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Investigation of Changes in Blood Lactate, Attention and Reaction Times during Competition in Wheelchair Basketball Players

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ORIGINAL ARTICLE

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Abstract

This study was carried out to examine the lactic acid (LA), attention (AT) and reaction time (RT) levels of wheeled basketball (WB) players during a match. 10 WB players playing in Turkey Mardin Kızıltepe Disabled Association Sports Club participated voluntarily in the 2021-2022 WB 1st League. The mean age of the subjects was 29.0±5.84 years, and the mean age of sports was 8.20±3.61 years. In our study, the mean LA average of the WB players was determined as 3.31 mmol/L and before the competition were determined as 1.75 mmol/L, 4.21 mmol/L at the end of the first half, and 3.99 mmol/L at the end of the match and it was determined that there is a statistically significant difference (P<0.05). The RT was determined as 436.80+73 ms before the competition, 347.60+50 ms between periods, and 326.40+32 ms after the competition and when looking at AT measurement values it was 815.40+40 ms before the competition, 729.50+95 ms at half-time, and 659.50+53 ms after the competition. İt is seen that there is a statistically significant difference beetween the parts of the competition in LA (P<0.05) also deterioration in RT and AT values during the competition (P<0.05).

Keywords: Blood Lactac, Attention, Reaction Time, Disabled, Wheelchair Basketball

Tekerlekli Sandalye Basketbolcularında Müsabaka Süresince Kan Laktat, Dikkat ve Reaksiyon Sürelerindeki Değişimlerin İncelenmesi

Öz

Bu çalışma tekerlekli basketbol (TB) oyuncularının maç esnasında laktik asit (LA), dikkat (D) ve reaksiyon süresi (RS) düzeylerinin incelenmesi amacıyla yapılmıştır. Çalışmaya 2021-2022 TB 1. Ligi'nde mücadele eden ve Türkiye Mardin Kızıltepe Engelliler Derneği Spor Kulübü'nde forma giyen 10 TB oyuncusu gönüllü olarak katıldı. Katılımcıların yaş ortalaması 29,40±5,84 yıl, spor yapma yaşı ortalaması 8,20±3,61 yıl olarak tespit edildi. Çalışmamızda TB oyuncularının LA ortalaması 3.31 mmol/L olarak müsabaka öncesi 1,75 mmol/L, ilk yarı sonunda 4,21 mmol/L ve maç sonunda 3,99 mmol/L olarak bulunmuş olup istatistiksel olarak anlamlı bir fark olduğu belirlendi (P<0,05). RS müsabaka öncesi 436,80+73 ms, periyotlar arası 347,60+50 ms ve müsabaka sonrası 326,40+32 ms olarak belirlenmiş olup, D ölçüm değerlerine bakıldığında müsabaka öncesi 815,40+40 ms devre arasında 729,50+95 ms ve müsabaka sonrasında 659,50+53 ms'dir. LA'da yarışmanın bölümleri arasında istatistiksel olarak anlamlı bir fark olduğu (P<0,05), ayrıca yarışma sırasında RT ve AT değerlerinde bozulmanın (P<0,05) olduğu görülmektedir.

Anahtar Kelimeler: Kan Laktat, Dikkat, Reaksiyon Süresi, Engelli, Tekerlekli Sandalye Basketbolu

Introduction

More than a billion people in the world continue their lives with any type of disability. (Pineda and Corburn, 2020). For people with disabilities regular physical activity serves as physical, psychological and social support (Jaarsma and Smith, 2018). In recent years, thanks to the sports branches specially designed for disabled individuals, the participation of disabled individuals in many sports branches has been ensured andin this way, the number of disabled athletes has increased considerably. (McLoughlin et al., 2017). Spinal cord, amputation, poliomyelitis, joint-musculoskeletal problems lead to physical disability. Wheelchair basketball (WB) is designed for individuals with permanent lower extremity disabilities that restrict movements such as running, jumping and foot turns due to these different physical disabilities (Seron et al., 2019). Wheelchair Basketball is one of the sports in which disabled people participate the most and its popularity is increasing every year (Yanci et al., 2015).

