Clinical Report

Introduction, interpretation and reliability of a simple wingate based modified field running test to assess anaerobic capacity (of female soccer players in Germany and the United States of America)

Abstract

Introduction: In team sports with short repeated sprints and changes of direction, it is important to know how the anaerobic capacity level of his players is and develops during the season. To test this ability the 15m Modified Shuttle Run Test (15m MSRT), based on the Wingate Cycle Test principles, was developed.

Method: Two groups of five female soccer players from Germany (GER) (average age 19.2 years; range 18–21) and the United States of America (US), (average age 18.8 years; range 17–21) performed a 15m MSRT on two occasions to test the reliability. Maximum (Highest Lap Velocity (HLV)), minimum (Lowest Lap Velocity (LLV)) and average speed (Mean (Individual) Velocity (M(I)V)) of the individual player and average lap speed (Mean Lap Velocity (M(L)V)), the Fitness Index (FiI), Fatigue Index (FaI) and Speed–Endurance–Index (SEI) was calculated for the individual player as well as for the whole team.

Results: The ICC and CV for the MLV was 0.95 and 1.41% resp (GER) and 0.72 and 3.24% (US), the Fitness Index (GER: 0.93 and 2.90%; USA: 0.78 and 4%) and Speed–Endurance–Index (GER: 0.95and 3.30%; US: 0.94 and 4.40%)

Conclusion and recommendation: The 15m MSRT is a reliable tool to assess and monitor both individual and team running speed. The MIV is useful to individualize anaerobic capacity training.

Keywords: anaerobic capacity, team sports, wingate, fatigue index

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Introduction

Anaerobic capacity is the maximal rate of energy production by the combined phosphagen and lactic energy systems for moderate–duration activities.[1] These activities with maximum intensity are quantified as the maximal amount of work per second performed in muscular activity ranging from 30 to 90 seconds.[1] For activities with maximum intensity the required energy is provided for by phosphorylation, a system that provides ATP (adenosine tri phosphate) primarily for short–term, high–intensity activities at the start of all exercises regardless of the intensity.[2] As soon as pure phosphorylation, about five seconds into activity, has ended, anaerobic lactic glycolysis starts. Both anaerobic lactic glycolysis and phosphorylation re–synthesize ATP in the absence of molecular oxygen[2] and are the main source of energy in many sports, such as soccer, team handball, basketball and ice hockey, where short high intense activities alternately interact with relative short recovery periods.

In the field of strength and conditioning the rate of recruiting energy, using both anaerobic systems is usually known as anaerobic capacity.

Many different tests are available to test for anaerobic capacity, among which the Wingate Anaerobic 30 seconds Cycle Test (WANT).[3] This test assesses anaerobic performance of young to elite athletes as well as people with physical disabilities. The test can be performed using your legs or your arms, depending one's needs and capabilities and is originally a cycle ergo meter test, specific to cycling based sports. The WANT consists of 30 seconds of all–out cycling with the ergo meter load predetermined based upon the athlete's body weight. The athlete is instructed to pedal as fast as possible and to complete as many revolutions as possible in 30 seconds. The number of revolutions, preferably counted electronically, and the peak mechanical and average power is calculated. By counting the number of revolutions per five seconds, the decline in power output is calculated.

Muniz et al.[4] investigated whether the accumulated oxygen deficit (AOD) and curvature constant of the power–duration relationship (W) are different during constant work–rate to exhaustion (CWR) and 3–min all–out (3MT) tests and the relationship between AOD and W during CWR and 3MT.

It is stated by Cooper et al.,[5] that a running based anaerobic test is a better, more reliable and valid indicator of anaerobic capacity in not cycling based sports such as team handball, basketball, soccer and badminton.[6] For swimmers, a swimming specific anaerobic capacity test gave reliable and valid results on anaerobic power output[7] and for ice hockey players a similar test was used on ice.[8] These non–cycling based sports have used Running based Anaerobic Sprint Tests (RAST) such as the Cunningham and Faulkner Test, 300–yd Shuttle Run Test and the Modified Shuttle Run Test (MSRT).[9]

Method

Members of two independent groups of female soccer players of comparable age in Germany (GER) and United States of America (US) were tested for their anaerobic capacity using a 15m modified shuttle run test (MSRT). The tests were executed two times with two days in between in GER and, due to schedule problems, eight days in between in the US. The equipment to perform the test consisted of two lines, a stopwatch with split time and memory, and a polar heart rate monitor Figure 1.

