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The effects of physical characteristics on the fatigue level after repeated sprints in Turkish National Greco-Roman Cadet wrestlers

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Abstract
Evaluation of repeated sprints induced fatigue levels of Greco-Roman wrestlers according to their weight and height categories will help trainers in preparing athlete specific training programs. So this study aims to determine the effects of physical characteristics on the fatigue level of Turkish National Greco-Roman Cadet Wrestlers after 10 repeated sprints test (RST). The data were collected from 25 male wrestlers. Short sprint or reduction in sprint speed level was tested by RST. One way ANOVA was used for more than two groups. A Paired t-test was used for comparing of first two sprints to last two sprints with respect to 10 and 20 meters. The results of this study showed that significant differences were observed in all physical characteristics with respect to body weight and height classes in cadet wrestlers. While there is no difference in RST averages depending on body weight categories, there were significant differences in 3th, 4th and 5th sprints in 10 meters, 2th, 3th and 4th sprints in 20 meters according to height categories. Both of LBWC and MBWC had a lower RST induced fatigue levels than HBWC in 10 m and 20 m sprints. In contrast, both of MBHC and HBHC had a higher RST induced fatigue levels than SBHC in 10 m and 20 m sprint. In conclusion, the intensity of loadings, number and duration of explosive sprints and rest periods in at least two different groups for light weight class or short body height class and other cadet wrestlers should be based on their RST fatigue levels.

Key words: Cadet Wrestling, Repeated sprints, Fatigue.

INTRODUCTION

In general, success in wrestling depends on not only to technical, but also to tactical and psychological as well as to conditioning factors. In wrestling, 90% of the energy comes from phosphagen and lactic acid system while the aerobic system contributes 10% of the energy production systems. So, enhancing the anaerobic system or anaerobic power is the most important component of wrestling (Kell, 1997; Watts, 1996). Clearly, it has been shown that anaerobic power and anaerobic capacity may help to differentiate between successful and less successful male and female wrestlers. Power is defined as the product of force (in Newtons) and velocity (in meters per second) and it is associated with quick, explosive movements that lead to control of the opponent in wrestling (Horswill, 1992; Horswill, Miller and Scott, Welk and Van Handel, 1992). Anaerobic and aerobic power in arms and legs of elite senior wrestlers. However, it is impossible to connect the performance in RST directly to wrestling performance. This measures the wrestlers' anaerobic energy systems and anaerobic fatigue and indirectly determines the recovery or the efficiency of aerobic power between intense bursts of activity. This means that wrestling needs a short duration, and high intensity bursts of activity, especially in intermittent explosive movements with continuous energy transfer in a biological system (Brooks, Fahey, White, and Baldwin, 2000). In this context, high intensity interval or repeated sprint training actually develops the aerobic metabolism by increasing recovery while the coach tends to develop two anaerobic energy production systems including ATP-PC and glycolysis (Plowman & Smith, 2014).

Many studies have reported results related to repeated sprinting ability of wrestlers and other athletes (Farzad, Gharakhanlou, Agha-Alinejad, Curby, Bayati, Bahraminejad, & Maestu, 2011; Ziyagil and Türkmen, 2017; Kaynak, Eryılmaz, Aydoğan, & Mihailov, 2017). Farzad et al. (2011) found that four weeks the sprint-interval training program with short recovery in addition to training during preparation period can improve both aerobic and anaerobic performances in trained İranian wrestlers. In addition, Ziyagil and Türkmen, (2017) aimed to compare the physical characteristics and multiple sprints performance and repeated sprints related fatigue level between male Turkish National Free Style Wrestlers (FSW) and Greco-Roman Styles Wrestlers (GSW). They pointed out that GSW had significantly higher explosive sprint speed during the first 10 m part of 20 m, while no significant difference was observed between two groups at the 20 meters sprint. Sprints variables correlated negatively with physical characteristics in two styles but success level of wrestlers was only correlated with first 10 m sprint speed in GSW. The fatigue level of GSW was higher than FSW during repeated sprints. Obviously repeated sprint training has a potential to rapid improvement in performance capacity and skeletal muscle energy metabolism (Laursen, Shing, Peake, Coombes, and Jenkins, 2005). Similarly, Kaynak et al. (2017) indicated that the integrating of a repeated sprint training program can improve both the anaerobic performance and aerobic capacity of college volleyball players following 6-weeks interval sprint training. Repeated sprint training can be an effective training strategy for inducing aerobic and anaerobic adaptations. Aerobic fitness is a prerequisite for the maintenance of sprinting speed during intermittent maximal efforts (Tomlin & Wenger, 2001). Durandt, Tee, Prim, and Lambert, (2006) stated that 5 meters repeated sprint test is not only a physical fitness feature, but also it is a result of combined interactions of many fitness components including body mass, strength and aerobic capacity. While both alactic and lactic acid systems use carbohydrates as fuel, aerobic system uses fat at low-intensity and carbohydrates at high-intensity as fuel. The most outstanding aim of body conditioning for wrestling is to delay the onset of fatigue by increasing the tolerance of lactic acid build-up which increases the production of ATP and creatine phosphate. This also improves both the efficiency of oxygen use, and the recovery between intense bursts of activity (Bompa & Carrera, 2005). The wrestlers should have repeated high speed movement ability for maintaining their quickness and movement speed at the highest level during the contest (Farzad et al. 2011). However, it is impossible to connect the performance in RST directly to wrestling performance. This measures the wrestlers' anaerobic energy systems and anaerobic fatigue and indirectly determines the recovery or the efficiency of aerobic power between intense bursts of activity. There is only a limited knowledge reported by Ziyagil and Türkmen (2017) about repeated sprints performance of Turkish free and Greco- Roman styles' wrestlers. There is lack of information available in the sports literature regarding the repeated sprint performance of young Greco-Roman wrestlers.They showed significant negative correlation with body height and weight, success level of wrestlers and order of sprints both wrestling styles. In another study supporting the results of our study, Maćkała, Fostiak, and Kowalski (2015) showed strong relationships between anthropometric characteristics including body height, leg length, the stride number and stride length and kinematics of 10 m, 30 m acceleration in competitive sprinters.

An understanding of repeated maximal efforts of young wrestlers could assist in diagnosing the deficiencies related to training efficiency including exercise-induced reduction in maximal power output or fatigue during sprinting exercise, recovery level between sprints and adjusting loading for athletes during workouts according to body height and weight groups. In our study, 10 repetitions (20 m x 10 repetitions) RST used measures the efficiency of the anaerobic power in Greco-Roman styles wrestling, where there are intermittent maximal efforts, and also anaerobic fatigue induced as the result of these high intensity efforts. Thus, this study aims to determine the effects of physical characteristics on the fatigue level after repeated sprints in Turkish National Greco-Roman Cadet wrestlers.