Lactic acid is a product formed during anaerobic metabolism and is formed as a result of the breakdown of glucose in an oxygen-free environment. It accumulates in the blood and muscle, causing fatigue and lowering the pH, leading to metabolic acidosis. Under normal conditions, 10 mg (or 1,1 mmol/L) of lactic acid is found in 100 cc of blood.In exercise, the amount of lactate increases with the effect of anaerobic metabolism, and the duration and intensity of the exercise determines the level of this increase.Lactate accumulation increases more in high-intensity exercises and together with the decrease in pH (metabolic acidosis), they cause fatigue (Astrand et al, 2003).

Attention and reaction are two important features that directly affect the entire physical performance of the athlete. Attention is focusing on a specific object, movement, activity, situation, event or phenomenon (Schefke and Gronek, 2010); reaction is defined as the first reaction time of the muscle to an impulse (Radák, 2018). Fatigue during exercise negatively affects attention and reaction characteristics (Whyte et al., 2015; Fery et al., 1997). Being able to control thoughts and focus on a certain point it is of great importance for effective performance in sports (Nideffer and Sharpe, 1993). Factors affecting attention and reaction can be counted as stimulus and response harmony, stimulus intensity, premonition, age, attention, concentration, insufficient training, gender, warming, nutrition, sleep, fatigue (Eyesenck and Keane, 2000; Era and Jokela, 1986).

Wheelchair basketball game is a sport based on fast movements, which physiologically requires alactic anaerobic system and lactic anaerobic metabolism. Individuals engaged in this sport

must have aerobic and anaerobic characteristics, be able to provide high concentration and attention, and have a quick reaction for success, and this must be maintained throughout the competition. This research was carried out in order to contribute to both the literature and the scientific preparation of the athletes by examining the level of lactate, attention and reaction during the competition in wheeled basketball.

Method

Participants

Ten wheelchair basketball players playing in Mardin Kızıltepe Disabled Association Sports Club participated in this research voluntarily in the 2021-2022 Wheelchair Basketball 1st League. The mean age of the subjects is 29.40±5.84 years, and the mean age of sports is 8.20±3.61 years. During the competition period, the subjects train 4 days a week, 3 hours a day, for a total of 12 hours.

Design and procedures

Study measurements were carried out in a preparatory competition just before the start of the 2021-2022 season Turkish Wheelchair Basketball Leagues. LA, AT and RT measurements were made at the end of the warm-up 15 minutes before the match, at the end of the first half and at the end of the match, on the field where the match was played. Measurements were taken simultaneously in 3 groups (2 groups of 3 athletes and 1 group of 4 athletes) by 3 coaches. All tests were applied by the same researchers and at the same time (in pre-competition; in half-time; in post-competition) in sports facilities where the athletes participated in team training. The reaction test was performed 5 minutes after the blood lactate test and the attention test was performed 5 minutes after the reaction test.

Blood Samples

Blood samples were drawn 3 times from each volunteer – at rest, within 1 min after the end of warm up, and immediately after the end of each half (within 1 min) of the matches. Each athlete was given a recovery time of 5 minutes after the other measurement. In our study, the Accutrend Lactate/Accusport Portable Lactate Analyzer device and the Lactate Strip belonging to this device were used to determine the lactic acid levels of the subjects. Before each use, the strips belonging to the device were introduced with the device. A very small amount of blood (0.5-7 μL) was dropped

on the strip from the ear of the subject with the help of the Accu Chek Softlix Lancet Needle. Results were obtained within 60 seconds.

Attention and Reaction time test measurements were taken over the internet using the Human Benchmark application (URL 1). It was carried out with the measurements under the heading of reaction time test (for RT) and aim trainer test (for AT). Both tests were conducted using a touch laptop.

Reaction Time

In the reaction time test measurement method, when the play button is touched, the test starts. During the start, the screen turns green with the wait warning and turns red. As soon as the screen turns green, the athlete touches the screen as quickly as possible. The best of three measurements was recorded as the athlete's degree. The measurement result was also recorded in milliseconds (ms).

Attention Test

In the target touching test, the test starts when the play button is touched. During the start, a target mark appears on the screen. It is necessary to touch the burning target 30 times in the fastest way possible in different parts of the screen. The best of three measurements was recorded as the athlete's degree. The measurement result was also recorded in milliseconds (ms).

Ethics Approval and Consent to Participate

This study was conducted according to the guidelines of the Declaration of Helsinki and Fırat University Non-Interventional Research Ethics Committee dated 09.03.2023 and numbered 2023/04-30.