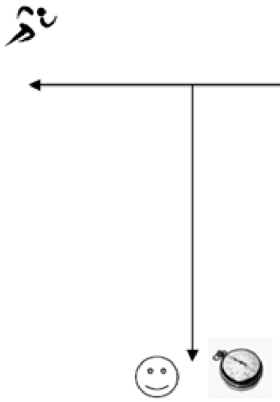

Figure 1 The smiley is the tester position with the secretary, 20m perpendicular to the 15m running area.

The test team consisted of two members: the head tester to take time and instruct the participants and a secretary to record the times the head tester passed to him after each 15m turn and to read maximum HR from the heart rate monitor upon completion of test. The time was recorded the instant the player touched the ground with one foot just outside the outline of the 15m lap.

During the test, the head tester took a position 20m perpendicular to the middle of the 15m track, the Participants (P) had to run. The start signal was given by hand signal and the time started the instant the P lifted one foot off the floor/ground.

Two lines were placed at the end of the 15m track: a non–slippery playing surface. The P were asked to warm up as usual, followed by a test run over four laps (60 meters). Then, after a ten minutes recovery period, the test was executed individually. At the start, the P had to stand with on foot outside the line that marked the running area. The P were asked to run, as fast as possible, ten laps of 15 meter (150m in total) back and forth and put one foot over the line (turning point) before running back. Although most of the players could only run 120m in about 30 seconds (Table 1), all players had to run all ten laps. Otherwise, the last lap could be ended finishing like a sprinter and would not have a deceleration phase. This would bias the recorded time and this lap time could not be included for analyses.

Male elite handball players, who were asked to do this test as well, ran about 135m in 30 seconds. Therefore, ten laps seemed to be the most appropriate for this test.

Table 1 Scored time after 120m (estimated distance to be covered in 30s) in seconds

	GER:	GER:	US:	US:
Participant	Test 1	Test 2	Test 1	Test 2
	120m (8 laps)	120m (8 laps)	120m (8 laps)	120m (8 laps)
P1	29.9	29.7	30.6	30.9
P2	32	33.3	30.4	30.6
P3	30	30.1	30.6	30.1
P4	30.9	30.7	27.5	27.2
P5	31.3	30.9	29.5	28.9

The heart rate after completion of the test was determined by using a polar heart rate (Polar®) monitor.

The other members of the team were asked not to encourage the participant verbally during the test. In GER the tests were executed with two days between the tests but in the US, due to schedule problems, the second test was eight days after the first. Therefore the data were held apart when comparing the test and re–test statistically. All lap times where converted into velocity (m/s). Then the Mean Lap Velocity (MLV) of the group, Mean (Individual) Velocity (MIV), the individual Highest Lap Velocity (HLV), Lowest Lap Velocity (LLV) as well as the fitness index (FiI=ratio of LLV and HLV) the Speed–Endurance–Index (SEI=product of FiI and MIV) where used for statistics.

The intra class correlation (ICC) and coefficient of variance (CV) where calculated using SPSS. (See also: (http://www.sportsci.org/resource/stats/relycalc.html).

If the test results show an ICC of at least 0.75 and a CV of no more than ten percent the test is regarded to be reliable.

Instead of the fitness index (a higher score means a higher anaerobic capacity level), the fatigue index can be calculated (1 minus fitness index). A higher fatigue index indicates a lower anaerobic capacity level. Zero means, no fatigue (all laps are the same), one means, complete exhaustion and the test could not be completed.

Both terms can be used, depending on how a coach wants to present the results, positively (fitness index)) or negatively (fatigue index) Table 2.

