultation, and clinical examination) to determine their health status to perform the exercise stress test. A 12-channel ECG (Fukuda) was performed at rest, heart rate was recorded and arterial blood pressure was measured on both arms. Ergometric testing monitored the function of CVS in exertion: ECG recording during exertion, the maximum heart rate, as well as the maximum value of arterial blood pressure. A treadmill (HP-COSMOS®) was used in executing the exercise stress test. Exercise stress test protocol of the first clinic of the sports medicine in Serbia, Vita Maxima, included stepwise increase in workload with an

initial speed of 5 km/h and an elevation of 3° was used for the test. The treadmill speed increased by 1 km/h every 60 seconds, while the elevation was constant during the test. Participants wore a mobile ECG device (Quarck® T 12x, Wireless 12-lead ECG) on their back to directly monitor heart rate during exercise. For the participants safety, i.e. overload avoidance and potential cardiologic complications, the test was terminated in the following two cases: 1. 90% or more of the predicted theoretical heart rate maximum for sex and age calculated by the formula: 220 - number of years, 2. a subjective feeling of exhaustion.

In the data analysis, basic descriptive parameters were calculated for all variables including arithmetic mean, standard deviation, minimum, maximum, and range. The differences in morphological characteristics and parameters of the CVS at rest and effort between handball players who had COVID 19 infection (with confirmed positive PCR test and no test performed, but with symptoms characteristic of COVID 19) and those who did not, were tested by t-test for independent groups. Statistical data processing was performed in the statistical package SPSS 20.0 for Windows.

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RESULTS

Results of the descriptive statistics are presented in Table 1.

Table 1. Descriptive characteristics of the selected variables for both groups of the sample

Variables	Group	Mean	SD	Range	Min	Max
Age	positive	21.8	3.7	13.0	17.0	30.0
	negative	26.6	7.5	19.0	20.0	39.0
BM (kg)	positive	90.0	9.4	27.2	77.7	104.9
	negative	96.9	14.9	43.0	78.2	121.2
BH (cm)	positive	187.3	5.4	19.0	178.0	197.0
	negative	186.3	5.4	16.0	179.0	195.0
Body fat (%)	positive	13.4	4.3	15.0	6.0	21.0
	negative	16.2	4.5	10.6	11.2	21.8
SBP at rest (mmHg)	positive	120.8	7.9	20.0	110.0	130.0
	negative	121.4	18.6	50.0	110.0	160.0
DBP at rest (mmHg)	positive	72.5	4.5	10.0	70.0	80.0
	negative	75.7	5.3	10.0	70.0	80.0
HR at rest (bpm)	positive	67.9	13.7	50.0	52.0	102.0
	negative	59.6	11.8	34.0	46.0	80.0
HR max (bpm)	positive	183.5	7.6	25.0	171.0	196.0
	negative	177.6	9.3	26.0	160.0	186.0
Percent of max HR	positive	92.6	3.7	12.5	85.5	98.0
	negative	91.8	4.1	11.4	85.5	96.9
HR recovery 1 min (bpm)	positive	153.6	12.8	46.0	127.0	173.0
	negative	155.1	8.9	21.0	145.0	166.0
HR recovery 2 min (bpm)	positive	128.3	20.1	80.0	78.0	158.0
	negative	125.0	11.1	34.0	107.0	141.0
HR recovery 3 min (bpm)	positive	115.3	17.6	73.0	73.0	146.0
	negative	113.4	9.3	26.0	100.0	126.0

Legend: BM – Body mass; BH – body height; SBP – systolic blood pressure; DBP – diastolic blood pressure; HR at rest – Heart rate at rest; HR max – Maximal heart rate; Mean – Arithmetic mean; SD – Standard deviation; Range – Difference between maximal and minimal result; Min – minimal result; Max – Maximal result

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The differences in morphological characteristics and parameters of the CVS at rest and effort between the two groups of participants were tested by t-test for independent samples (Table 2.)

