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Aspects of the relationship between heart rate and precision of throwing in wheelchair basketball. Preliminary study

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Abstract
One of the most practiced disciplines for athletes with disabilities is wheelchair basketball. At the same time, in order to achieve the highest level of competitiveness, the specific training methods are based on experimental research made on the players of wheelchair basketball teams engaged in official competitions.The **purpose** of the study is to evaluate the precision of throwing (PoT) in relation to the player's throwing position (TP), starting from the hypothesis that effort intensity, determined by heart rate (HR), could influence PoT.**Methods.** 5 athletes (My = 30.8 ± 7.5) members of the men's wheelchair basketball team, national champion in 2009, participated in the study. A HOSAND system (Italy, 2005) was used for HR monitoring and, for the determination of the PoT, each player made 10 throws at the edge of the 3sec. quad from: 45^0 left, 45^0 right and from the free throw line for the 120 HR, 140HR, 160HR, and 180HR crossings.**Conclusions.** Within the limits of our study, the data obtained show that, for each player, the PoT depends on PT and is influenced by HR values. These data can be used by the coach to design training sessions that aim to improve basketball and to place players on the field on tactical pitch. However, data must be approached with caution because, in their assessment and capitalization, account must also be taken of each player's competitive classification (IWBF functional classification).

Keywords :adjustedbasketball, effort intensity, performance improvement

Introduction

Lately, wheelchair basketball has become increasingly popular (Croft et.al., 2010); the number of professional teams has increased, the level of competitiveness increased, the studies and researches in this sporting sector have become various. More and more, training sessions harness the data from specialty studies to assist coaches in planning offensive and defensive game strategies during training sessions (Francis, J.M., et al., 2017). With caution, data from studies on normal basketball can also be used (e.g., 3-point shooting accuracy during fatiguing conditions, Freitas TT, et al., 2016) or wheelchair disciplines (e.g., improving training methods in wheelchair tennis, Roy, JLP, et.al., 2006), the latter having in common the fact that athletes use the arms and the upper train for both the movement (seat propulsion) and for making branch-specific skills.

A statistical analysis of Beijing Paralympics 2008 and World Wheelchair Basketball Championship 2010 shows that the percentage of successes in field and free throws are the most important factors in winning (Miguel, A.G., et al., 2014). At the same time, HR (Achten, J., And Jeukendrup, 2003) is the most common variable for monitoring effort intensity during training. On the other hand, the relationship between the precision of the basketball and the intensity of the effort was highlighted only in the usual basketball (Marcolin G., et.al., 2018) It is to be noted that in the official HR matches mean is around 150beat.min. (Coutts, K.D., 1988).

Methods

Subjects

The study was conducted on 5 subjects (30.8 ± 8.4years) members of the national champion team 2009. The participants have over 5 years of activity and the corresponding IWBF functional classification respectively: player1-1.5, player2-2, player3-4, player4-3 and player5-2.5. All participants were informed of the purpose and way of development of the study. This was done with the consent of the players, the coach and the Ethics Committee of AurelVlaicu University in Arad.

Experimental design

Each subject, having a Hosand device (2005, Italy), was determined the heart rate at rest ($HR_{rest} = 94.8 \pm 6.22$). They performed specific heating exercises up to HR = 120 beat.min. At this HR value, they executed 10 throws (TP) from 45^0 left and right of the 3sec. quad, and from the free throw line; if during the throws HR dropped below 120, the subject performed displacements, accelerations with change of direction until HR went up to 120beat.min. To reach each HR crossing, respectively 140, 160 and 180beat.min, the subjects performed a proper workout, consisting of displacements (propulsion), directional changes, all made with ball. The protocol proceeds from the data reported by Coutts, K.D. (1992) that, during the wheelchair basketball game, it was estimated that 64% of the time spent in propulsion and 36% in braking activity and that there are no significant differences between the on-site mobility of the players, whether we talk about the fence, forward or central players (Annemarie MH de Witte et al., 2016). The number of successes (ST) for each HR level has been recorded.

Statistical analysis

For data processing, SPSS version 20.0 was used. The results are shown in Table 1. All variables have a normal distribution. We calculated the correlation between heart rate (HR) and the number of successful throws (ST) and we used One-way ANOVA to determine the differences between the precision of throwing PoT and heart rate HR. The upper limit for statistical significance was set at $p = < 0.05$.

Results

The data obtained from the study are presented in Table 1. The correlation between HR and PoT is negative for all subjects, its value being around the group average ($r_{group} = - 0.683$). In other words, the higher the effort intensity estimated by the HR, the lower the accuracy of the basket throw. This can be seen in Figure 1.

