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Effects of Different Warm-Up Durations on Wingate Anaerobic Power and Capacity Results

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ABSTRACT

The purpose of this study was to determine the effects of different warm-up durations (5, 10, 15, 20, 25, 30 minutes) on Wingate anaerobic power and capacity results. 13 male handball players volunteered to participate in this investigation. The anaerobic power and capacity values of the participants were determined by Wingate test. After a 5, 10, 15, 20, 25 and 30-minute warm-up efforts, participants were applied to anaerobic power and capacity tests performed at least within 48-hour intervals. Furthermore, after the study ended, participants were subjected to another second anaerobic test including 5-minute warm-up duration to determine whether this study created any training effects on the participants. At the end of One-way ANOVA test, it was found that there were no significant differences in terms of absolute peak power ($F_{5,60}=0.768$; $P>0.05$), relative peak power ($F_{5,60}=0.908$; $P>0.05$), absolute average power ($F_{5,60}=0.440$; $P>0.05$) and relative average power ($F_{5,60}=0.347$; $P>0.05$) of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations. As a consequence of the performed study, Paired Samples T test was applied in repetitive measures to eliminate the possible training effects. The results indicated that there was no training effect in terms of absolute peak power, relative peak power, absolute average power and relative average power ($p>0.05$) At the end of this study, it has been found that different warm-up durations performed within 5 to 30-minute intervals on the bicycle ergometer at a certain intensity have no effects on the Wingate anaerobic power and capacity values.

Key Words: *Warm-up Duration, Wingate Anaerobic Power, Anaerobic Capacity*

INTRODUCTION

The warm-up exercises before a violent physical activity among athletes is one of the generally accepted activities. Most athletes, who will perform a particularly strenuous workout, should include some of the preliminary warm-up or the units of activity into their training program (Hawley et al, 1989; Shellock, 1983). Warm-up is regularly used by athletes to achieve high performance during training and competition and to prevent injuries (Sotiropoulos et al, 2010). The overall objective of warm-up is to increase the muscles and tendons suppleness, stimulate blood flow to the periphery, increase body temperature, and increase the free and coordinated movements (Mcmillian et al, 2006; Smith, 1994).

Warm-up techniques are classified under two main categories: passive warm-up and active warm-up. Passive warm-up increases the temperature of the muscles by some external means. Active warm-up involves exercise and is likely to induce greater metabolic and cardiovascular changes than passive warm up (Bishop, 2003).

Warm-up routines should be specific in duration, intensity and modality to both individual athletes and sports (Mandengue et al, 2005). The volume and intensity of a warm-up, along with heart rate and lactate concentration, as well as the time interval between the ends of warm-up are all important factors influencing performance (Mikolajec et al, 2007).

The aim of this study therefore was to determine the effects of different warm-up durations on wingate anaerobic power and capacity results.

METHODS

Subjects: 13 male handball players (mean (SD) age 21.69 (2.01) years, body mass 88.96 (15.59) kg, stature 182.23 (6.30) cm) all of whom were regular playing Dumlupınar University Handball Team were volunteered to participate in this investigation. Subjects were informed about the study and signed informed consent form. Before the data were collected participant were familiarized with test procedures.

Data Collection Tools: Prior to the start of the study, all subjects were informed in detail about the measurement procedures. Anaerobic power output was measured by 30-second wingate anaerobic test (Monark 894 E Peak Bike, Sweden). Wingate test consists of 30 seconds cycle pedaling as fast as possible against a specific external resistance. Prior to the wingate test, 5, 10, 15, 20, 25, 30 minutes warm-up durations at pace of 60-70 RPM were applied, respectively. There was a recovery period of at least 48 h between each test protocol. 5 minute passive recovery was applied after each warm-up session. Seat and handlebar adjustment is made for each subject. The test was started after the external resistance applied was equivalent to 7.5 % of each subject's body mass. Subjects were asked to reach a maximal pace of unloaded sprinting as fast as possible. When the pedal speed reaches 150 rev / min, the weight basket automatically fallen down and the test was started. The subjects were instructed to pedal as fast as possible from the onset of the test. The subjects were encouraged verbally during the test. Knowledge of the power parameters during the test transferred to computer software program via RS 232 connection. All the power parameters were calculated by the software program.

