Rest Intervals and its Effects on Agility for Junior Handball Players

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The current research aims to design a training program for agility of handball junior players less than 14 years and to identify the effects of rest intervals on improving various agility variables (ability to learn - ability to direct – ability to adapt and change). The researcher used the experimental approach (two-group design) with pre- and post-measurements. Participants (n=20) were purposefully chosen from junior handball players (less than 14 years) of Tanta Sports Club. They were randomly divided into two groups (experimental = control = 10). The researcher chose (12) players from Baladiat Al-Mahalla Sports Club as a pilot sample. Results indicated that the recommended training program improved the agility variables of experimental group as improvement percentages were 9.15%, 10.33% and 15.46% for ability to adapt and change, ability to learn and ability to direct respectively. Relatively longer rest intervals (2-3 min) led to improvements of all agility variables for the experimental group.

Key words: agility training – handball – junior athletes

Introduction

Various types of sports training are becoming a field of competition among nations all over the world. Recent advances in science and technology are now the main pillars of sports training and this led the training process to push forward towards excellence (Abd El-Khalek, E. 2003)

Gerges, M. (1999) and Al-Welily, M. (2001) indicated that modern handball requires players to be in high level of physical fitness. Physical variables are now of major significance for daily, weekly, monthly and annual training plans in handball. Beginner and elite players as well depend greatly in their training on physical variables. Players with poor physical condition get tired easily and this may lead to losing the ball in addition to poor tactical thinking. On the other hand, players with high physical fitness tend to end the match with full control over the ball and sound tactical thinking and technical performance of skills. Physical preparation is main base for all players to reach elite levels of performance and without it handball players can never perform their technical and tactical tasks as required (Gerges, M. 1999) (Al-Welily, M. 2001).

Al-Nemr, A. & Al-Khateeb, N. (2000) indicated that agility is one of the most important physical abilities for games with continuous high tempo and attack/deference maneuvers. These maneuvers require the athlete to change directions and to maintain balance quickly either on the ground or on air and with/without tools.

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It also requires modifying motor performance according to changing situations without losing balance no matter the performance is with the whole body or with a part of it. An excellent athlete knows how to run suddenly and quickly and how to trick his/her opponent with sudden directional changes during running or sudden stops and how to jump high on time (Al-Nemr, A. & Al-Khateeb, N. 2000).

Trimby Robin (1985), Marc Evans (1997) and Al-Welely, M. (2009) indicated that agility represents a vital component for handball players just like endurance, strength, speed, flexibility and power. It is the most commonly used ability during training and matches in situations requiring changes of running speed or direction with or without the ball. It is used in dribbling, attack, shooting, jumping high and ball control to save effort during performance of such skills (Trimby Robin 1985) (Marc Evans 1997) (Al-Welely, M. 2009)

Abd El-Maksoud, A. (1991) indicated that agility include three variables which are the ability to learn, the ability to direct and the ability to adapt and change. These variables are vital for agility as the athlete who lacks these variables cannot be described as an agile athlete. These variables depend on flexibility, velocity and speed. The athlete is considered agile if he/she managed to perform motor performances quickly and accurately no matter how difficulty they are (Abd El-Maksoud, A. 199166).

The researcher thinks that each one of following variables plays a distinct role in handball:

a) **Ability to learn:** The rate of advancement differs from one athlete to another according to external conditions. Sometimes an athlete reaches coordination at the first trial and remains unable to sustain good coordination. The researcher thinks that "the ability to learn" plays a major role in handball, especially for juniors as junior handball players can never achieve coordination in performance unless we develop his/her ability to learn.

b) **Ability to direct:** With the increase of performance requirements like in jump shots or drop shots, the motor task becomes more complex. In handball, we can see several skills performed at the same time like passing and jump shot. This requires a great deal of agility to enable the player to jump and shot or land and shot. The researcher thinks that this variable plays a major role in handball as the ability to direct comes first of all agility variables due to its importance in developing the athlete's performance and his/her acquisition of complex skills like shooting. Therefore, training junior players on this variable improves their performance level, agility and coordination.