METHODOLOGY

The data were collected from 25 Turkish National Greco-Roman Cadet male wrestlers during the national training camp for the world championship competitions. Short sprint or reduction in speed level of cadet wrestlers was tested by RST. All of them were training in National Camp for World Cadet Wrestling Championship. All the participants were asked not to participate in training a day before RST. They also went through a medical examination before the RST testing. The body height of the subjects was measured by a metal scale with 0.1 cm sensitivity, while the body weight measurement was taken by a digital weight with 0.1 kg sensitivity. For wrestlers, RST was modified from the sprint test of Bangsbo (1994). After 10 repetitions of 20 m multiple sprint, speed and decrement in the speed level of the subjects were tested by a New Test Photocell system on wooden floor with a sensitivity of 0.01 second.

Sprint speed of athletes was measured with 3 photocells at a height of one meter from the ground between the start and end points covering the first 10 and 20 meters sections.

After a standardized 30-min warm-up period including walking, jogging, running, several short sprints, and stretching exercises, the participants ran 20 m repeatedly for 10 times at the maximum speed. They took off with the order of "ready and go" in every 20 seconds with one of their feet toe tip being on the start line. They came back to the start point by walking and started other speed running when 20 seconds was over. All speed tests less than sixty meters measure positive acceleration ability of the athletes (Ward-Smith, 2001). Repeated sprints related fatigue level was computed by extracting the average of the last two sprints from the average value of the first two sprints. The difference between the two values was accepted as the sprint induced fatigue level. Sprint results were demonstrated as a mean of first 10 m part of 20 m sprint and whole 20 m sprint.

All statistical analyses were performed for groups formed by body height classes and body weight classes. Body height classes consisted of three categories. These were small body height class between 154 cm and 162 cm (SBHC), medium body height class between 165 cm and 175 cm (MBHC) and high body height class between 180 and 193 cm (HBHC). Similarly; body weight classes consisted of three categories. These were low body weight class between 50 kg and 60 kg (LBWC), medium body weight class between 62 kg and 70 kg (MBWC) and heavy body weight class between 80 kg and 103 kg (HBWC).

Firstly descriptive statistics including means, standard deviations, minimums, and maximums were computed. Secondly due to normality of data distribution, comparisons were performed by ANOVA for more than two groups. In addition, the origin of differences was determined by a post hoc Least Significance Difference (LSD) test. Moreover, a paired t-test was used for comparing of first two sprints with last two sprints in10 and 20 meters distances. Also, Cohen's d analysis was performed to determine the effect size of repeated sprints test on fatigue levels.

RESULTS

Results of this study were presented in Tables 1, 2, 3 and 4. Significant differences were observed in the means of physical characteristics including body height, body weight and body mass index with respect to body weight and body height classes in Turkish National Greco-Roman cadet wrestlers except mean age (Table 1).

Table 1. Comparison of physical characteristics along with respect to body weight and body height groups in Turkish National Greco-Roman cadet wrestlers.

	Body Weight Classification							Body Height Classification						
Variables	Groups	N	M.	S.D.	F	Sig.	Post Hoc.LSD.	Groups	N	M.	S.D.	F	Sig.	Post Hoc.LSD.
Age (in years)	**LWC**	8	16,38	0,52	,35	,711	N.D.	**SHC**	9	16,33	0,50	,784	,469	**N.D.**
	MWC	8	16,38	0,52				**MHC**	8	16,38	0,52			
	HWC	9	16,56	0,53				**HHC**	8	16,63	0,52			
	Total	25	16,44	0,51				Total	25	16,44	0,51			
Body Height (cms)	**LWC**	8	160,25	3,92	48,0	,000**	LCW < MCW, HCW; MCW < HCW	**SHC**	9	159,56	2,40	101,0	,000**	LHC< MHC, HHC; MHC< HHC
	MWC	8	168,13	5,11				**MHC**	8	170,75	3,20			
	HWC	9	182,44	5,08				**HHC**	8	183,38	4,53			
	Total	25	170,76	10,54				Total	25	170,76	10,54			
Body Weight (kgs)	**LWC**	8	53,75	3,01	37,2	,000**	LCW < MCW, HCW; MCW < HCW	**SHC**	9	55,33	5,17	34,1	,000**	LHC< MHC, HHC; MHC< HHC
	MWC	8	66,63	3,96				**MHC**	8	67,25	5,01			
	HWC	9	84,00	11,12				**HHC**	8	85,38	11,04			
	Total	25	68,76	14,57				Total	25	68,76	14,57			
Body Mass Index (BMI)	**LWC**	8	20,93	0,90	11,9	,000**	LCW < MCW, HCW;	**SHC**	9	21,73	1,91	6,62	,006**	LHC< HHC; MHC< HHC
	MWC	8	23,60	1,46				**MHC**	8	23,06	1,45			
	HWC	9	25,17	2,53				**HHC**	8	25,34	2,65			
	Total	25	23,31	2,49				Total	25	23,31	2,49			

Significant difference among groups at 0.01 level. **LBW=Lower Body Weight (50-60 kgs), **MBW**=Medium Body Weight (62-70 kgs), **HBW=**High Body Weight (80-103kgs); **SBH**=Small Body Height (154-162 cms), M**BH**=Medium Body Height (165-175 cms), **HBH=**High Body Height (180-193 cms);

No significant differences was observed in the mean speeds of 10 m and 20 meter during 10 repeated sprints among light, medium and heavy weight classes in Turkish National Greco-Roman cadet wrestlers (Table 2).

Table 2. Comparison of mean speeds in 10 m and 20 meter in 10 repeated sprints among light, medium and heavy weight classes in Turkish national Greco-Roman cadet wrestlers.