Data Analysis: Descriptive statistics for all variables were expressed as mean ± SD in the table. Before applying the wingate test; 5, 10, 15, 20, 25, 30 minutes warm-up protocols were applied, respectively. After the warm-up protocols, repeated measures of ANOVA were examined the differences between power outputs derived from the wingate anaerobic test. As a consequence of the performed study, Paired Samples T test was applied in repetitive measures to eliminate the possible training effects. Statistical analysis of the measurements was performed by using SPSS 15 for Windows and $P<0.05$ was used to determine statistical significance.

RESULTS

Table 1. Age, stature, body mass and body fat percentage of the male handball players

Variables	Mean (X)	Standard Deviation (SD)
Age (years)	21.69	2.01
Stature (cm)	182.23	6.30
Body Mass (kg)	88.96	15.59
Percentage of body fat (%)	8.24	1.24

The descriptive characteristics of the male handball players are presented in table 1. The mean age, stature, body mass and body fat percentage of the handball players were 21.69 (2.01) years, 182.23 (6.30) cm, 88.96 (15.59) kg and 8.24 (1.24) % respectively.

Table 2. Absolute peak power values after the 5, 10, 15, 20, 25 and 30-minute warm-up durations

Variables	Mean ± Sd	F	P
Absolute Peak Power (After 5 min warm-up)	897.06±142.14	0.768	>0.05
Absolute Peak Power (After 10 min warm-up)	930.31±116.94		
Absolute Peak Power (After 15 min warm-up)	919.21±127.56		
Absolute Peak Power (After 20 min warm-up)	928.46±109.01		
Absolute Peak Power (After 25 min warm-up)	923.18±142.90		
Absolute Peak Power (After 30 min warm-up)	925.99±103.85		

Absolute peak power outputs of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations are presented in table 2. The results indicated that there were no significant differences in terms of absolute peak power of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations ($F_{5,60}=0.768$; $P>0.05$).

Table 3. Relative peak power values after the 5, 10, 15, 20, 25 and 30-minute warm-up durations

Variables	Mean ± Sd	F	P
Relative Peak Power (After 5 min warm-up)	10.16±1.23	0.908	>0.05
Relative Peak Power (After 10 min warm-up)	10.58±1.21		

Relative Peak Power (After 15 min warm-up)	10.43±1.20		
Relative Peak Power (After 20 min warm-up)	10.57±1.26		
Relative Peak Power (After 25 min warm-up)	10.44±1.00		
Relative Peak Power (After 30 min warm-up)	10.56±1.31		

Relative peak power outputs of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations are presented in table 3. The results indicated that there were no significant differences in terms of relative peak power of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations ($F_{5,60}$=0.908; P>0.05).

Table 4. Absolute mean power values after the 5, 10, 15, 20, 25 and 30-minute warm-up durations

Variables	Mean ± Sd	F	P
Absolute Mean Power (After 5 min warm-up)	659.10±105.17	0.440	>0.05
Absolute Mean Power (After 10 min warm-up)	663.02±94.18		
Absolute Mean Power (After 15 min warm-up)	657.00±96.39		
Absolute Mean Power (After 20 min warm-up)	666.56±94.27		
Absolute Mean Power (After 25 min warm-up)	666.77±109.92		
Absolute Mean Power (After 30 min warm-up)	654.92±84.71		

Absolute mean power outputs of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations are presented in table 4. The results indicated that there were no significant differences in terms of absolute mean power of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations ($F_{5,60}$=0.440; P>0.05).

Table 5. Relative mean power values after the 5, 10, 15, 20, 25 and 30-minute warm-up durations

Variables	Mean ± Sd	F	P
Relative Mean Power (After 5 min warm-up)	7.44±0.73		
Relative Mean Power (After 10 min warm-up)	7.51±0.74		
Relative Mean Power (After 15 min warm-up)	7.43±0.68	0.347	>0.05
Relative Mean Power (After 20 min warm-up)	7.54±0.61		
Relative Mean Power (After 25 min warm-up)	7.52±0.67		
Relative Mean Power (After 30 min warm-up)	7.43±0.72		

Relative mean power outputs of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations are presented in table 5. The results indicated that there were no significant differences in terms of relative mean power of the handball players after the 5, 10, 15, 20, 25 and 30-minute warm-up durations ($F_{5,60}$=0.347; P>0.05).