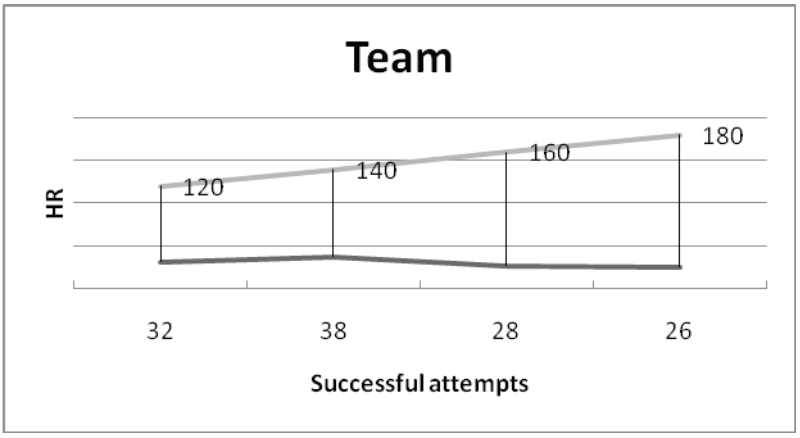

Fig.1 Number of successful team trials for each HR level

Figure 1 shows that the highest number of successes (SA = 38) is around HR = 140. Values are close to those reported by Coutts, K.D. (1988), i.e., 148 ± 6.4 beat.min and Croft, L., et al., (2010), i.e. 163 ± 11 beat.min.

Table 1 The players'number of successful attempts(SA) by heart rate(HR) and throwing position(TP)

	Player 1			Player 2			Player 3			Player 4			Player 5		
Age	42			34			28			31			19		
Heart rate in rest(HR_R)	88			88			99			100			99		
	Successful Attempts (AS) /Throwing Position (TP)														
	L_{eft}	C_{enter}	R_{ight}	L_{eft}	C_{enter}	R_{ight}	L_{eft}	C_{enter}	R_{ight}	L_{eft}	C_{enter}	R_{ight}	L_{eft}	C_{enter}	R_{ight}
120HR	1	3	2	3	3	3	0	0	0	3	2	1	4	3	4
140HR	3	3	2	3	2	4	1	0	1	2	3	3	4	2	5
160HR	1	2	1	3	2	4	1	0	1	3	2	0	1	2	5
180HR	1	2	2	4	1	3	2	0	0	2	1	2	5	1	0

Discussion

If we associate SA with TP and HR, we find that at HR120 the number of successes (PoT: 11,11,10) is not influenced by PT (fig. 2), for HR140 throws are favored from 45^0 right (PoT: 15) (Figure 3), HR160 is similar to HR140 (Figure 4), while HR180 is favored predominantly by 45^0 left throws (PoT: 14) (Fig.5). In other words, PoT is influenced by both HR and TP. One-way ANOVA descriptor analysis (for C.I. 95% and $p < 0.05$) shows that there is a significant difference between the success means at HR140 (SA_{mean}=7.60) and HR160 (SA_{mean}=5.60), suggesting that refinement of basket throws should be in the range of 140-160HR for all throw positions (Figure 6).)

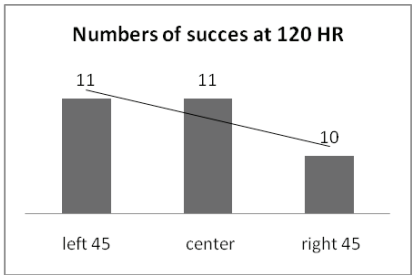

Fig.2. Number of throws at 120 HR.

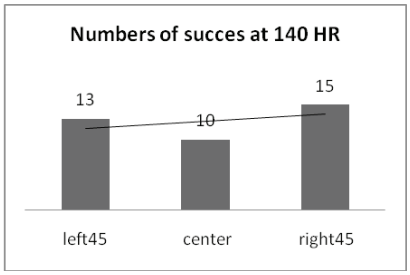

Fig.3. Number of throws at 140 HR.

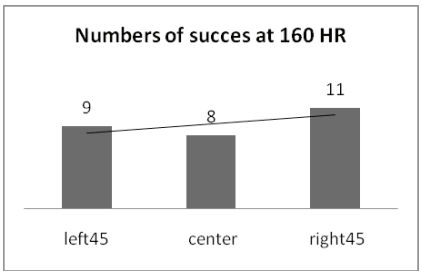

Fig.4. Number of throws at 160 HR.