Sprints		10 m Sprints (m/sec)					20 m Sprints (m/sec)				
No.	Groups	N	M.	S.D.	F	Sig.	N	M.	S.D.	F	Sig.
1th	**LBWC**	8	4,87	0,25	,180	,837	8	5,73	0,26	,333	,720
	MBWC	8	4,95	0,20			8	5,85	0,21		
	HBWC	9	4,96	0,45			9	5,85	0,44		
	Total	25	4,93	0,32			25	5,81	0,32		
2nd	**LBWC**	8	4,97	0,38	,707	,504	8	5,81	0,35	,781	,470
	MBWC	8	4,86	0,25			8	5,65	0,23		
	HBWC	9	5,03	0,23			9	5,80	0,31		
	Total	25	4,96	0,29			25	5,76	0,30		
3th	**LBWC**	8	4,67	0,26	,508	,609	8	5,47	0,24	,468	,632
	MBWC	8	4,55	0,31			8	5,33	0,28		
	HBWC	9	4,69	0,31			9	5,44	0,36		
	Total	25	4,64	0,29			25	5,42	0,29		

4th	**LBWC**	8	4,47	0,23	,638	,538	8	5,26	0,25	,413	,667
	MBWC	8	4,39	0,25			8	5,14	0,25		
	HBWC	9	4,57	0,46			9	5,31	0,54		
	Total	25	4,48	0,33			25	5,24	0,37		
5th	**LBWC**	8	4,56	0,24	,265	,770	8	5,26	0,25	,203	,818
	MBWC	8	4,42	0,18			8	5,13	0,17		
	HBWC	9	4,53	0,59			9	5,18	0,63		
	Total	25	4,50	0,38			25	5,19	0,40		
6th	**LBWC**	8	4,41	0,42	,049	,953	8	5,12	0,43	,052	,950
	MBWC	8	4,35	0,20			8	5,05	0,19		
	HBWC	9	4,40	0,52			9	5,07	0,53		
	Total	25	4,39	0,39			25	5,08	0,40		
7th	**LBWC**	8	4,32	0,27	,178	,838	8	4,96	0,28	,179	,837
	MBWC	8	4,29	0,16			8	4,93	0,24		
	HBWC	9	4,23	0,43			9	4,86	0,47		
	Total	25	4,28	0,30			25	4,92	0,34		
8th	**LBWC**	8	4,26	0,43	,036	,965	8	4,95	0,46	,154	,858
	MBWC	8	4,30	0,14			8	4,98	0,17		
	HBWC	9	4,27	0,31			9	4,89	0,35		
	Total	25	4,28	0,30			25	4,94	0,34		
9th	**LBWC**	8	4,25	0,40	,276	,761	8	4,93	0,46	,414	,666
	MBWC	8	4,21	0,28			8	4,89	0,30		
	HBWC	9	4,12	0,39			9	4,76	0,41		
	Total	25	4,19	0,35			25	4,86	0,39		
10th	**LBWC**	8	4,46	0,40	1,766	,194	8	5,16	0,46	1,871	,178
	MBWC	8	4,44	0,25			8	5,09	0,20		
	HBWC	9	4,16	0,45			9	4,79	0,51		
	Total	25	4,34	0,39			25	5,00	0,43		

There is no significant difference among groups. **LBW**=Lower Body Weight (50-60 kgs), **MBW**=Medium Body Weight (62-70 kgs), **HBW=**High Body Weight (80-103kgs).

On the other hand, there were statistically significant differences among the short body height, medium body height and high body weight classes in the third, fourth and fifth sprints speed in 10 m, and in the second, third and fourth sprints speed of 20 m (Table 3).

Table 3. Comparison of mean sprint speeds in 10 m and 20 meters during 10 repeated sprints among small, medium and high height classes in Turkish national Greco-Roman cadet wrestlers.

Sprints No.	**Groups**	**10 m Sprints (m/sec)**						**20 m Sprints (m/sec)**					
		N	**M.**	**S.D.**	**F**	**Sig.**	**Post. Hoc. LSD**	**N**	**M.**	**S.D.**	**F**	**Sig.**	**Post. Hoc. LSD**
1th	**SBHC**	9	4,81	0,20	1,418	,263	N.D.	9	5,68	0,23	1,473	,251	N.D.
	MBHC	8	5,06	0,18				8	5,94	0,16			
	HBHC	8	4,93	0,47				8	5,82	0,47			
	Total	25	4,93	0,32				25	5,81	0,32			
2nd	**SBHC**	9	5,04	0,33	3,377	,053	N.D.	9	5,87	0,28	4,141	,030	LHC> MHC; HHC<MHC
	MBHC	8	4,76	0,22				8	5,54	0,22			
	HBHC	8	5,07	0,22				8	5,86	0,28			
	Total	25	4,96	0,29				25	5,76	0,30			
3th	**SBHC**	9	4,70	0,29	3,833	,037	LHC>, MHC, HHC>MHC	9	5,51	0,27	3,864	,036	LHC> MHC; HHC>MHC
	MBHC	8	4,43	0,29				8	5,20	0,24			
	HBHC	8	4,77	0,20				8	5,53	0,28			
	Total	25	4,64	0,29				25	5,42	0,29			
4th	**SBHC**	9	4,52	0,24	4,648	,021	LHC>MHC;	9	5,30	0,25	3,640	,043	LHC> MHC;
	MBHC	8	4,24	0,27				8	4,99	0,32			

	HBHC	8	4,68	0,36			HHC>MHC	8	5,43	0,42			HHC>MHC
	Total	25	4,48	0,33			LHC<HHC.	25	5,24	0,37			
5th	**SBHC**	9	4,60	0,20	3,477	,049	LHC>MHC; HHC>MHC;	9	5,29	0,23	2,182	,137	N.D.
	MBHC	8	4,24	0,32				8	4,96	0,37			
	HBHC	8	4,66	0,48				8	5,32	0,52			
	Total	25	4,50	0,38				25	5,19	0,40			
6th	**SBHC**	9	4,46	0,40	1,159	,332	N.D.	9	5,18	0,41	1,311	,290	N.D.
	MBHC	8	4,21	0,22				8	4,90	0,22			
	HBHC	8	4,48	0,50				8	5,15	0,51			
	Total	25	4,39	0,39				25	5,08	0,40			
7th	**SBHC**	9	4,36	0,26	1,487	,248	N.D.	9	5,00	0,26	1,337	,283	N.D.
	MBHC	8	4,13	0,33				8	4,76	0,39			
	HBHC	8	4,34	0,31				8	4,98	0,35			
	Total	25	4,28	0,30				25	4,92	0,34			
8th	**SBHC**	9	4,31	0,40	,213	,810	N.D.	9	5,02	0,43	,426	,658	N.D
	MBHC	8	4,22	0,16				8	4,87	0,18			
	HBHC	8	4,29	0,33				8	4,93	0,36			
	Total	25	4,28	0,30				25	4,94	0,34			
9th	**SBHC**	9	4,34	0,34	2,422	,112	N.D.	9	5,01	0,40	1,677	,210	N.D.
	MBHC	8	3,99	0,37				8	4,67	0,43			
	HBHC	8	4,21	0,29				8	4,87	0,28			
	Total	25	4,19	0,35				25	4,86	0,39			
10th	**SBHC**	9	4,44	0,39	,414	,666	N.D.	9	5,15	0,42	,788	,467	N.D.
	MBHC	8	4,30	0,51				8	4,92	0,53			
	HBHC	8	4,28	0,27				8	4,92	0,34			
	Total	25	4,34	0,39				25	5,00	0,43			