Table 2 Overview of the data after conversion of the lap times into lap velocity (LV in m/s) and calculation of the mean individual velocity (MIV) and mean lap velocity (MLV). The Speed-Endurance-Index (SEI) for the individual player is the product of the ratio of the lowest (LLV) and highest lap velocity (HLV (= Fitness Index=FiI)) and the mean individual velocity (MIV). Additionally the Highest Mean Lap Velocity (HMLV), the Lowest Mean Lap Velocity (LMLV) and the Mean Team Velocity (MTV) are used to determine the Team SEI

Player	15m	30m	45m	60m	75m	90m	105m	120m		Speed-Endurance-Index (SEI)(= FI*MIV)
1a	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	**MIV (m/S)**	(LLV/HLV)*MIV
2a	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	**MIV (m/S)**	(LLV/HLV)*MIV
3a	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	**MIV (m/S)**	(LLV/HLV)*MIV
4a	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	**MIV (m/S)**	(LLV/HLV)*MIV
5a	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	LV (m/S)	**MIV (m/S)**	(LLV/HLV)*MIV
	MLV (m/S)	**MLV (m/S)**	**MLV (m/S)**	**MLV (m/S)**	**MLV (m/S)**	**MLV (m/S)**	**MLV (m/S)**	**MLV (m/S)**	**MTV**	(LMLV/HMLV)*MTV

Results

All participants completed both tests and in the same order and at the same time of day as the first test and under comparable weather conditions (sunny, no wind). The intra class correlation (ICC) and coefficient of variation (CV) was calculated for the Mean Lap Velocity (GER: 0.95 and 1.41%; US: 072 and 3.24%), Mean Individual Velocity (GER: 0.93 and 0.42%; USA: 0.98 and 2.58%), Fitness Index/Fatigue Index (GER: 0.93 and 2.90%; US: 0.78 and 4%) and Speed–Endurance–Index (GER: 0.95and 3.30%; USA: 0.94 and 4.40%) Table 3a&3b.

The ICC for the MLV was 0.95 in GER and 0.72 in USA; the CV was 1.41% and 3.24% respectively (Table 4a&4b).

For the HLV the ICC in GER was 0.94 and in US 0.52. For the LLV the ICC was 0.82 in GER and 0.96 in US (Table 5a&5b).

Table 3a Fitness/Fatigue Index and Speed-Endurance-Index overview and statistical analyses of German players

G ER	Fitness Index Test 1	Fitness Index Test 2	Speed Endurance Index Test 1	Speed Endurance Index Test 2	Fatigue Index 1	Fatigue Index 2
P 1	0.76	0.73	3.06	3	0.24	0.27
P 2	0.77	0.76	2.89	2.74	0.23	0.24
P 3	0.85	0.82	3.39	3.3	0.15	0.18
P 4	0.81	0.86	3.15	3.37	0.19	0.14
P 5	0.86	0.84	3.3	3.26	0.14	0.16
Mean	0.81	0.8	3.16	3.13	0.19	0.2
S D	0.05	0.05	0.2	0.26	0.05	0.06
ICC	0.93		0.95		0.93	
CV (%)	2.90%		3.30%		2.90%	

Table 3b Fitness/Fatigue Index and Speed-Endurance-Index overview and statistical analyses of the US players

US	Fitness Index Test 1	Fitness Index Test 2	Speed Endurance Index Test 1	Speed Endurance Index Test 2	Fatigue Index 1	Fatigue Index 2
P1	0.75	0.81	2.93	3.17	0.25	0.19
P2	0.81	0.8	3.26	3.18	0.19	0.2
P3	0.86	0.8	3.36	3.22	0.14	0.2
P4	0.91	0.88	4.01	3.68	0.09	0.13
P5	0.86	0.85	3.54	3.56	0.14	0.15
Mean	0.84	0.83	3.42	3.36	0.16	0.17
SD	0.06	0.04	0.4	0.24	0.06	0.03
ICC	0.78		0.94		0.78	
CV (%)	4.00%		4.40%		4.00%	

Table 4a Mean Lap Velocity correlation and coefficient of variance of the GER players

