Can home exercises keep professional handball players in shape on Covid-19 quarantine days?

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Abstract
The purpose of the research is to show professional handballers that high-density exercises applied in the home environment are similar to aerobic and anaerobic capacity in the field environment. The research group is 16 national handball players with an average age of 24.67±5.71 years, length of 186.69±6.40 cm and body weight 89.63±8.64 kg. Polar watch was used to detect heart beat counts during exercises performed by handball players in the home environment. Five weeks of exercises of different intensity are divided into 4 different intensity exercise groups. Handball players recorded heart rate and perceived difficulty at the end of their workouts in the home environment. According to the findings, HR_{max} values in the field environment have a moderate relationship with some exercise RPE values with RPE_{max}, which is a high level of relationship with some exercise HR values of some exercise HR values of different densities. As a result, the training from handball players is planned to resemble the training load of HR values, while some training structures have not been determined to capture the target HR value.
Key words: Team Handball, Covid 19, Home exercises, Interval training.

Introduction
Covid 19 pandemic sparked the 2019 New Coronavirus, formerly known as "2019 novel coronavirus (2019-nCoV) and the disease was officially named COVID-19 by the World Health Organization on February 11, 2020. Studies have shown that the virus that causes COVID-19 is mainly transmitted through the theme of respiratory droplets of an infected person. The COVID-19 outbreak has affected all areas of life, including sports (www.who.int).

Every stakeholder of the sport has been affected by this pandemic, from sportsman to members of the media. During the COVID-19 process, many sporting activities, including professional leagues, have been suspended to limit the rate of transmission of the virus. Even the Summer Olympics, the world's most watched sports event, have been postponed for a year.

These and similar methods of protection have caused the public to stay in their homes, and professional athletes have been forced to stop their professional activities and reduce their work towards their physical structures (Eirale et al., 2020).

Professional athletes have applied for home exercises to maintain their form during this time they are under quarantine at home. This experience has been a first for them as well. Of course, home exercises are not expected to replace hall trainings. But how close could he get to physiological requirements?

Home exercises are usually designed with body weight exercises. In addition, body weight exercises were preferred because elite handball players could not be homogeneous in terms of sports equipment found in their homes. Exercise with body weight is based on the principle of using one's own body as a means of resistance without using external resistance such as weightlifting, bar or machine (Harrison, 2010). Typical body weight exercises include variations such as push-ups, step-by-step, sit-ups, crouching and traction. In short, any movement that does not apply to additional resistance to the body is considered a body weight exercise (ACSM, 2013).

Effort during team handball is often described as long-term acyclical work, with an interval character, where energy is obtained both aerobically and anaerobically (Zwierko et al 2008).

Max VO^2 improvements generally occur when a high percentage of VO^2_{peak} is elicited during exercise, the general goal of interval conditioning is to accumulate a greater training stimulus at high intensities compared to what can be tolerated in a single bout of continuous exercise (Wenger 1986). The prescription of interval training is based on five variables: work interval intensity and duration,

recovery interval intensity and duration and total work duration. These variables can be manipulated to generate a large range of interval training prescriptions designed to primarily stress aerobic and/or anaerobic energy metabolism. Sufficient physiological data are now available to classify different types of aerobic interval training, ranging in intensity from %85 to %130 of the power or velocity associated with VO^2_{peak} (Billat 2001).

When we look at the relationship between team handball physiological nature and interval training (both aerobic and/or anaerobic), we can see the importance of interval training is the one of the most important conditional factor in handball (Buchheit 2008)

Interval training is a type of discontinuous physical training that involves a series of low- to high-intensity exercise workouts interspersed with rest or relief periods. Because of the intermittent nature of this form of training, the exercise intensity and the total amount of work performed can be greater than with continuous training, making discontinuous training a versatile method that is widely used by athletes, as well as individuals with low cardiorespiratory fitness. This method is popular among athletes because it allows the athlete to exercise at higher relative intensities during the work interval than are possible with longer duration, continuous training. Interval training programs also can be designed to improve speed and anaerobic endurance, simply by means of modifications in the exercise intensity and length of the work and relief intervals (Heyward 2006).