Significant difference among groups at 0.01 level. **SBHC=Small Body Height Class (154-162 cm), MB**HC**=Medium Height Class (165-175 cm), **HBHC=**High Height Class (180-193 cm);

HBHC had the highest average speeds of 5.00 and 5.84 m/sec on the first two 10 and 20 m sprints, and 4.25 and 4.90 m/sec on the last two 10 and 20 m sprints, respectively. **SBHC** showed the second highest average speeds of 4.92 and 5.77 m/sec on the first two 10 and whole 20 m sprints, and 4.39 and 5.08 m/sec on the last two 10 and whole 20 m sprint, respectively. **MBHC** had the third highest average speeds of 4.91 and 5.74 m/sec on the first two 10 and whole 20 m sprint, and 4.15 and 4.80 m/sec on the last two 10 and whole 20 m sprints, respectively (Table 4, Graph 1).

On the other hand, HBWC had the highest average speeds of 4.99 and 5.83 m/sec on the first two 10 and 20 m sprints, and 4.15 and 4.79 sec on the last two 10 and 20 m sprints, respectively. **LBWC** showed the second highest average speeds of 4.92 and 5.78 m/sec on the first two 10 and 20 m sprints, and 4.36 and 5.05 m/sec on the last two 10 and 20 m sprints, respectively. **MBWC** had the third highest average speeds of 4.87 and 5.70 m/sec on the first two 10 and 20 m sprints, and 4.41 and 5.07 m/sec on the last two 10 and 20 m sprints, respectively (Table 4).

In the context of 10 m as a very short running sprint speed, SBHC had the average value of the first two 10 m sprints decreased from 4.92 m/sec to 4.39 m/sec in the last two 10 m distance and a decrease in the average sprint speed of 10.77% due to RST fatigue was observed. In MBHC, the average value of the first two 10 m sprints decreased from 4.91 m/sec to 4.15 m/sec in the last two 10 m distance and a decrease in the average sprint speed of 15.48% due to RST fatigue was observed. In HBHC, the average value of the first two 10 m sprints decreased from 5.00 m/sec to 4.25 m/sec in the last two 10 m distance and a decrease in the average sprint speed of 15.00% due to RST fatigue was observed. While HBHC has the highest fatigue level with the highest average sprint value of 10 m, SBHC has the lowest fatigue level with the lowest average sprint value of 10 m. MBHC had a lower mean sprint in 10 meters distance than those of SBHC and HBHC but higher fatigue level than these two height classes. As a result, a high average sprint speed in 10 m distance results partly in great fatigue (Table 4).

In the context of 20 m as a short running sprint speed, SBHC the average value of the first two 20 m sprints decreased from 5.77 m/sec to 5.08 m/sec in the last two 20 m distance and a decrease in the average sprint speed of 11.96% due to RST fatigue was observed. In MBHC, the average value of the first two 20 m sprints decreased from 5,74 m/sec to 4.80 m/sec in the last two 20 m distance and a decrease in the average sprint speed of 16.38% due to RST fatigue was observed. In HBHC, the average value of the first two 20 m sprints decreased from 5,84 m/sec to 4.90 m/sec in the last two 20 m distance and a decrease in the average sprint speed of 16.10% due to RST fatigue was observed. MBHC with lower mean of the first two 20 m sprints had a higher fatigue level than that HBHC. Compare to the HBHC had highest values in both 20 m sprint and fatigue due to repeated sprints when evaluated with SBHC. Partially a high average sprint speed in 20 m distance results in great fatigue (Table 4).

In the context of 10 m as a very short running sprint speed, SBWC had the average value of the first two 10 m sprints decreased from 4.92 m/sec to 4.36 m/sec in the last two 10 m distance and a decrease in the average sprint speed of 11.38% due to RST fatigue was observed. In MBWC, the average value of the first two 10 m sprints decreased from 4.87 m/sec to 4.41 m/sec in the last two 10 m distance and a decrease in the average sprint speed of 9.45% due to RST fatigue was observed. In HBWC, the average value of the first two 10 m sprints decreased from 4.99 m/sec to 4.15 m/sec in the last two 10 m distance and a decrease in the average sprint speed of 16.83% due to RST fatigue was observed. While HBWC has the highest fatigue level with the highest average sprint value of 10 m, MBWC has the lowest fatigue level with the lowest average sprint value of 10 m. MBWC had a lower mean sprint in 10 meters distance than those of SBWC and HBWC but higher fatigue level than these two height classes. As a result, a high average sprint speed in 10 m distance results partly in great fatigue (Table 4).

In the context of 20 m as a short running sprint speed, SBWC the average value of the first two 20 m sprints decreased from 5.78 m/sec to 5.05 m/sec in the last two 20 m distance and a decrease in the average sprint speed of 12.63% due to RST fatigue was observed. In MBWC, the average value of the first two 20 m sprints decreased from 5,70 m/sec to 5.07 m/sec in the last two 20 m distance and a decrease in the average sprint speed of 11.05% due to RST fatigue was observed. In HBWC, the average value of the first two 20 m sprints decreased from 5,83 m/sec to 4.70 m/sec in the last two 20 m distance and a decrease in the average sprint speed of 17.84% due to RST fatigue was observed. MBWC with lower mean of the first two 20 m sprints had a higher fatigue level than that SBWC and HBWC. Compare to the HBWC had highest values in both 20 m sprint and fatigue due to repeated sprints when evaluated with SBWC and MBWC. Partially a high average sprint speed in 20 m distance results in great fatigue (Table 4).