Table 2. *The results of the t-test between COVID 19 positive and negative groups*

Variables	t	p
Age	-1.460	0.09
BM (kg)	-0.880	0.93
BH (cm)	0.080	0.93
Body fat (%)	-0.720	0.48
SBP at rest (mmHg)	0.175	0.87
DBP at rest (mmHg)	-0.426	0.68
HR at rest (bpm)	0.950	0.36
HR max (bpm)	1.080	0.30
Percent of max HR	0.180	0.86
HR recovery 1 min (bpm)	-0.690	0.50
HR recovery 2 min (bpm)	0.100	0.92
HR recovery 3 min (bpm)	0.060	0.95

Legend: BM – body mass; BH – body height; BMI – body mass index; SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate

The t-test did not show a statistically significant difference in morphological and cardiovascular characteristics of handball players who had COVID 19 infection (with a positive PCR test), who had symptoms of infection but no PCR test for the virus, and those who did not ($p > 0.05$).

DISCUSSION

By examination of handball players, we assessed the function of the cardiovascular system (CVS) at rest and effort, heart rate and arterial blood pressure in both arms, maximum heart rate, and maximum value of arterial blood pressure. There were no statistically significant differences observed between the participants with COVID 19 infection, and/or with characteristic symptoms, but without a PCR test,

and the participants who did not have COVID 19. The insight into the ergometry results suggested that handball players did not have cardiac rhythm disorders, nor signs of ischemic heart disease in both groups of participants. COVID 19 infection did not lead to heart muscle damage or affect the morphological characteristics of infected athletes. The limitations of the current study are primarily a

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small sample of infected athletes as well as the total sample. At the same time, we did not have the results from COVID 19 pre-pandemic period of these athletes with the same parameters with which obtained results could be compared. Namely, the ergospirometric testing that was not done with these participants, would have given a more concrete insight into the functional status of participants, in terms of possible pulmonary obstructions, indirect assessment of the left ventricular function, but also fitness in terms of maximum oxygen consumption and anaerobic endurance. There is a research, where besides MRI scanning, ergospirometric was performed and new conclusions were drawn (Fikenzer, S., Fikenzer, K., Laufs, Falz, Pietrek, & Hepp, 2021). Namely, eight top level handball players (27 ± 3.5 years) who had COVID 19 infection were tested and compared with four uninfected teammates (22 ± 2.6 years). The infected athletes were examined 19 ± 7 days after the first positive PCR test. MRI showed fewer signs of acute inflammation/edema in all the infected, while ergospirometric analysis showed a significant decrease in $VO_2\max$ (-292 ml/min, -7.0%), pulse (-2.4 ml/beat, -10.4%), and respiratory minute volume VE (-18.9 l/min, -13.8%) in athletes with a history of COVID 19 infection ($p < 0.05$). All above mentioned parameters have remained unchanged in the uninfected handball players. Due to the very limited number of studies on the handball

players, the findings of the current study, where no differences were found between the post COVID 19 and non COVID 19 players, can be compared with the study of Fikenzer, S., Fikenzer, K., Laufs, Falz, Pietrek, & Hepp, (2021). The existing differences in results are probably due to the time of testing of the convalescents which significantly differs in these two studies (19 ± 7 days after the confirmed diagnosis in Fickenzer et al., and 6 months in the current study). Considering that the Fikenzer, S., Fikenzer, K., Laufs, Falz, Pietrek, & Hepp, (2021) undoubtedly concluded that the COVID 19 infection causes impairment of cardiopulmonary performance during the physical exertion in elite handball players, it supports the recommendation of conducting ergospirometric testing of professional athletes after a COVID 19 infection. The importance of the echocardiographic heart examination, in order to exclude suspicion of the occurrence of myocarditis, which may also be a consequence of coronary infection, were confirmed in an earlier study (Stöbe, Richter, Seige, Stehr, Laufs, & Hagendorff, 2020). Any suspicion of the development of myocarditis, according to the latest literature data related to a COVID 19 infection, should be further examined and verified by an examination that includes magnetic resonance imaging of the heart, especially when echocardiographic examination does not show clear signs of myocardial

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inflammation (Fikenzer, Kogel, Pietsch, Lavall, Stöbe, Rudolph, Laufs, Hepp, & Hagendorff, 2021). Unfortunately, sports clubs often do not have the financial means to do all the necessary tests, which was the case with presented testing as well.