GER	MLV Test 1	MLV Test 2
15m	4.48	4.48
30m	4.014	4.02
45m	4.034	3.968
60m	3.89	3.988
75m	3.736	3.692
90m	3.74	3.924
105m	3.734	3.702
120m	3.682	3.7
Mean=MV	3.91	3.91
ICC	0.95	
CV	1.41%	

Table 4b Mean Lap Velocity correlation and coefficient of variance of the American players

US	MLV Test 1	MLV Test 2
15m	4.38	4.34
30m	4.24	4.42
45m	4.08	4.1
60m	3.96	4
75m	4.18	4.02
90m	4	4.12
105m	3.96	3.88
120m	3.82	4.06
Mean=MV	4.06	4.06
ICC	0.72	
CV	3.24%	

Table 5a Highest and Lowest lap Velocity correlations and coefficient of variance of the GER players

GER	HLV Test 1	HLV Test 2		LLV Test 1	LLV Test 2
P1	4.84	5	P1	3.66	3.66
P2	4.55	4.41	P2	3.49	3.33
P3	4.55	4.55	P3	3.85	3.75
P4	4.41	4.28	P4	3.57	3.66
P5	4.16	4.16	P5	3.57	3.49
Mean	4.5	4.48	Mean	3.63	3.58
ICC	0.92		ICC	0.82	
CV	1.90%		CV	2%	

Citation: Madou KH, Pribish C. Introduction, interpretation and reliability of a simple wingate based modified field running test to assess anaerobic capacity (of female soccer players in Germany and the United States of America). *MOJ Sports Med.* 2020;4(2):43–51. DOI: 10.15406/mojsm.2020.04.00093

Table 5b Highest and Lowest lap Velocity correlations and coefficient of variance of the US players. Typically the LLV shows less bias then the HLV

USA	HLV Test 1	HLV Test 2		LLV Test 1	LLV Test 2
P1	4.4	4.3	P1	3.3	3.5
P2	4.3	4.4	P2	3.5	3.5
P3	4.3	4.6	P3	3.7	3.7
P4	4.5	4.8	P4	4.1	4.2
P5	4.4	4.6	P5	3.8	3.9
Mean	4.38	4.54	Mean	3.68	3.76
ICC	0.4		ICC	0.97	
CV	2.70%		CV	1.70%	

The Fil showed an ICC of 0.93 in GER. In US the ICC for the FiI was only 0.78, which might be due to the fact, that the second test was postponed and actually held one day before an important match and not on a comparable training day like the first test. The Speed–Endurance–Index is less sensitive to outliers due to measurement errors or under–, respectively over–performance of participants. This phenomenon is often observed in team sports like soccer and handball. These sometimes biased results can be compensated by using the average velocity (MIV) in the calculation, which does not show extreme results in individual laps Tables 6–11.

Table 6 Results of 6 September. The players could be split up into two groups of comparable level

Field Position:	Age (years):	Height (cm):	Body Weight (kg):	Maximum Speed (m/s) inimum Speed (m		Fitness Index	Fatigue Index	Average Speed	Training Speed (m/s)	Distance in 10 s
Centre	21	186	80	5.36	4.69	0.88	0.13	4.97	4.85	48.50m
Centre Left	24	194	80	5.3	4.66	0.88	0.12	4.94		
Wing (Right/Left)	18	180	73	5.05	4.53	0.9	0.1	4.81		
Wing Left	24	180	77	5.36	4.13	0.77	0.23	4.69		
Goalkeeper	24	187	87	5.17	4.36	0.84	0.16	4.65		
Goalkeeper	29	189	90	4.97	4.25	0.86	0.14	4.63		
Wing Right	17	174	73	4.85	4.25	0.88	0.12	4.59	4.52	45.20m
Centre Left	19	189	79	4.97	4.21	0.85	0.15	4.57		
Centre	31	193	99	4.85	4.21	0.87	0.13	4.51		
Pivot	27	187	90	4.78	4.07	0.85	0.15	4.48		
Centre Right	30	196	98	4.76	4.24	0.89	0.11	4.46		
MEAN	24	186.82	84.18	5.04	4.33	0.86	0.14	4.66		
MAX	31	196	99	5.36	4.69	0.9	0.23	4.97		
MIN	17	174	73	4.76	4.07	0.77	0.1	4.46		
SD	4.88	6.65	9.22	0.23	0.21	0.03	0.03	0.18		