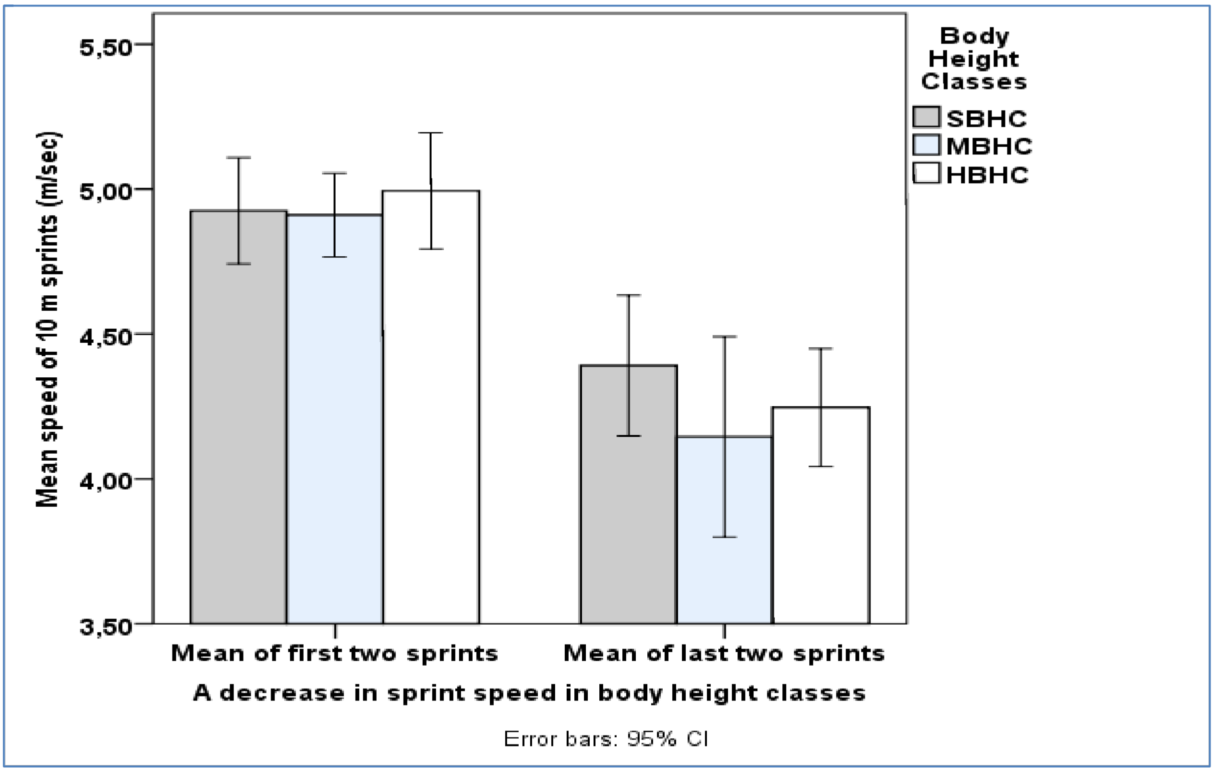
Both of LBWC and MBWC had a lower RST induced fatigue levels than HBWC in 10 m and 20 m sprint. In contrast, both of MBHC and HBHC had a higher RST induced fatigue levels than SBHC in 10 m and 20 m.

Table 4. Comparison between the mean values of the first two and the last two sprints in the 10 m and 20 meters distance and RST related fatigue according to body height and weight classes.

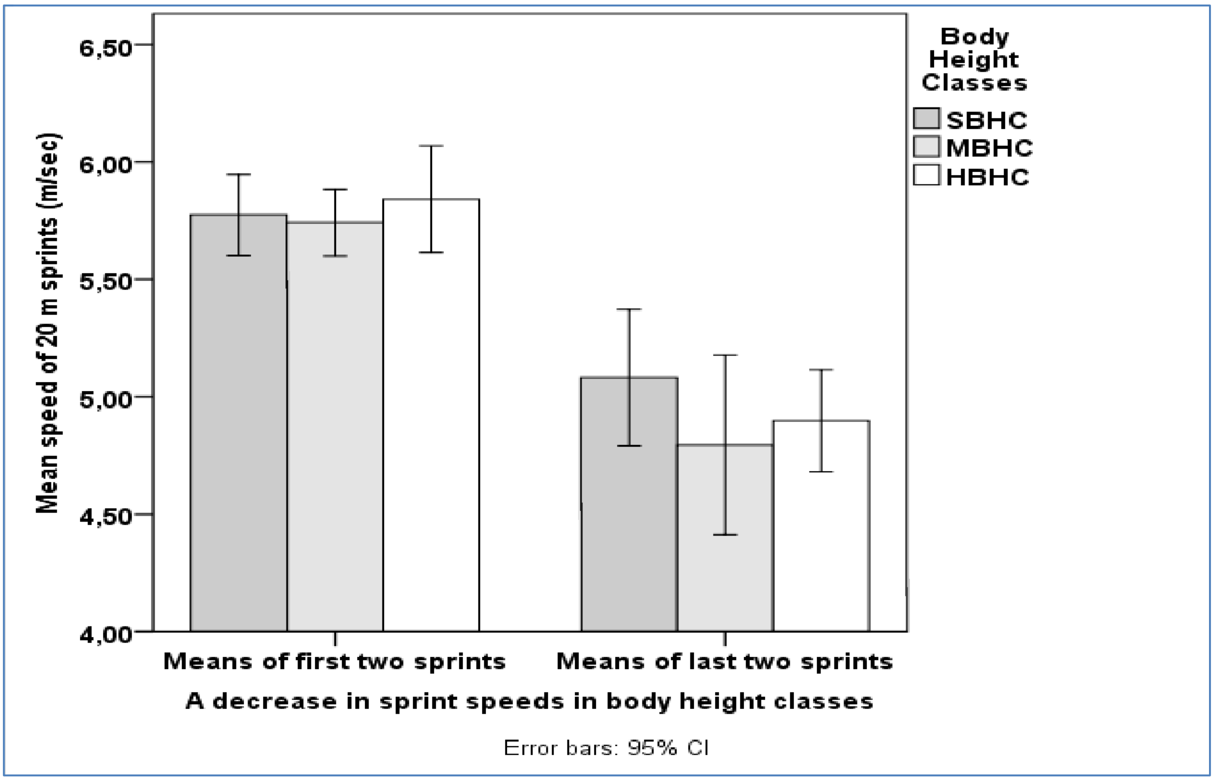
Category Variables	Groups	N	DoS	Mean of first 2 Sprints (m/sec) M.	S.D.	Mean of last 2 Sprints (m/sec) M.	S.D.	Diff.	% diff.	t-value	Sig.	Cohen's d
Body Height (cms)	**SBHC**	9	**10 m**	4,92	0,24	4,39	0,32	0,53	10,77	4,151	,003**	**1.88‡**
	(154-162 cm)	9	**20 m**	5,77	0,22	5,08	0,38	0,69	11,96	5,586	,001**	**2.22‡**
	MBHC	8	**10 m**	4,91	,17	4,15	,41	0,76	15,48	4,333	,003**	**2.42‡**
	(165-175 cm)	8	**20 m**	5,74	,17	4,80	,46	0,94	16,38	5,223	,001**	**2.71‡**
	HBHC	8	**10 m**	5,00	,24	4,25	,24	0,75	15,00	6,655	000**	**2,71‡**
	(180-193 cm)	8	**20 m**	5,84	,27	4,90	,26	0,94	16,10	7,256	000**	**3,55‡**
Body Weight (kgs)	**LBWC**	8	**10 m**	4,92	,24	4,36	,37	0,56	11,38	3,933	,006**	**1.80‡**
	(50-60 kg)	8	**20 m**	5,78	,24	5.05	,43	0,73	12,63	4,918	,002**	**2,09‡**
	MBWC	8	**10 m**	4,87	,21	4,41	,17	0,46	9,45	4,994	,002**	**2.41‡**
	(62-70 kg)	8	**20 m**	5,70	,20	5.07	,18	0,63	11,05	6,645	,000*	**3,31‡**
	HBWC	9	**10 m**	4,99	,21	4,15	,34	0,84	16,83	5,836	,000**	**2.97‡**
	(80-103 kg)	9	**20 m**	5,83	,22	4,79	,38	1,04	17,84	6,715	,000**	**3,35‡**