It would be ideal to do an exercise test (ergometry), an ultrasound examination of the heart and ergospirometry, to determine whether there are malignant heart rhythm disorders.

Certainly, it would be wrong to ignore any hints of changes in the state of performance of athletes at submaximal and maximum loads, even in asymptomatic forms of a COVID 19 infection. A new study has proven that only cardiac magnetic resonance imaging (CMR) has revealed focal myocarditis (Nedeljković, Giga, Ostojić, Đorđević-Dikić, Stojmenović, Nikolić, Dikić, Nedeljković-Arsenović, Maksimović, Dobrić, Mujović, & Beleslin, 2021).

CONCLUSION

Based on the ECG findings, parameters of the arterial blood pressure, and heart rate which were monitored continuously by a sports medicine specialist during the exercise stress testing, it has been observed that within both groups of participants there were no cardiac rhythm disorders, nor signs of an ischemic heart disease. These parameters, as well as the results at the exercise stress test in participants who recovered from a COVID 19 infection, indicate that the disease did not lead to a heart muscle damage or affected the morphological characteristics of infected athletes.

In line with the earlier findings, it could be recommended to perform ergospirometry as a useful means in identifying limitations in performances of athletes after the COVID 19 infection, and based on this information it could be easier to control and manage their return to the training process.