Table 7 Mean Individual Velocity (MIV) and Statistics of the GER Soccer Players

IV	Test 1	Test 2	Test Difference
P1	4.04	4.1	0.06
P2	3.77	3.63	-0.1
P3	4.01	4	0
P4	3.9	3.94	0.04
P5	3.84	3.88	0.04
Mean	3.91	3.91	0
SD	0.19	0.16	
ICC	0.86		
CV (%)	1.50%		

Table 8 Mean Individual Velocity (MIV) and Statistics of the "USA" Soccer Players

MIV	Test 1	Test 2	Test Difference
P1	3.94	3.9	-0.04
P2	3.96	3.95	-0.01
P3	3.93	4	0.07
P4	4.34	4.42	0.09
P5	4.08	4.14	0.04
Mean	4.05	4.08	
SD	0.17	0.21	
ICC	0.97		
CV (%)	0.90%		

Table 9 Heart Rate (HR), Heart Rate Statistics and Body Weight of the GER soccer players

Individual Heart Rate	Body Weight	HR Test 1	HR Test 2	Test Difference
P1	58	175	178	3
P2	74	183	183	0
P3	60	171	168	-3
P4	62	162	162	0
P5	78	182	181	-1
Mean	66.4	174.6	174.4	-0.2
SD		8.62	9.02	
ICC			0.97	
CV (%)			0.90%	

Table 10 Heart Rate (HR), Heart Rate Statistics and Bodyweight of the US soccer players

Individual Heart Rate	Body Weight	HR Test 1	HR Test 2	Test Difference
P1	72	176	183	7
P2	50	176	178	2
P3	76	177	192	15
P4	51	178	176	-2
P5	52	174	175	1
Mean	60.2	176.2	181.8	4.8
SD		1.48	6.98	5.5
ICC			0.14	
CV(%)			2.60%	

Table 11 Results of 6 September and 31 October. After six weeks of competition, the anaerobic capacity level decreased, fatigue increased, but maximum speed improved

	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep
Field Position	Time after 150m	Time after 150m	Average speed	Average speed	max speed	max speed	Min speed	Min speed	Fatique index	Fatique index	Fitness index	Fitness index	d-Endurance-	d-Endurance-
Centre Left	33.96	32.93	4.42	4.57	5.17	4.97	4.17	4.21	0.19	0.15	0.81	0.85	3.57	3.87
Centre	30.64	30.25	4.9	4.97	5.26	5.36	4.6	4.69	0.13	0.13	0.87	0.88	4.29	4.35
Centre	34.06	33.34	4.4	4.51	4.97	4.85	4.18	4.21	0.16	0.13	0.84	0.87	3.7	3.91
Centre Right	33.83	33.69	4.43	4.46	4.82	4.76	4.21	4.24	0.13	0.11	0.87	0.89	3.87	3.97
Pivot	34.08	33.59	4.4	4.48	4.85	4.78	3.97	4.07	0.18	0.15	0.82	0.85	3.6	3.81
Left Wing	31.27	32.22	4.8	4.69	5.23	5.36	4.32	4.13	0.17	0.23	0.83	0.77	3.96	3.61
Right Wing	33.4	32.71	4.49	4.59	4.81	4.85	4.2	4.25	0.13	0.12	0.87	0.88	3.92	4.02

Table Continued...