*p<.05, **p<.01. **Diff** =Difference, **DoS=**Distance of Sprints. **SBHC**=Small Body Height Class (154-162 cm), MB**HC**=Medium Body Height Class (165-175 cm), **HHC=**High Body Height Class (180-193 cm); **LBWC**=Lower Body Weight, **MBWC**=Medium Body Weight Class, **HBHC=**High Body Height Class;

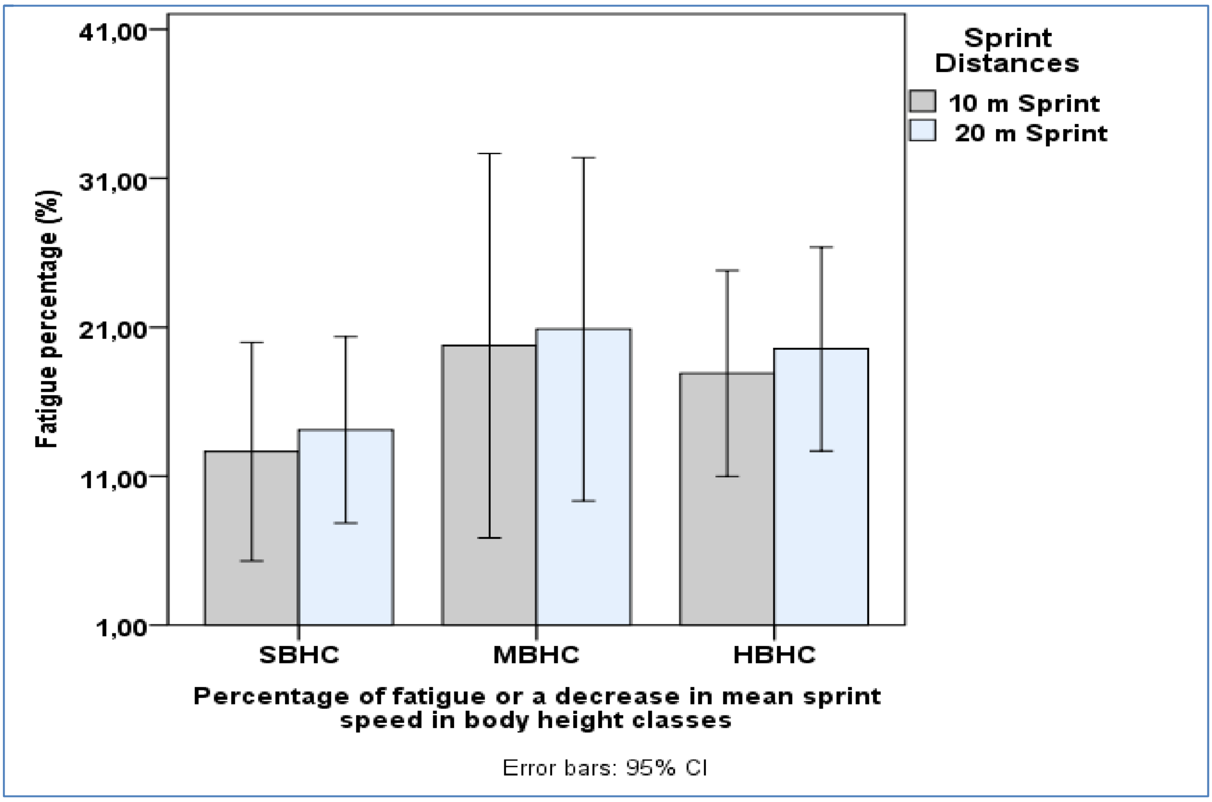
Effect size (ES), Cohen's *d*.
+ES is small if Cohen's d value is higher than 0,2 and lower than 0,5.24,57
†ES is medium if Cohen's d value is higher than 0,5 and lower than 0,8.
‡ES is large if Cohen's d value is equal 0,8 and higher.



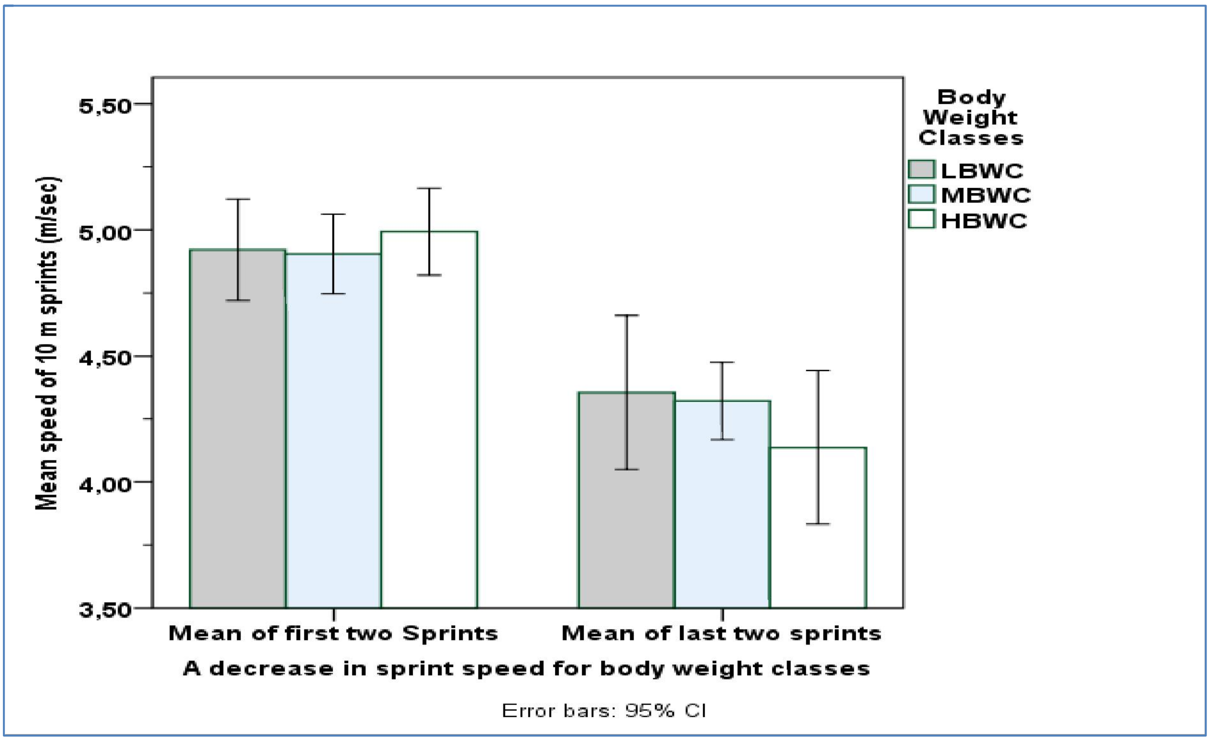
Graph 1. Comparison of mean sprint speeds between first two and last two sprints in body height classes in 10 m sprint distance after 10 repeated sprints.