We can define as the interval training specific to handball in five parts:

1. Athletic performance must be taken under team handball requirements.
2. The loadings must be defined for the purpose of development of motor skills especially for handball performance.
3. Physiological changes must not turn back to normal levels between the repetitions.
4. Different recovery types must be used in the different loads (aerobic and/or anaerobic, extensive or intensive).
5. Load intensity – Work duration – Rest duration – Repetition and also total work must be designed according to the simulation of the handball match (Heyward 2006, Baechle 2000, Stone 2007).

As the requirements of the athletic performance in the game, team handball is a complex intermittent sport game which requires players to have well developed aerobic and anaerobic capacities (Delamarche 1987, Gorostiaga 2006). Several motor abilities such as sprinting, jumping, flexibility and different technical competences like passing, shooting, dribbling, faking, defensing or saving balls are considered as important aspects of the game that contribute to the high performance of the team Granados 2007, Marques 2006, Marczinka 1993, Clanton 1997). Zapartidis 2009 pointed that the importance of VO2max in terms of distinguishing young handball players according to their level. Depending on the level of competition and the playing position, players usually cover a distance between 4,5 – 6,5 km/h and require high level of aerobic capacity to aid recovery after high intensity periods of activity. On the other hand, he stated that a number of differences in anthoropometric and physical fitness characteristics exist between playing position.

When we look at the nature of handball's energy consumption, the metabolic demands of modern handball involve the aerobic and anaerobic energy pathways. As a supportive evidence, during a Handball match, players perform 190 rhythm variations, 279 change of direction, 16 jumps and also an handball players performs a total of 485 high-intensity movements in 60 minutes (EHF Seminar 2004)

These studies support the idea of Handball as an intermittent activity. This intermittent activity is determined by high-intensity motion (with energy mostly furnished by ATP-PC and anaerobic pathways) and low intensity motion (in which the aerobic pathways have the function of active recovery).

In the study, which we planned with the studies carried out in the field writing, the criteria specific to the structure of the handballers have shaped our study. The aim of the study in this context is to show professional handballers the similarity of high-density exercises applied in the home environment to aerobic and anaerobic capacity in the field environment.

Method

The research group is made up of 16 national handball players who play for Spor Toto Handball in the Turkish Men's Super League.

Five weeks of exercises of different intensity are divided into 4 different intensity exercise groups. Handball players recorded the degree of difficulty perceived by heart beat rates during and at the end of their workouts in the home environment. HR_{max} values of athletes were evaluated by the handball-specific 30-15 Intermittent Fitness Test, which is regularly performed during the season, and athletes' depletion rate was considered maxify (Buchheit et al, 2010).

The S-800 Model Polar watch was used to determine the number of heart beats during exercises performed by handball players in the home environment. A 6-20 degree Borg scale was used to determine the degree of repeated perceived exertion.

Table 1. Content of 5-week exercises applied to handball players

1. Aerobic Interval Continuous Training Programme	2. Extensive Interval Training Programme
60 s jump rope + 30 s isometric core + 30 s dynamic core x 12 station= 24 min	30 s jogging 30 s jumping jacks 30 s long jump 30 s 1-2-3 step 30 s but kicks 30 s high knees 30 s mummy kicks 3 set
HR measurement and 30 s break	HR measurement and 30 s break
7 min stretching	7 min stretching
30 min break	30 s break
20 s leg work + 10 s jump x 8 station (Tabata Protocol))	30 s hit the floor 30 s power squat 30 s mountain climbing 30 s ski down 30 s break 3 set
HR measurement and 30 s break	HR measurement and 30 s break
20 s leg work + 10 s jump x 8 istasyon (Tabata Protocol)	30 s scissors run 30 s skipping 30 s Handball shot 4 push up + 8 sprinting (4 repetition) 30 s swing legs 30 s back and forth legs 30 s defense touches 30 s cross jacks 30 s break 3 set
HR measurement and 30 s break	HR measurement and 30 s break
3 min stretching + Cool Down	3 min stretching + Cool Down