c) **Ability to adapt and change:** The athlete may face sudden changes during the match. He/she should be able to adapt to such changes quickly. This ability to change and adapt is a very important component of agility as it is indispensable

in all sports. The ability to adapt and change is of major importance for handball as this sport is full of sudden changing situations. The player turns from attack to defense or vice versa in seconds. In addition, the opponent's repeated moves that change may affect the player. It is necessary to concentrate on training this variable so that the player can adapt to external conditions of changing nature.

Allawy, M. (1994) and Al-Welely, M. (2009) indicated that canonizing rest intervals represents a major problem in sports training in general, and especially in junior training. Junior players are under several pressures affecting their physiological and psychological conditions and may lead to decreasing their performance level due to their inability to maintain good balance. Therefore, junior athletes should be provided with sufficient rest intervals during training and competitions in addition to extending these intervals and using a lot of cool down exercises so that junior players can recover easily and avoid overloads. (Allawy, M. 1994) (Al-Welely, M. 2009)

Rest intervals between exercises and repetitions are of major importance when planning a training program for junior athletes. These periods are periods for recovery during performance that may lead to fatigue. It is necessary to consider the recovery period through observing the exercises volume and intensity. A simple rule, we should provide longer rest intervals when exercises are higher in intensity and vice versa. Coaches should provide athletes with rest intervals according to athletes' levels and the optimum condition of improving their achievements.

As a coach and instructor of hand ball, and through review of related literature, the researcher noticed that agility plays a major role in handball as the player is required to maintain the ball during the whole match (60 minutes). This makes individual differences among players appear. Some players have the ability to show agility for a short time at the beginning of the match and then it disappeared due to weaknesses of physical, technical and tactical aspects while other players maintain the ball all along the match.

Abbas, E. et al (2007) indicated that handball is characterized by sudden and continuous changes like fake, fast passes and directional changes like flash attack and shooting. Players with required agility and good preparation are able to continue performing well all along the match and to fulfill their duties. (Abbas, E. et al 2007).

This signifies the importance of agility as each playing position needs specific physical, technical and tactical preparation according to playing plan. The need for agility depends on the playing position and court line. Neglecting agility exercises during competitive season leads to athletes' inability to perform well in addition to the decrease of their technical level and the appearance of fatigue that hinders motor learning.

Therefore, the researcher thinks that rest intervals play a significant role in players' recovery to normal condition as athletes in general, and especially juniors are vulnerable to many requirements during matches and training. This affects their physiological and psychological conditions as their ability to work and good balance decreases. Agility is very significant for junior players as they cannot maintain it all along the match and they should be given relatively longer periods of rest to maintain their performance level.

The researcher reviewed related literature like Faeza Abd El-Gabbar (2005) who indicated that rest intervals according to pulse rate (120bpm) improved speed endurance and 400m running performance. Shawky Abd El-Rahman (2012) indicated that double rest improves physical variables of soccer players. Medhat Bahy El-Ding (2006) indicated that the recommended training program improved agility and coordination in addition to attack skills of participants. Waleed Ibrahim (2006) indicated that mini-courts affect agility of handball players positively. Naera Mohamed (2011) indicated that the recommended program improved agility and attack skills of junior basketball players. Miller et al (2006) indicated that a plyometric training program for 6 weeks had significant effects on improving technical skills and agility (Ahmed, Faeza, A. 2005) (Abd El-Rahman, Mohamed S. 2012) (Bahy El-Din, Medhat M. 2006) (Abd El-Maksoud, Waleed I. 2006) (Heba, Naira M. 2011) (Miller et al 2006)

According to the researcher's knowledge, there are no previous studies that dealt with rest intervals and its effects on agility of junior handball players.

