EXAMINING THE RELATIONSHIP BETWEEN MULTISTAGE 20 M SHUTTLE RUN TEST AND RUNNING TESTS PERFORMED AT DIFFERENT DISTANCES

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Abstract

Military staff are required to have a high level of fitness to be able to cope with the physical challenges of his profession to perform the tasks assigned to him and to be protected from the possible injuries. Therefore, their strength and cardiovascular endurance parameters are measured and evaluated by tests. The aim of present study was to determine the relationship between the multistage 20 m shuttle run test*(MSRT) and 1200 m,1600 m, 2400 m running tests performed on the military high school students and the number of shuttles that counterbalance different running times. In present study, 588 volunteer military school students were recruited in this study and categorized in 3 groups according to age. In the first group (G1) 15 ages (n = 168, height 171 ± 6,22 cm, weight 64 ± 8.69 kg), in the second group (G2) 16 ages (n = 121, height 175 ± 5.14 cm, weight 65 ± 7.21 kg) ad the third group (G3) 17 and 18 ages (n = 300, height 177 ± 5.18 cm, weight 70.5 ± 7.55 kg) took place. G1, G2 and G3 groups performed 1200 m, 1600 m, 2400 m running tests, respectively the running speed were set. All of the students performed the shuttle run test two days later. The relationship between the number of shuttles and running speed were analyzed by multiple regression analysis. It determined following formulas. Formula 1: 1200 m n of shuttles for running = (6.893 x 1200 m running speed ($km.h^{-1}$)) + (-22.513), Formula 2: 1600 m n of shuttles for running = (8.889 x 1600 m running speed ($km.h^{-1}$)) + (-43.548), Formula 3: 2400 m n of shuttles for running = (7.691 x 2400 m running speed ($km.h^{-1}$)) + (18.410). In conclusion, there are positive relationship between the shuttle run test and 1200 m, 1600 m, 2400 m running tests. Also, we can say military high school students could be used the shuttle run test instead of other distance running tests to determine cardiovascular endurance.*

Key words: *endurance, running tests, cadet*

Introduction

Military staff should always maintain the fitness level to be able to cope with the physical difficulties required by the profession and to be able to successfully perform the tasks assigned to him and to be protected from possible injuries. For this reason, the strength and durability parameters of the military staff are measured and evaluated by the tests (Wilkinson, et al., 2014; Knapik, et al., 2009; NATO, 2009). One of the most important criteria for military physical fitness is aerobic and cardiovascular resistance. Aerobic and cardiovascular endurance is tested with medium and long distance conditions in military institutions and evaluated according to running time in age groups. The aerobic endurance is determined by the maximum oxygen consumption capacity (VO_2max) and the gold criterion is tested directly in the laboratory environment by means of the gas analyzer when VO_2max is specified (Wagner, 1996). However, the alternate method is to determine the VO_2max capacity indirectly because the test group to be tested is crowded and the expert staff is in need and expensive (Cooper, 1968; Knapik, 1989).Aerobic and cardiovascular endurance in military high school is determined by running tests at 1200 m, 1600 m and 2400 m according to age groups. However, due to the fact that running tests are usually carried out on roads, difficulties due to climatic conditions (extreme heat and humidity, wind, rain etc.) adversely affect performance.

In addition, security issues arise because the roads are usually open areas within the boundaries of the military units. A valid, reliable, cost-effective and safe multistage 20 m shuttle run test (MSRT) as an alternative test may be a good option as long road conditions can create adverse conditions in terms of intervening injuries to occur during running (Ramsbottom, et al, 1988; Leger& Lambert, 1982; Leger, et al., 1988; Nora, et al., 1992). MSRT has been used as a valid test in many sports so far but we have not used it in our country to determine military physical fitness.Is there a significant relationship between MSRT and 1200 m, 1600 m and 2400 m running tests? If there is a relationship, what kind of relationship is this and if these two tests can be used in place of each other, can we score by estimating the number of shuttle runs by looking at one person's 1200 m, 1600 m and 2400 m running times?The hypothesis of the research is that there is a significant relationship between MSRT and 1200 m, 1600 m and 2400 m conditions and that they can give consistent results about the endurance performance instead of each other.Previously, the relationship between the MSRT and the 2400 m run was investigated in a study conducted in the United Kingdom (Wilkinson et al., 2014). This study was also applied to Turkish military students to investigate the relationship between 1200, 1600 & 2400 distances and MSRT. The study group was tested at different distances according to the age (15-18 years).