Table 6. Peak and mean power test-retest scores after the 5-minute warm-up periods

Variables	Test	Retest	t
Absolute Peak Power	897.06	903.44	-0.498
Relative Peak Power	10.16	10.26	-0.647
Absolute Mean Power	659.10	662.13	-0.587
Relative Mean Power	7.45	7.50	-0.846

*p<0, 05

After the 5, 10, 15, 20, 25 and 30-minute warm-up periods, peak and mean power of the subjects were obtained and then participants were subjected to another second anaerobic test 48 hours later, including 5-minute warm-up duration, to determine whether this study created any training effects on the participants. The results indicated that there was no training effect in terms of absolute peak power, relative peak power, absolute mean power and relative mean power.

DISCUSSION

Warm-up is a process depending on two variables: intensity and duration. By manipulating the two variables, infinite number of possibilities can be obtained (Mandengue et al., 2005). In the present study, examining the different warm-up durations on the wingate anaerobic power and capacity parameters, there were no significant differences in terms of power parameters (absolute peak power, relative peak power, absolute mean power and relative mean power) of the athletes after the 5, 10, 15, 20, 25 and 30-minute warm-up durations. In spite of the data obtained from previous studies gives us to make general recommendations for specificity, duration, intensity and recovery intervals of the warm-up (Mcmillian et al, 2006; Bishop, 2003), questions remain as to the optimal parameters for these factors (Mcmillian et al, 2006). Some of the studies suggested the beneficial effects on exercise performance after warm-up (Ingjer, Stromme, 1979; Genovely, Stamford, 1982; Houmard et al, 1991). The other studies reported no or negative effects after warm-up on subsequent performance (De Bruyn-Prevost, Lefebvre, 1980; Bishop et al, 2001). The differences between the studies may be explained by the characteristics of the subjects, intensity of the warm-up and recovery duration.

If the warm-up is too intense and there is insufficient recovery duration between warm-up and the subsequent task, the short-term exercise performance may have decrease following warm-up (Bishop, 2003; Margaria et al, 1971; Sargeant, Dolan, 1987). Short-term exercise performance is associated with the ability to use high-energy phosphate stores (Bishop, 2003; Hirvonen et al, 1987). Studies reported that warm-up, at workload intensity above 60% VO2 max, deplete high-energy phosphate concentration and decrease subsequent short-term exercise performance (Bishop, 2003; Sargeant, Dolan, 1987; Karlsson et al, 1970; Dolan, Sargeant, 1984) and at workload intensity between 40-60% VO2 max lead to minimal phosphate consumption and significantly improve the performance of short-term exercise (Bishop, 2003). It has also been suggested that at intensities greater than the "anaerobic threshold" (AnT) the rates of anaerobic glycolysis and subsequent lactate production are very high. The accumulation of lactate (La) results in a decrease in muscle pH that can serve to reduce or inhibit the reaction velocity of phosphofructokinase (Hermansen, 1981). Thus, the metabolic acidemia induced by too intense warm-up may impair supramaximal performance via inhibition of anaerobic glycolysis and interference with contractile processes (Bishop et al, 2001). Genovely and Stamford (1982) showed that the warm-up at anaerobic threshold was more effective than below the anaerobic threshold in terms of both performance and metabolic effects and the exercise performance was impaired when the warm-up above the anaerobic threshold.

One of the most important points about the warm-up is also the recovery time between the active warm up and the subsequent task. 3-5 minute moderate intensity warm-up is likely to significantly improve short-term performance. However, short-term performance may be impaired if the warm-up protocol does not allow sufficient recovery duration and results in a decreased availability of high-energy phosphates before commencing the task. Poprzęcki et al. (2007) used 5 and 15 minutes recovery durations at moderate intensity warm-up (workload intensity % 50 VO2 max) before the short-term exercise performance and reported that there were no significant differences in anaerobic power variables after the 5 and 15 minutes recovery durations.

In conclusion, if the warm-up is not too intense and there is sufficient recovery duration between warm-up and the subsequent task, short-term exercise performance may not be affected by the 5-30 minutes warm-up durations.

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