The current research aims to design a training program for agility of handball junior players (13-14 years) (born in 2000-2001) and to identify the effects of rest intervals on improving various agility variables (ability to learn - ability to direct – ability to adapt and change). It was hypothesized that there are statistically significant differences between rest intervals of control and experimental groups in favor of the experimental group on all agility variables.

Methods

Participants

Participants (n=20) were purposefully chosen from junior handball players (13 - 14 years born in 2000-2001) of Tanta Sports Club. They were randomly divided into two groups (experimental = control = 10). The researcher chose (12) players from Baladiat Al-Mahalla Sports Club as a pilot sample. Main and pilot sample members were chosen according to the following criteria:

- All participant are registered at the Egyptian Federation of handball
- A training experience not less than (2-3) years
- Age ranges from 13 to 14 years

Table (1) shows some descriptive data of the participants

Table (1) Growth Factors, Pulse and Physical Tests of the Participants (N=20)

Variables	Measurements	Mean	Median	SD	Flatness	Squewness
Growth factors:						
Age	Year/month	13.06	13.10	0.52	0.01	-0.53
Height	Cm	162.80	163	2.75	-0.65	-0.27
Weight	Kg	60.20	60	2.49	-0.41	0.34
Training period	Year/month	3.41	3.35	0.27	-0.35	0.54
Pulse:						
At rest	Bpm	54.40	54	2.41	0.35	0.35
During effort	Bpm	160.55	160	1.64	-0.94	0.02
Agility variable:						
Ability to learn (running around the circle test)	Sec	4.63	4.50	0.33	-1.76	0.04
Ability to direct (30m zigzag run among hurdles)	Sec	9.42	9,35	0.29	1.28	1,45
Ability to adapt and change (multi-directional running)	Sec	5.78	6.00	0.44	-1.67	-0.28

Table (1) indicated that squewness values were between (±3) and this indicates that data is free of radical distributions.

Table (2) shows mean differences between pre-measurement of the control and Experimental

Table (2) Means Differences between Pre-Measurements of the Control and Experimental Groups (N1=N2=10)

Variables	Measurements	Control		Experimental		Means difference	F	(t)
		Mean	SD	Mean	SD			
Growth factors:								
Age	Year/month	13.09	0.59	13.03	0.48	0.06	1.53	0.25
Height	Cm	163.70	2.63	161.90	2.69	1.80	1.05	1.51
Weight	Kg	60.80	2.53	59.60	2.01	1.20	1.58	1.11
Training period	Year/month	3.50	0.24	3.32	0.18	0.18	1.75	1.80
Pulse:								
At rest	Bpm	53.90	2.28	54.90	2.56	1.00	1.26	0.92
During effort	Bpm	160.20	1.69	160.90	1.60	0.70	1.12	0.95
Agility variables:								
Ability to learn (running around the circle test)	Sec	4.71	0.34	4.55	0.32	0.16	1.12	1.08
Ability to direct (30m zigzag run among hurdles)	Sec	9.36	0.25	9.48	0.33	0.12	1.74	0.93
Ability to adapt and change (multi-directional running)	Sec	5.86	0.38	5.69	0.51	0.17	1.82	0.85

F table value on P≤0.05 and freedom degrees of (9, 9) = 3.18
(t) Table value on P≤0.05 = 2.10

Table (2) indicated no statistically significant differences between the pre-measurements of the control and experimental groups. This indicates sample homogeneity.

Measures

The researcher reviewed related literature and choose the tests shown in table (3):

Table (3) Tests Used for Agility Variables

Variable	Test	Measurement
Ability to learn	(running around the circle test)	Sec
Ability to direct	(30m zigzag run among hurdles)	Sec
Ability to adapt and change	(multi-directional running)	Sec

The researcher used construe validity and test/retest Procedure to calculate validity and reliability of tests. Tests were applied from 22-6-2014 to 26-6-2015 with 5-day interval between test and retest. Results were shown in tables (4) and (5).