The aim of present study was to determine the relationship between MSRT and different distance running tests applied by military high school students and determine the number of shuttles that correspond to different running times.

Methods

Subjects
All of the military students voluntarily participating in the study (n = 588) were male. The students were divided into three different groups. The first group (G1) was run at 1200 m, the second group (G2) run at 1600 m, and the third group (G3) run at 2400 m. In G1 (n = 168, age 15, 171 ± 6.22 cm, weight 64 ± 8.69 kg), G2 (n = 121, age 16, height 175 ± 5.14 cm, weight 65 ± 7.21 kg) (n = 156, age 17 years, height 176 ± 12 cm, weight 69 ± 17 kg) and G3 (n = 144, 18 years, height 178 ± 5.18 cm, weight 72 ± 7.55 kg) voluntary students were included. MSRT was applied to the entire study group. All of the participants participate in sports regularly, and at the same time they eat the same food and sleep at the same time. Permission obtained from the relevant institution for the research.

Data collection
The MSRT is a indoor that gives an estimate of VO_2max, the basic physiological parameter for durability, that can be made up to 20 meters and gradually increasing the speed of running with audio signal (Wilkinson, et al., 2014). Prior to the testing, participants were informed about the purpose of study and motivated to do their best. The running tests were conducted at a temperature of 26-30 degrees C on a 200 m running track with tartan ground, between 8:30 a.m. and 12:00 a.m. and the morning and 2:00 p.m. and 4:30 p.m. A digital timer was used as a timer (Casio HS70W, japan). The groups participating in the running test were taken to the MSRT after resting for three days. The shuttle test was also held at the same time in the indoor sports hall (Beep Test Team Trainer, Fast software Pty Ltd). The shuttle run is a run test between 8 and 13 laps starting at 8 km/hin the form of a round trip between 20 m distance and running until the end of the cycle according to the signals increasing by 0.5 km/h. During the run, 3 participants could not complete the test due to minor injuries.

Statistical analysis
SPSS 23.0 for Windows program was used for statistical analysis. Running times of 1200 m, 1600 m and 2400 m were converted to running speed at the clock. The shuttle numbers for the MSRT were determined. The relationship between the shuttlerun and the running speed was done by multiple regression analysis. Linear relationship was found. The statistical significance level was $p<0.05$.

Results

On the G1 1200 m running test, an average of 4.71 minutes (min. 4.00 – max. 6.39 minutes) and an average of 80 shuttles (min. 51 – max. 132) were measured on the MSRT. In the G2 1600 m running test, an average of 6.15 minutes (min. 5.22 – max. 7.49) and 92 MSRT (min. 58 – max. 133 shuttle) were measured on average. On the G3 2400 m running test, an average of 9.79 minutes (min. 8.30 – max. 12.10 minutes) and an MSRT of 93 shuttles (min. 56 – max. 147) were measured on average.

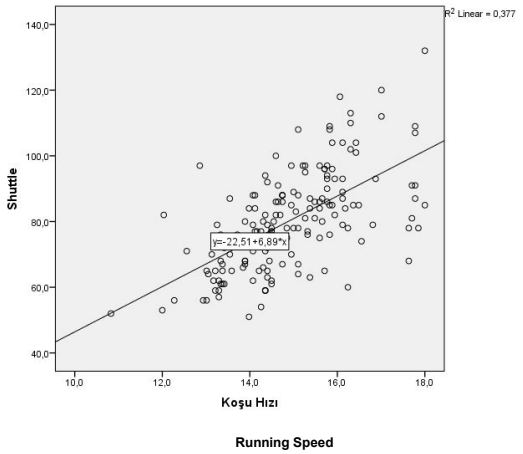

Figure 1. Relationship between 1200 ms running and MSRT performance

Formula 1 was determined by MSRT performance in 1200 m run as a result of the regression analysis relating to the run. Formula 1 => Number of shuttles for 1200 m run = (6.893 x 1200 m running speed [km.h^{-1}]) + (-22.513)r = 0.91 ($p< 0.05$). Table 1 shows the number of shuttles corresponding to the different periods in the 1200 m run test according to formula 1.