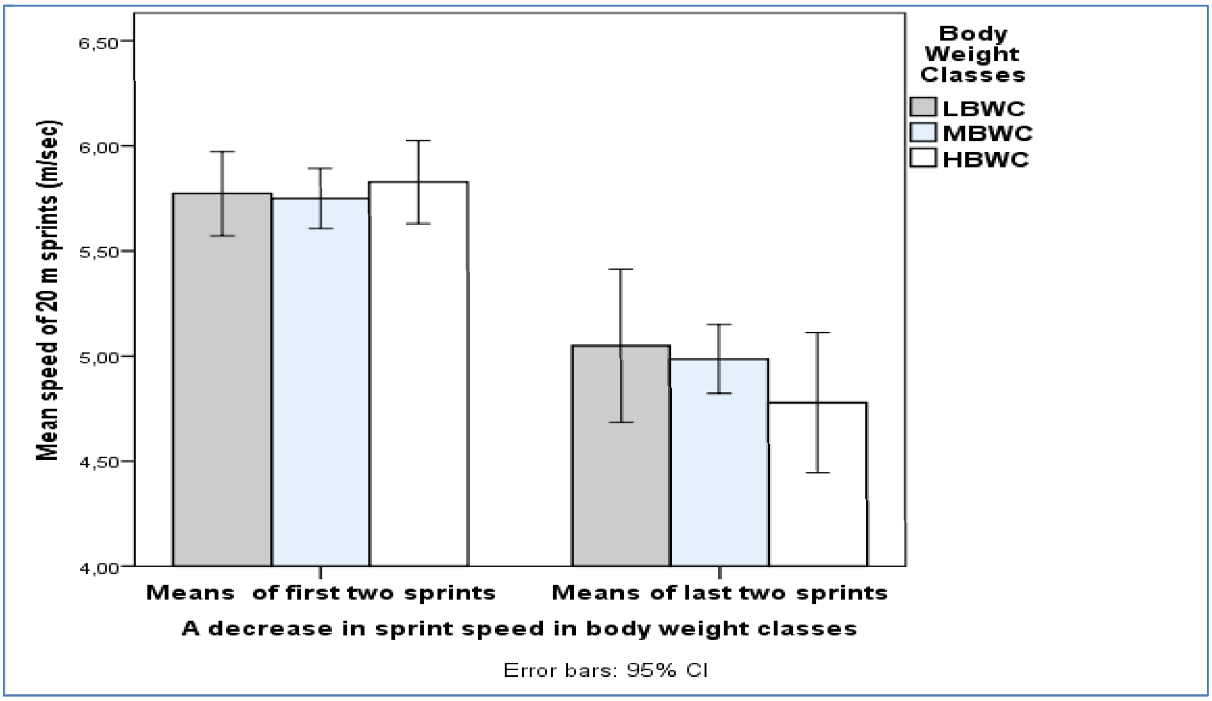
Graph 2. Comparison of mean sprint speeds between first two and last two sprints in body height classes in 20 m sprint distance after 10 repeated sprints.



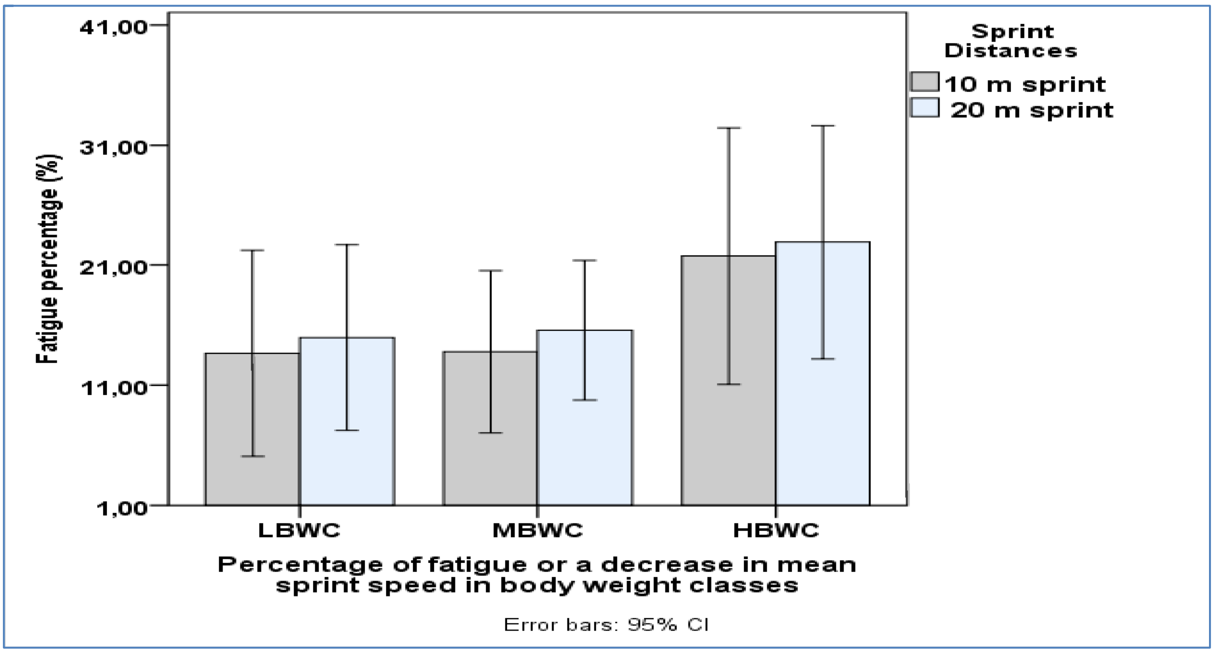
Graph 3. Comparison fatigue percentages among body weight classes in 10 m and 20 m sprint distances after 10 repeated sprints.