Whole Aerobic Interval Continuous Training Programme can be watched at:
https://www.youtube.com/watch?v=QRWdM6TZA_w&t=8s

Whole Extensive Interval Training Programme can be watched at:
https://www.youtube.com/watch?v=B59qULa0LGI

Whole Intensive Interval Training Programme can be watched at:
https://www.youtube.com/watch?v=1DFg7p1EhHM&t=358s

Whole High Intensity Interval Training Programme can be watched at:
https://www.youtube.com/watch?v=kkJZhGLepTA&t=6s

3. Intensive Interval Training Programme	4. High Intensity Interval Training Programme
30 s jogging 30 s power jack 30 s long jump 30 s 1-2-3 step 30 s but kicks 30 s high knees 30 s vertical jumps — 3 set	30 s jogging 30 s Jumping jack 30 s heisman 30 s 1-2-3 step 30 s but kicks 30 s high knees 30 s mummy kicks — 3 set
HR measurement and 30 s break	HR measurement and 30 s break
7 min stretching	7 min stretching
30 s break	30 s break
30 s power jump 30 s squat kick 30 s hit the floor 30 s V push up 30 s triceps dips 30 s one leg triceps dips — 3 set	60 s suicide drill 60 s swith kicks 60 s skipping 60 s stance jacks 60 s sprint-lungs 60 s side stepping 60 s power jacks
HR measurement and 30 s break	HR measurement and 30 s break
30 s hurdle jump 30 s square jump 30 s moving push up 30 s floor sprint 8 hop squat 8 push up — 3 set	8 push-up + 8 skipping + burpee 60 s frog jump 60 s power knees 60 s mountain climbing 60 s ski down 60 s scissors run 60 s burpee 60 s push up jacks
HR measurement and 30 s break	HR measurement and 30 s break
3 min stretching + Cool Down	3 min stretching + Cool Down

Regression analysis was applied to create the research group in order that the HR and RPE values obtained from different training loads from handball players predict the maximum HR and RPE. Descriptive statistics of handball players' age, height and body weight were obtained. SPSS 25.0 package program was used for statistical analysis. $P < 0.05$ was taken for the significance differences.

Finding and Discussion

In this section, the results related to the maximum values procedure of exercises applied at different intensities are given with tables and comments. Regression analysis results related to the prediction of HR_{max} values (X_{mean}= 189.63±5.51 beats / min) of trainings with different intensities applied in the upper league are given in Table 2.

Table 2. Regression analysis results regarding the prediction of the HR_{max} ability of the research group.

Parameter	B	SE_B	β	t	p	Dual	Partial
Constant	94,380	21,653		4,359	,001		
Aerobic Training X=140,95±14,02 beat/min	,184	,071	,468	2,583	,025	,768	,614
Extensive Int Training X=164,61±6,06 beat/min	,370	,665	,407	,556	,590	,779	,165
Intensive Int Training X=166,80±6,06 beat/min	,619	,629	,681	,983	,347	,796	,284
HIIT X=169,70±6,81 beat/min	-,558	,238	-,690	-2,344	,039	,583	-,577
$F_{(4-11)}$= 12,234	P=,000						
R=,904	R^2=,816						

When Table 2 is examined, a high level of positive and statistically significant correlation is observed with HR_{max} together with the HR values of different intensity training obtained from handball players (R =, 904, R^2 =, 816, P <0.05). The mentioned 4 variables together explain about 82% of the total variance in the HR_{max} value. In other words, there is a high similarity between training HR and HR_{max}. According to the standardized regression coefficient, the relative importance order of predictor variables on the HR_{max} ability is high intensity, intensive range, and aerobic and extensive range.

When the T-Test results regarding the significance of the regression coefficients are examined, it is seen that HR values of high-intensity interval and aerobic training are significant predictors of HR_{max} ability, while there is no significant effect on HR obtained from extensive and intensive training. According to this finding, the most significant similarity to HR_{max} values shows the HR values obtained from aerobic and high intensity interval training.