Table 1. Number of shuttles

1200 m		Tur Sayısı												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Level	5	6,15	6,13	6,11	6,09	6,07	6,05	6,03	6,01	5,59	-	-	-	-
	6	5,57	5,55	5,53	5,51	5,49	5,47	5,45	5,43	5,41	-	-	-	-
	7	5,39	5,37	5,35	5,33	5,31	5,29	5,27	5,25	5,23	5,21	-	-	-
	8	5,19	5,17	5,15	5,13	5,11	5,09	5,07	5,05	5,03	5,01	-	-	-
	9	4,59	4,57	4,55	4,53	4,51	4,49	4,47	4,45	4,43	4,41	4,39	-	-
	10	4,37	4,35	4,33	4,31	4,29	4,27	4,25	4,23	4,21	4,19	4,17	-	-
	11	4,15	4,13	4,11	4,09	4,07	4,05	4,03	4,01	3,59	3,57	3,55	3,53	-
	12	3,51	3,50	3,48	3,46	3,44	3,43	3,41	3,39	3,38	3,36	3,35	3,33	-
	13	3,32	3,30	3,29	3,27	3,26	3,24	3,23	3,22	3,20	3,19	3,18	3,16	3,15
	14	3,14	3,13	3,11	3,10	3,09	3,08	3,07	3,05	3,04	3,03	3,02	3,01	3,00
	15	2,59	2,58	2,57	2,56	2,55	2,54	2,53	2,52	2,51	2,50	2,49	2,48	2,47

Table 2. Expected 1600 m running performance based on MSRT performance

1600 m		Tur Sayısı												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Level	5	10,27	10,21	10,15	10,09	10,03	9,53	9,47	9,41	9,35	-	-	-	-
	6	9,29	9,23	9,17	9,11	9,05	8,59	8,54	8,48	8,43	-	-	-	-
	7	8,37	8,32	8,27	8,20	8,17	8,13	8,08	8,03	7,59	7,54	-	-	-
	8	7,51	7,46	7,42	7,37	7,33	7,29	7,26	7,22	7,18	7,14	-	-	-
	9	7,11	7,07	7,03	7,00	6,57	6,53	6,50	6,41	6,47	6,44	6,40	-	-
	10	6,37	6,34	6,31	6,28	6,25	6,22	6,20	6,17	6,14	6,12	6,10	-	-
	11	6,08	6,05	6,03	6,00	5,57	5,55	5,52	5,50	5,48	5,45	5,43	5,41	-
	12	5,38	5,36	5,34	5,32	5,30	5,28	5,26	5,23	5,21	5,19	5,17	5,15	-
	13	5,14	5,12	5,10	5,08	5,06	5,04	5,02	5,01	4,59	4,57	4,55	4,54	4,52
	14	4,50	4,49	4,47	4,45	4,44	4,42	4,41	4,39	4,38	4,36	4,35	4,33	4,32
	15	4,30	4,29	4,27	4,26	4,25	4,23	4,22	4,21	4,19	4,18	4,17	4,15	4,14

Table 3. Expected 2400 m running performance based on MSRT performance

2400 m		Tur Sayısı												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Level	5	20,33	20,11	19,49	19,28	19,08	18,48	18,31	18,11	17,54	-	-	-	-
	6	17,37	17,21	17,04	16,49	16,34	16,19	16,05	15,51	15,38	-	-	-	-
	7	15,25	15,12	15	14,48	14,36	14,25	14,13	14,03	13,52	13,42	-	-	-
	8	13,32	13,22	13,12	13,03	12,54	12,45	12,36	12,28	12,20	12,11	-	-	-
	9	12,03	11,56	11,48	11,41	11,33	11,26	11,19	11,12	11,06	10,59	10,53	-	-
	10	10,46	10,40	10,34	10,28	10,22	10,16	10,11	10,05	10,00	9,54	9,49	-	-
	11	9,44	9,39	9,34	9,29	9,24	9,19	9,15	9,10	9,06	9,01	8,57	8,52	-
	12	8,48	8,44	8,40	8,36	8,32	8,28	8,24	8,20	8,17	8,13	8,09	8,07	-
	13	8,06	8,02	7,59	7,55	7,52	7,49	7,45	7,42	7,39	7,36	7,33	7,30	7,27
	14	7,24	7,21	7,18	7,15	7,12	7,09	7,07	7,04	7,01	6,59	6,56	6,53	6,51
	15	6,48	4,46	6,43	6,41	6,39	6,36	6,34	6,32	6,29	6,27	6,25	6,23	6,21