Graph 4. Comparison of mean sprint speeds between first two and last two sprints in body weight classes in 10 m sprint distance after 10 repeated sprints.



Graph 5. Comparison of mean sprint speeds between first two and last two sprints in body weight classes in 20 m sprint distance after 10 repeated sprints.



Graph 6. Comparison fatigue percentages among body weight classes in 10 m and 20 m sprint distances after 10 repeated sprints.

DISCUSSION

RST as a short sprints of a maximal exercise lasting 10 seconds or less helps measure body control with high force production, and how well athletes can not only accelerate and get to a new position, but also control body segments, decelerate, and move in another direction without losing body position and control (Association NNSC, (2012). Wrestling is a sport requiring many fast and complex movement and maneuvers by whole body power including sudden start and stops requiring high intensity intermittent workloads with short rest intervals in attacks and counter-attacks during a match. In other words, Greco-Roman wrestling requires to execute explosive technical movements and maximal efforts interspersed short active or passive resting periods in 2 periods of 3 minute bouts against opponent resistance for successful wrestling performance. In our study, all comparisons were made between groups arranged by considering body weight and height classes.

Results of this study showed that physical characteristics of cadet wrestlers including body height, body weight and body mass index were significantly changed depending on the body weight and body height classes (Table 1). Sprint speed in 10 m and 20 m differentiated depending on height classes not weight classes during ten consecutive sprints (Table 2 and 3). These results were in consistent with the results reported of Turkish senior free and Greco-Roman style wrestlers by Ziyagil and Türkmen (2017). They showed significant negative correlation with body height and weight, success level of wrestlers and order of sprints both wrestling styles. In another study supporting the results of our study, Maćkała, Fostiak, and Kowalski (2015) showed strong relationships between anthropometric characteristics including body height, leg length, the stride number and stride length and kinematics of 10 m, 30 m acceleration in competitive sprinters.

In our study, MBHC had lower sprint speed than SBHBC and HBHC in 10 m and 20 m distance. The percentages of decrement in the speed level of the subjects for HBHC, MBHC and SBHC were 15%, 15.48% and 10.77%, respectively. The effect size level of RST on the decrement of 10 m and 20 m sprint speed has become smaller from HBHC to MBHC and SHBC (Table 4, Graphs 1, 2 and 3). MBWC had lower sprint speed than SBWC and HBWC in 10 m and 20 m distance. The percentages of decrement in the speed level of the subjects for HBWC, MBWC and SBWC were 16.83%, 11.38% and 9.45%, respectively. The effect size level of RST on the decrement of 10 m and 20 m sprint speed has become bigger from LBWC to MBWC and HBWC (Table 4, Graphs 4, 5 and 6). There are studies in the literature that reveal the relationship among structural and motor features and performance. Cvetković, Marić and Marelić (2005) investigated the relation of technical efficiency of wrestlers to some anthropometric and motor variables and reported that technical efficiency in young top-level wrestlers depends on a large number of motor ability variables as well as some morphological characteristics like body weight. Furthermore, Vardar, Tezel, Öztürk and Kaya (2007) investigated the relationship between body composition and anaerobic performance of elite young wrestlers from the Turkish national team and they indicated that there is a significant relationship between mean power and lean body mass (r=0.90), however, no significant relationship was found between anaerobic parameters and percent body fat. Mirzaei and Ghafouri (2007) studied the physiological profile of Iranian senior Greco-Roman wrestlers. They concluded that with the increase of weight in weight classes, the pull-up records are reduced, while no significant differences were found in the results of the flexibility tests. Moreover, it was concluded that physical and speed characteristics were differentiated depending on wrestlers' success level. They demonstrated that wrestlers who were first in their weight classes were leaner, more muscular, stronger, and had wider chest, long arm, short legs, and more developed strength and speed than wrestlers who came second at a national junior championship in Turkey (Ziyagil, Zorba and Eliöz,1989).

A higher work/relief ratio during RST is generally associated with reduced PCr resynthesis and an accumulation of blood lactate and metabolites in the muscle, which may partially explain the greater impairment of repeated sprinting ability (Buchheit, & Laursen, 2013).

The mean 10 m values of body height and weight classes for 10 m sprint in this study were lower than both those of reported by Ziyagil and Türkmen (2017) for Turkish Senior Free and Greco-Roman Style wrestlers. This difference can be especially explained with negative correlation between age and 10 m sprint in a study of Ziyagil and Türkmen (2017).

Both of LBWC and MBWC had a lower RST induced fatigue levels than HBWC in 10 m and 20 m sprint. In contrast, both of MBHC and HBHC had a higher RST induced fatigue levels than SBHC in 10 m and 20 m. These results were in consistent with the study of Turkish senior free and Greco-Roman style wrestlers by Ziyagil and Türkmen (2017). They also reported that multiple sprint performance differentiated between two wrestling styles for 10 meters but not for 20 meters repeated sprints.

Vardar et al. (2007) investigated the relationship between body composition and anaerobic performance in young elite wrestlers. They proposed that both female and male wrestlers and their coaches should take into account fat free mass levels rather than % fat mass for higher anaerobic performance. Similar to this study, the sprint speed representing the power in our study and the fatigue level after the multiple sprint test may be partially dependent on the lean body weight and/or body fat mass due to the increased body mass index.

The fatigue level during the RST changes significantly according to the sprint distance, body height and body weight groups, and the effect of repeated sprint test on the fatigue level increases from the short to the tall group and from the low body weight group to the heavy. The quantification and monitoring of interval sprint training load is an important aspect of young wrestler physical preparation to competition and has the potential to provide coaches with an objective framework for evidence-based decisions.

In our study, the effect size level of RST on the decrement of sprint speed diminished with decreasing the body height in wrestlers. Similarly, the effect size level of RST on the decrement of sprint speed has declined with decreasing the body weight in Turkish National Greco-Roman Cadet Wrestlers.

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Further research is required in order to determine for enhancing sprint power by determining suitable distance of sprint, duration of rest intervals with respect to morphological variables in large groups with different conditioning levels.

CONCLUSION

This study can present basic knowledge about the associations between repeated sprint performance and fatigue percentages in relation to adjusting the training load for each specific group are important in understanding the training process and the validity of specific internal measures for body height and weight classes.

It can be conclude that the intensity, number and duration of explosive sprints, and the resting time between intervals should be done according to the RST fatigue levels in two different body weight or height groups.

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