Statistical Analysis

SPSS 23.0 statistical package program was used to evaluate the data and find the calculated values. Data are summarized with mean and standard deviations. Differences between measurements were analyzed by repeated measures ANOVA. Bonferroni test was used for post hoc comparisons. In this study, the error level was taken as 0.05.

Results

Looking at Table 1, it is seen that the average age of the participants is 29.40+5,84 years, and their training age is 8.20+3,61 years.

Table 1

Demographic Characteristics of the Participants

Variables	n	X	SS	Min	Maks
Age (years)	10	29.0	5.84	21	35
TA (years)	10	8.20	3.61	3	13

TA: Training Age

Table 2

Statistical Analyzes of Participants between Measurements

Variables	PrCM	HTM	PoCM	ACA	p	DBM
LA (mMol/L)	1.75+0.11	4.21+0.44	3.99+0.49	3.31+0.31	0.000*	PrCM- HTM, PrCM- PoCM
RT (ms)	436.80+73	347.60+50	326.40+32	370.26+34.24	0.000*	PrCM- HTM, PrCM- PoCM
AT (ms)	815.40+40	729.50+95	659.50+53	734.80+77.66	0.000*	PrCM- HTM, PrCM- PoCM, HTM- PoCM

***p<0,05; PrCM:** Pre-Competition Measurement; **HTM:** Half-Time Measurement; **PoCM:** Post-Competition Measurement; **ACA**: All Competition Average; **LA:** Lactic Acid; **RT:** Reaction Time AT: Attention; **DBM:** Difference Between Measurements

Looking at Table 2, it was determined that there was a statistically significant difference between the three measurements in all three parameters in the LA, RT and AT tests. When Table 2 was examined, it was determined that there was a statistically significant difference between the measurements of the LA level of the athletes participating in the research, between PrCM (1.75+0.11 mMol/L) and HTM (4.21+0.44 mMol/L), and PrCM (1.75+0.11 mMol/L) and PoCM (3.99+0.49 mMol/L) measurement (P<0.05). When the RT results are examined, there are statistically significant differences (P<0.05) between PrCM (436.80+73 ms) and HTM (347.60+50 ms) and PrCM (436.80+73 ms) and PoCM (326.40+32 ms). Considering the AT test measurements, there are also statistically significant differences (P<0.05) between PrCM (815.40+40 ms) and half-time (729.50+95 ms) and PrCM (815.40+40 ms) and PoCM (659.50+53 ms). It was determined that there was a statistically significant difference between HTM (729.50+95 ms) and the PoCM of the match (659.50+53 ms).

Discussion

This study was carried out to examine the lactate level, attention and reaction levels of

wheeled basketball players during a match. 10 wheelchair basketball players playing in Turkey Mardin Kızıltepe Disabled Association Sports Club participated voluntarily in the 2021-2022 WB 1st League.The mean age of the subjects was 29.40±5.84 years, and the mean age of sports was 8.20±3.61 years.

In this study in order to reveal the metabolic stress created by the game, as in the studies in the literature (Astrand and Rodabl, 1986; Iturricastillo et al., 2018; Majeed et al., 2018), the change in LA values was used. In our study, the mean La average of the wheeled basketball players was determined as 3.31 mmol/L. In the literature, Narazaki et al. (2009) reported the La whole competition average of the subject groups consisting of men and women as 4.2 mMol /L. In addition Mroczek et al. reported in their study in 2011 that the LA levels of volleyball players reached a maximum of 3.2 mmol/L during the match. In another study, it is reported that laclate concentrations observed during the game in football vary between 3-6 mMol/L (Mohr et al., 2005). According to this, when the data we obtained in our study and the information in the literature are compared, it can be said that WB has a high-intensity game character.

In our study, the LA levels of the WB players before the competition were determined as 1.75 mMol/L, 4.21 mMol/L at HTM, and 3.99 mMol/L at PoCM and it was determined that there is a statistically significant difference between PrCM and HTM and the PoCM ($P<0.05$). When we look at the results of our study, we can say that the LA level between the half time is higher than the results before and after the competition.