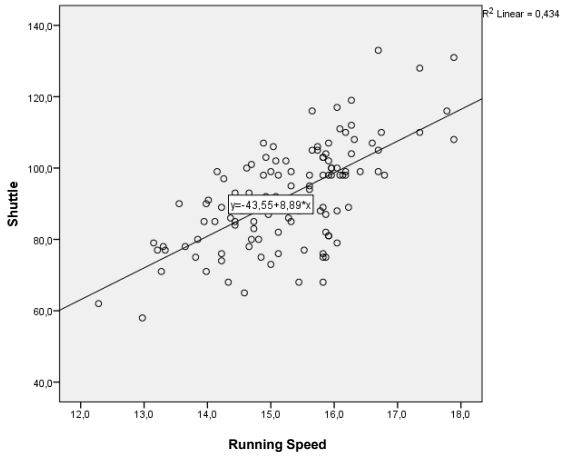

Figure 2. Relationship between 1600 m running and shuttle running performance

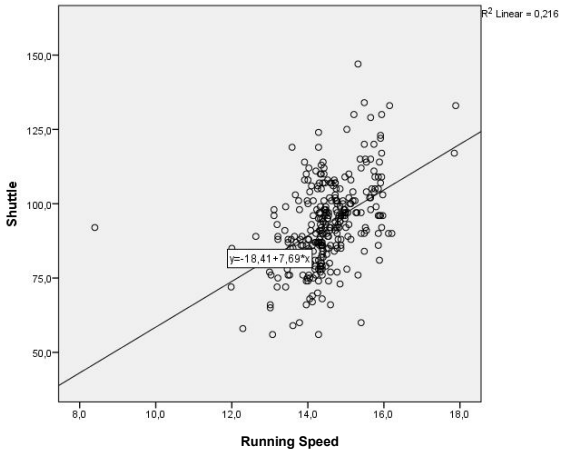

Figure 3. Relationship between 2400 m running and shuttle running performance

Formula 2 was determined by MSRT performance in 1600 m run as a result of the regression analysis relating to the run. Formula 2 => Number of shuttles for the 1600 m run = (8.889 x 1600 m running speed [km.h^{-1}]) + (- 43.548) r = 0.82 ($p<0.05$). Table 2 shows the number of shuttles corresponding to the different periods in the 1600 m running test according to Formula 2. Table 3 shows the number of shuttles corresponding to the different periods in the 2400 m running test according to Formula 3. Formula 3 was determined by MSRT performance in 2400 m run as a result of the regression analysis relating to the run. Formula 3 => Number of shuttles for the 2400 m run = (7.691 x 2400 m running speed [km.h^{-1}]) + (- 18.410) r = 0.93 ($p<0.05$)

Discussion

In our knowledge, this is the first study to examine the linear relationship between running speed and MSRT performance in 1200 m, 1600 m and 2400 m running tests applied to military students.

All sports activities of Turkish Armed Forces staff and military students are determined according to the directive. The running distance (1200 m, 1600 m, 2400 m) in the Physical Education and Sports Directive is evaluated according to the running speed and scored between 0-100. The same score table can be used with the MSRT that can be applied as an alternative to the running test applied to military students in our study.

Because all the running speeds are associated with the tables we have created in our study. For example; It is necessary to complete 5.00 minutes (73 shuttles according to Table 1) in order to get 50 points which is the passing criterion for 1200 m. Completion is required for 4.10 minutes (97 shuttles according to Table 1) for 100 full points. It is necessary to complete 6.30 minutes (86 shuttles according to Table 2) in order to get 50 points which is the passing criterion for 1600 m.