Regression analysis results regarding the prediction of RPE obtained from the training at different intensities and RPE (X_{mean} = 9.45±0,52 units) obtained from the maximum test are given in Table 3.

Table 3. Regression analysis results regarding the prediction of the RPE_{max} ability of the research group.

Parameter	B	SE_B	β	t	p	Dual	Partial
Constant	13,093	2,256		5,803	,000		
Aerobic Training X=5,75±,58 unit	-,512	,300	-,572	-1,706	,116	-,447	-,457
Extensive Int Training X=7,13±,50 unit	-,169	,584	-,163	-,289	,778	-,258	-,087
Intensive Int Training X=8,25±,68 unit	,452	,511	,598	,885	,395	-,189	,258
HIIT X=8,50±,63 unit	-,373	,356	-,457	-1,050	,316	-,204	-,302
$F_{(4-11)}$= 1,062	P=,420						
R=,528	R^2=,279						

When Table 3 is examined, it is seen that the RPE values of different intensity training obtained from handball players are moderately positive with the RPE_{max} applied together. However, this relationship is not statistically significant (R =, 528, R^2 =, 279, P> 0.05). The mentioned 4 variables together explain about 28% of the total variance in the RPE_{max} value. In other words, it can be said that

there is a low similarity between RPE and RPE_{max} specified in training, and the athletes do not respond in accordance with the training load in determining the AZD values. According to the standardized regression coefficient, the relative importance order of the predictor variables on the RPE_{max} ability is dense spaced, aerobic, high intensity and widespread.

When the T-Test results regarding the significance of the regression coefficients are examined, it is seen that the training RPE values taken from the handball players do not have a significant effect on the RPE_{max}. According to this finding, it was determined that it was not similar to RPE taken in RPE_{max} training.

Results and Discussion

While the training HR values taken from handball players are planned to resemble the training load, it may be suggested that some training structures do not capture the target HR value, that RPE values taken from handball players are subjective, as well as verifying according to the HR value during training.

Maintaining physical capacity is a fundamental requirement for the athlete. In particular, for team sports athletes, aerobic strength and muscle strength are a fundamental prerequisite for maintaining performance that maintain a good level of both. Training physiological adaptation is a reversible process. Indeed, many aspects of physiological adaptation have been lost during long-term inactivity (Mallo, 2015). Speed and maximum strength are loss for greater physical capacity than durability and strength continuity. Overall, total inactivity is considered to be a general loss of up to 10% for each week (Varandas et al., 2017).

In the study, it is observed that interval studies within the scope of the low rate of this lack of training have created warnings, especially in the effects of the HRmax obtained in the field environment.

After the pandemic period, which will be considered a similar process to the transition period, it is very important that players maintain their fitness levels to tolerate a rapid increase in the frequency and intensity of training, while at the same time trying to minimize the risk of injury (Gabbett, 2007). In the study, which supports this literature, it was determined that the effect of high-pulse training satisousin in the athlete, in particular, that RPE values do not match the training load.

It is stated that high intensity aerobic capacity (VO2max) causes a significant decrease in high density aerobic capacity (VO2max) in 20 days or more. For this reason, after the off-season, athletes may have difficulty in tolerateing high training volume and intensity especially in the first weeks of the season (Silva et al., 2016). Hansen et al., (2018) noted that in addition to the recommendations for a 60 min load that should be considered in cardio-style exercises, the work coincides with 80% of HR (McMullen et al., 2018) training intermittent or intermittent training in which both aerobic and anaerobic lactic acid system is dominant (Dufour et al., 2006; Billat et al., 2000; Laffite et al., 2003) can minimize the effect of non-training in the pandemic process (Chen et al., 2020; Zheng et al., 2020; Wang et al., 2020). In this context, it can be said that the training system in accordance with the criteria specified by the researchers is presented with the findings of the study.

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