In the literature, there is no study investigating the LA levels of the players before, during and after the match in the WB branch. When we look at studies related to other branches Akkoyunlu et al. (2004) reported that in his study with football players, they found the mean LA values of the players before the match, at the end of the first half and at the end of the match, respectively, 1.98, 4.25 and 3.94 mMol/L, and there was a significant difference between the measurements ($p<0.05$).Coutts and Reaburn determined the lactate concentrations as 7.2 mMol\L before the match, 8.4 mMol \L at the end of the first half and 5.9 mmol \L after the match in their research on semi-professional rugby league teams. Melchiorri et al. (2010) reported the LA values as 7.7, 7.8, 7.5, and 7.2 mMol\L in the quarters of the game, respectively, in their study on water gunners. Looking at the other two studies in the literature Abdelkrim et al. (2010) male basketball players

were 5.7 mMol\L at the end of the first half and 4.4 mMol\L at the end of the match, Scanlan et al. (2012) reported that the mean LA level of female basketball players at the end of the first half and at the end of the competition was 4.1 and 3.4 mMol /L, respectively, and there was a statistical difference between the measurements.

Although the LA values obtained in the study are different according to the studies in the literature, the change in the competition process (PrCM, HTM and PoCM) is similar to the literature. There may be differences in LA production between individuals as the rate of intense exercise during competition depends on factors such as the player's motivation, play style, tactics and strategy. Other factors are the differences between teams and playing styles.For example, when man-to-man marking, a higher LA value may occur compared to the area defense, another can be listed as higher LA values of the athletes in fast attacking teams.In addition, the different LA values obtained in our study can be explained by the fact that the subjects play with a wheelchair.

The fact that LA values are lower at the end of the match compared to the end of the first half can be explained by the effect of the half-time rest period on recovery, the score advantage of the basketball players in the second half or the decrease in tempo due to fatigue.Because there is a high positive correlation between onset of blood lactate accumulation (OBLA) and psychomotor fatigue threshold (Chmura et al., 2010). OBLA is defined as the exercise load during which lactate concentration in blood attains 4 mmol l/L (Heck et al., 1985). This information supports our study. In our study, it is understood that the athletes increased to the level of 4 mMol/L (Table-2).

Although there are many studies on the organism and general health of exercise (Yu et al, 2015; Sammoud et al., 2019; Zemková et al., 2021) in the literature, there are not many studies examining the effects of exercise on mental functions (Moore et al., 2012). In our study, the effects of exercise on AT and RT in WB players were investigated. In this study, RT was determined as 436.80+73 ms before the competition, 347.60+50 ms between periods, and 326.40+32 ms after the competition. Considering the AT measurement values, it was determined that it was 815.40+40 ms before the competition, 729.50+95 ms at half-time, and 659.50+53 ms after the competition. Mroczek et al. (2011) reported that there was a significant decrease in the reaction times of volleyball players during the match compared to the pre-game ($p<0.05$). Moreover, there are studies in the literature stating that exercise causes a decrease in reaction times (Chmura et al., 2010; Smith

et al., 2016). Looking at the literature, Whyte et al. (2015) applied the Stroop test immediately after the end of the high-intensity exercise and reported that the cognitive functions of the athletes were weakened. Fery et al. (1997) reported in their study that the attention levels of the subjects deteriorated after high-intensity exercise.This information supports our study. Contrary to this information, there are also studies reporting that exercise has no effect on attention level (Lambourne and Tomporowski, 2010; Chang, 2012) or has a positive effect (Mcmorris and Graydon, 2000), but this is thought to be due to low exercise intensities.İt is seen that there is a deterioration in reaction time and attention values compared to the pre competition ($P<0.05$).

Conclusion

If the exercise intensity exceeds the anaerobic threshold, the rate of lactate accumulation increases a lot, and as it increases, the time to continue the exercise at the same intensity decreases. Energy is mostly provided by the breakdown of creatine phosphate during short periods of high-intensity anaerobic exercise with an increase in LA. On the other hand, aerobic ways are used during the regeneration of energy sources during the rest periods and when the intensity of play decreases. In WB, especially in the first section, due to the fact that the energy stores are full, the athletes can perform short-term high-intensity exercises in this section, and their attention and reaction skills are high. In the second part, it is thought that there is a decrease in attention and reaction skills as well as in motor performance due to fatigue caused by the increase in LA level.

Ethics Committee Permission Information

Ethics review board: Fırat University Non-Interventional Research Ethics Committee

Date of ethics assessment document: 09.03.2023

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Statement of Researchers' Contribution Rates

The entire study was conducted by the sole author of the study.

Conflict Statement

The authors have no declarations of conflict regarding the research.

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