Table (4) Differences between Distinguished and Non-Distinguished Groups for Tests' Validity (n1=n2=6)

Variable	Measurement	Distinguished		Non-distinguished		Differences	(t) test
		Mean	SD	Mean	SD		
Ability to learn	Sec	3.84	0.28	4.71	0.36	0.87	4.35
Ability to direct	Sec	7.80	0.53	9.65	0.60	1.85	5.14
Ability to adapt and change	Sec	4.98	0.37	5.86	0.42	0.88	3.52

(t) Value on P≤0.05 = 1.81

Table (4) indicates statistically significant differences between the distinguished and non-distinguished groups on all tests. This indicates the validity of tests.

Table (5) Correlation Coefficient between Test and Retest for Agility Measurements (N=12)

Variable	Measurement	Test		Retest		R
		Mean	SD	Mean	SD	
Ability to learn	Sec	4.28	0.51	4.23	0.47	0.93
Ability to direct	Sec	8.73	0.96	8.61	0.87	0.89
Ability to adapt and change	Sec	5.42	0.64	5.35	0.69	0.91

R Value on P≤0.05 = 0.57

Table (5) indicates statistically significant correlations between test and retest which in turn indicate test reliability.

Procedure

The recommended training program aims to identify rest intervals and its effects on improving agility variables for junior handball players.

Principles of the training program:

- The program should be consistent with the general aim
- The program should be suitable for the age group
- Training load should be suitable in accordance with volume and intensity to avoid overload
- Rest intervals between repetitions should be calibrated so that participants recover to normal
- Volume and intensity of load should be increased gradually

- The program should be flexible during application and experimental matches
- Required tools and equipment should be provided
- High/low interval training should be used to improve agility variables under investigation
- The psychological aspect should be considered to help junior athletes improve

Steps for designing the experimental program:

- According to review of literature, the researcher identified the program content including:
  - Agility variables under investigation
  - Physical tests used to measure agility variables
- Calculating validity and reliability of tests
- Identifying pre- and post-measurements
- Measuring pulse using Polar watch
- Identifying the total duration of the recommended program
- Identifying number of training units, total duration of each unit and number of days
- Identifying the training method (high/low interval training)
- Identifying training loads (moderate – high – max)

Program content

The researcher applied the recommended training program from 15-7-2014 to 21-9-2014 for (10) weeks (3 units per week) with total number of (30) units.

The researcher applied the part of agility training for (25) minutes per unit after suitable warm-up with suitable rest intervals between exercises table 6.

Table (6) Distributing of the Training Program

Training stage	Weeks	Weekly units	Unit duration	Total minutes
General preparation	2	3	20-30 min	150 min
Specific preparation	5	3	20-30 min	375 min
Preparation for matches	3	3	20-30 min	225 min
Total	10	30	Mean 25 min	750 min

The researcher used suitable rest intervals between exercises and repetitions. Rest should lead player to recover to normal (55 to 65 bpm). We should notice that full recovery differs from one player to another and is not done according to regular rates. Table (7) indicates these criteria.

Table (7) Intensity and Suitable Rest Intervals for Agility Variables

Variable	Intensity	Duration to recovery
Ability to learn	60-70%	1-2 minutes to recovery
Ability to direct	80-90%	2-3 minutes to recovery
Ability to adapt and change	90-100%	40-90 sec to recovery

Pre-measurements were taken from 1-7-2014 to 7-7-2014. The training program was applied from 15-7-2014 to 21-9-2014. Post-measurements were taken from 25-9-2014 to 30-9-2014.

Results

Table (8) shows the Differences between Pre- and Post-Measurements of the Control Group on Pulse Rate.