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REFERENCE

1. COVID-19 Treatment Guidelines. Clinical Spectrum | COVID-19 Treatment Guidelines. <https://www.covid19treatmentguidelines.nih.gov/overview/clinical-spectrum/> (2021).
2. Fikenzer, S., Fikenzer, K., Laufs, U., Falz, R., Pietrek, H., & Hepp, P., (2021). Impact of COVID-19 lockdown on endurance capacity of elite handball players. *J. Sports Med. Phys. Fitness.* 61(7), 977-982. doi:23736/s0022-4707.20.11501-9; PMID: 33269880
3. Fikenzer, S., Kogel, A., Pietsch, C., Lavall, D., Stöbe, S., Rudolph, U., Laufs, U., Hepp, P., & Hagendorff, A., (2021). SARS-CoV2 infection: functional and morphological cardiopulmonary changes in elite handball players. *Sci. Rep.* 11, 17798 doi:10.1038/s41598-021-97120-x
4. Font, R., Iruiria, A., Gutierrez, J.A., Salas, S., Vila, E., & Carmona, G. (2021). The effects of COVID-19 lockdown on jumping performance and aerobic capacity in elite handball players. *Biology of Sport*, 38(4), 753-759. doi.org/10.5114/biolsport.2021.109952
5. McKinney, J. Connelly, K. A., Dorian, P., Fournier, A., Goodman, J. M., Grubic, N., Isserow, S., Moulson, N., Philippon, F., Pipe, A., Poirier, P., Taylor, T., Thornton, J., Wilkinson, M., & Johri, A. M., (2021). COVID-19-myocarditis and return to play: Reflections and recommendations from a Canadian Working Group. *Can. J. Cardiol.* 37(8), 1165-1174. doi: 10.1016/j.cjca.2020.11.007; PMID: 33248208; PMCID: PMC7688421
6. Nedeljković, I., Giga, V., Ostojić, M., Đorđević-Dikić, A., Stojmenović, T., Nikolić, I., Dikić, N., Nedeljković-Arsenović, O., Maksimović, R., Dobrić, M., Mujović, N., & Beleslin, B., (2021). Focal Myocarditis after Mild COVID-19 Infection in Athletes. *Diagnostics*, 11(8), 1-7. doi: 10.3390/diagnostics11081519; PMID: 34441453; PMCID: PMC8392699.
7. Northridge, D. B., Grant, S., Ford, I., Christie, J., McLenachan, J., Connelly, D., McMurray, J., Ray, S., Henderson, E., & Dargie, H. J., (1990). Novel exercise protocol suitable for use on a treadmill or a bicycle ergometer. *British Heart Journal*, 64(5), 313-316. doi: 10.1136/hrt.64.5.313; PMID: 2245110; PMCID: PMC1216809
8. Phelan, D., Kim, J. H., Elliott, M. D., Wasfy, M. M., Cremer, P., Johri, A. M., Emery, M. S., Sengupta, P. P., Sharma, S., Martinez, M. W., & La Gerche, A., (2020). Screening of potential cardiac involvement in competitive athletes recovering from COVID-19: An expert consensus statement. *JACC Cardiovasc. Imaging*. 13(12), 2635–2652. doi: 10.1016/j.jcmg.2020.10.005; PMID: 33303102 PMCID: PMC7598679
9. Stöbe, S., Richter, S., Seige, M., Stehr, S., Laufs, U., & Hagendorff, A., (2020). Echocardiographic characteristics of patients with SARS-CoV-2 infection. *Clin. Res. Cardiol. Off. J. Ger. Cardiac Soc.* 109(12), 1549–1566. doi: 10.1007/s00392-020-01727-5; PMID: 32803387; PMCID: PMC7428201
10. Tahir, F., Bin Arif, T., Ahmed, J., Malik, F., & Khalid, M. (2019). Cardiac manifestations of coronavirus disease 2019 (COVID-19): A comprehensive review. *Cureus.*, 12:e8021. doi: 10.7759/cureus.8021; PMID: 32528760 PMCID: PMC7282369
11. Verwoert, G.C. de Vries, S. T., Bijsterveld, N., Willems, A. R., Vd Borgh, R., Jongman, J. K., Kemps, H. M. C., Snoek, J. A., Rienks, R., & Jorstad, H. T., (2020). Return to sports after COVID-19: A position paper from the Dutch Sports Cardiology Section of the Netherlands Society of Cardiology. *Neth. Heart J.* 28(7-8), 391–395. doi: 10.1007/s12471-020-01469-z; PMID: 32662058; PMCID: PMC7357275

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SAŽETAK

Rukomet je jedna od vrlo popularnih sportskih igara na svijetu. Trenutna pandemija virusom COVID 19, pored ostalih sportista, direktno otežava igračima rukometa trenažni proces, kao i održavanje takmičenja u svim uzrasnim kategorijama, s tim da su profesionalni igrači vjerovatno pod većim rizikom od zaražavanja. Ovo istraživanje je imalo za cilj da se procijeni morfološki i kardiovaskularni status 20 ispitanika koji se profesionalno bave rukometom u vrhunskom rangju takmičenja kako bi se adekvatno mogao prilagoditi trenažni proces i da se ispituju razlike između ispitanika koji su bili pozitivni na testu za COVID 19 i ispitanika koji su bili negativni na testu za COVID 19. Testiranja su obuhvatala mjerenja osnovnih morfoloških parametara, a funkcionalnost kardiovaskularnog sistema (CVS) je testirana u mirovanju i naporu – testom progresivnog opterećenja po protokolu Vita Maxima. Rezultati t-testa su pokazali da ne postoje statistički značajne razlike u morfološkim i kardiovaskularnim karakteristikama ispitanika koji su imali COVID 19 infekciju (sa pozitivnim PCR testom), igrača koji su imali simptome ali bez PCR testa i igrača koji nisu imali COVID 19.

Ključne riječi: COVID 19, rukometaši, maksimalni test opterećenja, kardiopulmonarne performanse

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