	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep	31-Oct	06. Sep
Field Position	Time after 150m	Time after 150m	Average speed	Average speed	max speed	max speed	Min speed	Min speed	Fatique index	Fatique index	Fitness index	Fitness index	d-Endurance-	d-Endurance-
Centre Left	31.27	30.41	4.8	4.94	5.47	5.3	4.44	4.66	0.19	0.12	0.81	0.88	3.9	4.34
MEAN	32.81	32.39	4.58	4.65	5.07	5.03	4.26	4.31	0.16	0.14	0.84	0.86	3.85	3.99
MAX	34.08	33.69	4.9	4.97	5.47	5.36	4.6	4.69	0.19	0.23	0.87	0.89	4.29	4.35
MIN	30.64	30.25	4.4	4.46	4.81	4.76	3.97	4.07	0.13	0.11	0.81	0.77	3.57	3.61
SD	1.48	1.36	0.21	0.2	0.24	0.27	0.19	0.23	0.03	0.04	0.03	0.04	0.23	0.25
Effect Size	0,31		0,35		0,16		0,2		0,44		0,44		0,54	

Discussion

Observational studies[10] showed the importance of the ability to perform repeated short sprints in team handball. In soccer similar observations were made by Meckel et al.[11] and 2003 Krustrup et al.[12] examined the physiological response and reproducibility of the Yo–Yo intermittent recovery test and its application to elite soccer. Höner et al.[13] recognized also the importance of psychometric properties of the motor diagnostics in the German football talent identification and development programme.

Overall it may be stated, that the 15m MSRT is a reliable tool for testing the anaerobic capacity of (female) soccer players. This study confirms the conclusions made by Cooper et al.,[5] in 2004 using a similar test protocol. Calculating MLV, HLV, LLV and FiI it may be possible to use this test to conduct anaerobic capacity training individually. A try out in the field was very promising (see practical application), but further studies in this area are needed to determine the practical value of this test.

Practical application

Conducted on a regular basis throughout the training program, the test results can be used to be compared with previous results, to determine if the training program is achieving the desired results and to appropriately adjust an anaerobic capacity training program.

This MSRT should be used on a regular basis (every 3 to 6 weeks) throughout the season. The period between tests is the coach decision and experience and depends on the training phase of the team.

The 15m MSRT is a very specific tool to monitor athletes in all events with repeated short sprints and changes of direction like team players in soccer, handball, basketball, rugby and individual athletes in tennis, badminton and squash.

To determine the practical use of the MSRT, the players of an elite Swiss handball team conducted the test at the begin of the playing season and again six weeks later.

Games in handball consist of two halves, lasting 30 minutes each, with a 15–minute break. The field is 20 x 40m, with a goalkeepers area of 6m (half circle) in which no players is allowed to enter. A team has seven players in the field and may have another seven as substitutes. Substitution of players is unlimited. Players in handball have very different roles and often their physical and functional appearance differ a great deal.[14] For every position in the team normally two players are available. The goalkeeper should be tall, fast and agile, wing players right and left should be explosive, fast runners and good jumpers and the right wind should be left handed, the left wing right handed, the pivot strong, tall, heavily build but nevertheless agile. The most important player is the centre with a forward left and forward right players at each side of him. These players should be tall, great jumpers and strong. Top professional players in Europe are around 95kg, 195–200cm tall and very good throwers (above 100km/h).

The game is played using a 425–475gr ball with a 58–60cm circumference (senior men).

The nature of the game (30 second rule) makes it necessary to have great speed, and anaerobic lactic and alactic capacity and power, because all 6 field players both attack and defend as a unity, where an attack has to end in an attempt to score within 30 seconds. If not, the referee will interfere and the opponent gets a free throw and starts an attack. The distance from one 6m–line to the other is 28 m. After losing the ball, the attacking team has to sprint back to defend, while the defending team starts an attack as fast as possible (fast break=first and second wave), or controlled without speed (third wave) in order to find a way to score using the 30 seconds rule. In the first wave the wing players will try to outsprint their opponent and the ball will be played to them while sprinting. If the wing player has no opportunity to score, he will try to involve other players in his fast break (second wave) or he will stop the fast break and the entre starts a controlled attack (third wave).

During a game, the score percentage of the winning team lies around 60% per attack. The number of goals score lies between 30 and 40. This means, that a team has to defend and attack between 50 and 70 times, because after each attack the role changes. In other words: each team covers the field distance up to 140 times per game. That makes 25 seconds on average. During this time, the distance from one goal to another is covered, players will run from left to right (centre players), pushing and pulling (by the pivot and the defenders) and jumping and throwing (all players). The energy system, which is most active in this kind of activity, is the fastest energy system we have, the anaerobic system (both alactic and lactic). The physical activities are short sprints, fast changes of direction, jumps and throws.