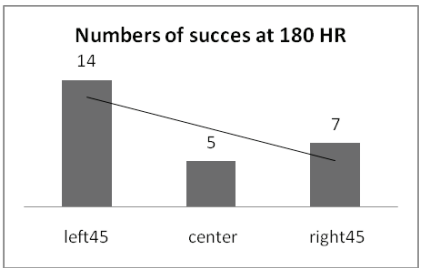

Fig.5. Number of throws at 180 HR.

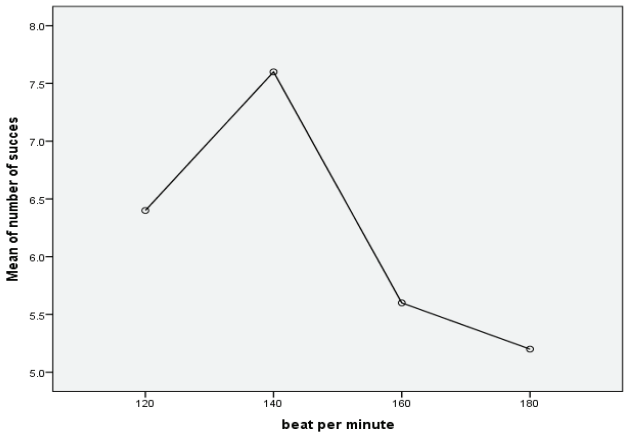

Fig.6 The average of successes for each HR level

Given the preliminary stage of the study, the analysis mainly focused on the relationship between HR, PoT and TP. Fig.7 can suggest the best model with 3 variables, starting from the consideration that PoT is the best at HR140beat.min.

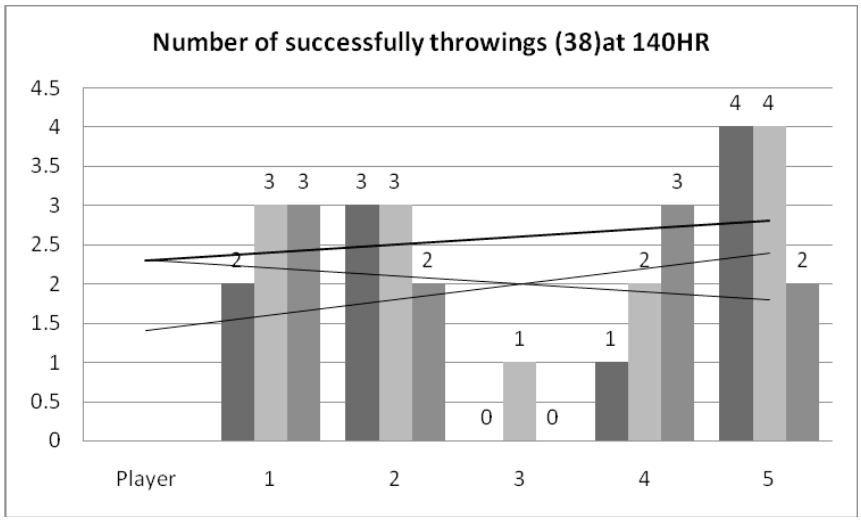

Fig.7 The number of successes to HR140beat.min for each player and the throw position (first column = 45^0 left, second column = center, third column = 45^0 right).

Calculation of the R^2 value shows that the most efficient linear grouping of the 3-variable model is for the 45^0 left throws (R^2 = **0.04** left 45^0, R2 = 0.019 center and R^2 = 0.016 right 45^0) at HR-140beat.min. Basically, this model shows the coach the following: Players 1 and 2 throw with the same efficiency regardless of the throw position but are weaker in relation to the player 5; he has to refine his 45^0 right throws. Player 3 has an almost null return, while player 4 has to refine his left and free throws.

Summary and Perspectives

Given the influences between HR, TP, and PoT, the protocol developed to evaluate these parameters may be a preliminary step for developing a field test to determine performance-related throwing in wheelchair basketball. The test for determining the precision of throwing based on heart rate should also take into account the competitive classification of each player (Sonia De Groot et.al., 2012). At the same time, the classification is not based solely on the same type of injury, but rather on athletes' functional ability to support their trunk and use their upper extremities (Rajat Mathur et al., 2018). It should be noted that physiological responses are not constant during a training session (Yenci, J., et.al., 2014).

Studies have to be continued because data provided to coaches following such tests can guide the content of training sessions, help to establish holders and configure tactics and ultimately improve performance in wheelchair basketball.

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