Completion is required for 6.00 minutes (98 shuttles according to Table 2) for 100 full points. For 2400 m, it is necessary to complete 10.20 minutes (99 shuttles according to Table 3) to get the passing criterion 50 points. Completion is required for 9.10 minutes (102 shuttles according to Table 3) for 100 full points. The paradigm in these criteria indicates that MSRT is an appropriate option as an alternative to road running tests (McNaughton, 1998; Ludbrook, 2002). It is estimated that the relatively low levels (level 9 lanes = 73 shuttles) at 1200 m are due to low training levels due to military students being first class students. Aandstad et al. (2011) found that there is a relationship between VO_2max estimation and aerobic capacity of military personnel in their study. According to the results from various studies, there is a high correlation between MSRT performance (r>0,9) and 10 km and 2,4 km run tests (Paliczka et al., 1987; Ludbrook, 1997; Aandstad et al., 2011) Our study also showed a high correlation between MSRT performance and 1200 m (r = 0.91), 1600 m (r = 0.82) and 2400 m (r = 0.93). There are many research results regarding the relationship between 2400 m running distance and MSRT (Vega, 2015). A study by Cunningham et al. (1994) found a high correlation (r = 0.88) between 1 mile (1609 m) running distance and MSRT for measuring aerobic endurance at shorter distances. According to Kayıhan et al (2014) 1 mile running test and MSRT are valid and reliable tests to measure aerobic performance can be used to measure aerobic capacity regardless of gender and age. The fact that my research group was a military student made it possible for me to conduct an investigation with a working group that has many of the same characteristics. Participants who did not researched were the same age, sleeping at the same time, eating the same food, and having a similar psychological situation. This is the strength of our study. Our work on military high school students is required to carry out a future study on whether MSRT can be used as an alternative to the 3000 m road run test, in which the entire Turkish Armed Forces staff must attend.

Conclusion

There is a significant positive correlation between MSRT and 1200 m, 1600 m and 2400 m running tests and we can say that MSRT can be used instead of other distance running tests to determine the cardiovascular endurance of military high school students.

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ISTRAŽIVANJE ODNOSA IZMEĐU VIŠERAZINSKOG 20 M SHUTTLE RUN TESTA I TESTA TRČANJA PROVEDENOG NA RAZLIČITIM UDALJENOSTIMA

Sažetak
Vojno osoblje mora imati visoku razinu sposobnosti da se može nositi s fizičkim izazovima svoje struke i obavljati zadaće koje mu se dodjeljuju i da bude zaštićeno od mogućih ozljeda. Stoga su njihova snaga i parametri kardiovaskularne izdržljivosti mjereni i ocijenjeni testovima. Cilj ovog istraživanja bio je utvrditi povezanost između testiranja multistage 20 m shuttle-a (MSRT) i trčanja na 1200 m, 1600 m, 2400 m testova provedenih na vojnim srednjoškolskim učenicima s brojem shuttle-a koji čine protutežu različitim vremenima trčanja. U ovom radu, u ovom je radu angažirano 588 dragovoljaca učenika vojnih škola kategoriziranih u 3 skupine prema uzrastu. U prvoj skupini (G1) uzrast 15 (n = 168, visina 171 ± 6,22 cm, težina 64 ± 8,69 kg), u drugoj skupini (G2) uzrast 16 (n = 121, visina 175 ± 5,14 cm, težina 65 ± 7,21 kg) i u trećoj (G3) uzrast 17 i 18 (n = 300, visina 177 ± 5,18 cm, masa 70,5 ± 7,55 kg). G1, G2 i G3 grupe izvodile su testove od 1200 m, 1600 m, 2400 m, odnosno postavljene brzine trčanja. Svi učenici su izvodili test dva dana kasnije. Odnos broja brojeva i brzine trčanja analiziran je višestrukom regresijskom analizom. Određene su sljedeće formule. Formula 1: 1200 m, n shuttle-a = (6,893 x 1200 m brzina trčanja (km.h-1)) + (-22.513), Formula 2: 1600 m, n shuttle-a = (8.889 x 1600 m brzina trčanja (km.h .3): + (-43.548), Formula 3: 2400 m, n shuttle-a = (7.691 x 2400 m brzina trčanja (km.h-1)) + (18.410). Zaključno, postoji pozitivan odnos između testa 'shuttle run' i 1200 m, 1600 m, 2400 m testova. Također, možemo reći da se vojni srednjoškolci mogu koristiti testom trčanja 'shuttle run' umjesto drugih testova na daljinu kako bi se odredila kardiovaskularna izdržljivost.

Ključne riječi*: izdržljivost, testovi, kadet*

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