The Mean Individual Velocity was used to determine the running speed of an individualized short running program, performed once a week at the end of the Tuesday training session for six weeks. The test results were compared to determine the anaerobic capacity level development during this first part of the season.

The goal of this program was to apply an individualized running program in order to maintain the anaerobic capacity level during the season.

Application protocol

Eleven semi professional elite handball players completed the MSRT test on 6 September, at the end of their preseason preparation period (July and August). The regular season for Swiss handball players is from the end of September until early may, depending on whether or not they qualify for the play offs. At the time of testing, the season had about 40 regular games.

To test the ability to perform repeated short sprints, with maximum change (180 degree turn) of direction and use the outcome to individualize the training to maintain and/or improve this ability, the MSRT seems to be a perfect tool, easy to conduct, very specific, reliable and least of all, suitable for team players, with very different demands and levels.

As a try out, we where allowed to conduct this test two times with a semi professional handball team in Switzerland, with eight weeks between the two tests. With the test results a special training exercise (running program) was executed once a week at the end of the Tuesday night training session. By calculating the average individual speed (MIV), the team was split up into in two groups of comparable level (fast and slow). The average speed of the group members was used to decide, what distance each group had to cover per lap (shuttle), respectively two laps, as each running bout consisted of two shuttles/laps.

The groups had to run continuously for two minutes (120 seconds), changing speed every ten seconds. The first ten seconds the groups had to run in the calculated group speed (4.85 and 4.52 m/s resp.) with a turn after the 5 seconds distance (= 5 times the group speed (5 x 4.85m=24,25m and 5 x 4.52m=22.60m resp)). The second ten seconds the groups ran one shuttle/lap in half speed. This was repeated for 120 seconds, which means that each group ran 6 times in group speed (fast run) and six times in half group speed (recovery run). After a 3 minute recovery this 120 seconds run was repeated.

All members of the team participated, but the two goalkeepers only executed one run, more because of team spirit reasons.

Test results on 6 September

Two centre players and two wing players scored the highest speed during the test with an average speed of 4.85m/s. They had to cover 48,50m in 10 seconds (one shuttle was 24,25m) in full and 24.25m in half speed (recovery). The second group consisted of one wing player, two centre players and a pivot player. They had an average speed of 4,52m/s and had to cover 45,20 meter in 10 seconds in full speed and 22,60m (one shuttle) in half speed. To control the speed, a beep/whistle every 5 seconds could be heard. After two weeks the shuttle distance increased by 1 m.

The greatest advantage, especially for the coach, was, that all players had to run in the same speed (within their group) and all players had to turn at the same moment at the end of their lap. Thus it was/is very easy for a coach to see, which player stayed/stays behind.

Especially for team players this kind of training is not very popular, but the training level can be controlled almost optimal. It is a very demanding exercise at the end of a two hour training session and the opportunity to hide in the group was practically zero.

During the first 4 weeks, only few players could end both runs in the calculated speed. After 8 weeks all players could perform the first and 7 could perform the second bout as well.

Although this was not the goal, the test results after 8 weeks intervention where compared with the first test. The average speed had decreased and fatigue index had increased slightly, but the team level was more balanced. Before the fatigue index had a range from 12–23 (mean:14), after the intervention period however it was between 13 and19 (mean:16). The average maximum speed had increased slightly (before: 5.03m/s, after 5.07m/s). For the coach the most important result was, that his team stayed on a comparable level, which normally during the season is not the case because of the high number of games to play,[6,15–17] the lack of recovery time and/or basic training sessions (endurance, strength) between matches.

Conclusion

A MSRT based running program for team players enables the coach and/or players, to individualize, control the performance/execution of the team as well as of the individual player and to direct and monitor the group running development. Also it is a very specific training tool, which is easy to conduct at the end of a training session within a short period of time (around ten minutes for two runs) and therefore could be a valuable part of the training.

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None.

Conflicts of interest

None.

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