Table (8) Differences between Pre- and Post-Measurements of the Control Group on Pulse Rate (N=10)

Variables	Measurement	Pre-		Post-		Means difference	Standard error	(t)	Significance	Improvement percentage (%)
		Mean	SD	Mean	SD					
Pulse at rest	BPM	53.90	2.28	52.80	2.35	1.1	0.31	3.5	0.007	2.04
Pulse at effort	BPM	16.20	16.20	159	1.41	1.2	0.36	3.34	0.009	0.75

(t) Value on P≤0.05 = 1.83

Table (8) indicates statistically significant differences between the pre- and post-measurement of pulse rates for the control group in favor of the post-measurements as the improvement percentages ranged from 0.75% as the least improvement for pulse at effort and 2.04% as the highest improvement for pulse at rest.

Table (9) shows the Differences between Pre- and Post-Measurements of the Experimental Group on Pulse Rate.

Table (9) Differences between Pre- and Post-Measurements of the Experimental Group on Pulse Rate (n=10)

Variables	Measurement	Pre-		Post-		Means difference	Standard error	(t)	Significance	Improvement percentage (%)
		Mean	SD	Mean	SD					
Pulse at rest	BPM	54.90	2.56	50.00	3.02	4.90	0.38	12.89	0.00	8.93
Pulse at effort	BPM	160.9	1.60	156.3	2.31	4.6	0.47	9.79	0.00	2.86

(t) Value on P≤0.05 = 1.83

Table (9) indicates statistically significant differences between the pre- and post-measurement of pulse rates for the experimental group in favor of the post-measurements as the improvement percentages ranged from 2.86% as the least improvement for pulse at effort and 8.93% as the highest improvement for pulse at rest.

Table (10) shows the Differences between Post-Measurements of the Experimental Group on Pulse Rate.

Table (10) Differences between Post-Measurements of the Control and Experimental Groups on Pulse Rate (N1=N2=10)

Variables	Measurement	experimental		control		Means difference	(t)	Significance	Improvement percentage (%)
		Mean	SD	Mean	SD				
Pulse at rest	BPM	52.80	2.35	50.00	3.02	2.80	2.32	0.03	6.88
Pulse at effort	BPM	159.00	1.41	156.30	2.31	2.70	3.15	0.00	2.11

(t) Value on P≤0.05 = 1.73

Table (10) indicates statistically significant differences between the post-measurements of pulse rates for the control and experimental groups in favor of the experimental group as the improvement percentages ranged from 2.11% as the least improvement for pulse at effort and 6.88% as the highest improvement for pulse at rest.

Table (11) shows the Differences between Pre- and Post-Measurements of the Control Group on agility Variables.

Table (11) Differences between Pre- and Post-Measurements of the Control Group on Agility Variables (n=10)

Variables	Measure	Pre-		Post-		Means difference	Standard error	(t)	Significance	Improvement percentage (%)
		Mean	SD	Mean	SD					
Ability to learn	sec	4.71	0.24	4.41	0.24	0.31	0.08	3.64	0.005	6.49
Ability to direct	sec	9.36	0.24	9.05	0.24	0.31	0.12	2.61	0.028	3.33
Ability to adapt and change	sec	5.86	0.38	5.60	0.39	0.26	0.08	3.27	0.01	4.44

(t) Value on P≤0.05 = 1.83

Table (11) indicates statistically significant differences between the pre- and post-measurement of agility variables for the control group in favor of the post-measurements as the improvement percentages ranged from 3.33% as the least improvement for ability to direct and 6.49% as the highest improvement for ability to learn.

Table (12) shows the Differences between Pre- and Post-Measurements of the Experimental Group on agility Variables.

Table (12) Differences between Pre- and Post-measurements of the Experimental Group on Agility Variables (n=10)

Variables	Measurement	Pre-		Post-		Means difference	Standard error	(t)	Significance	Improvement percentage (%)
		Mean	SD	Mean	SD					
Ability to learn	sec	4.55	0.32	3.79	0.33	0.77	0.11	6.92	0.00	16.82
Ability to direct	sec	9.48	0.33	7.7	0.51	1.78	0.14	13.17	0.00	18.80
Ability to adapt and change	sec	5.69	0.51	4.92	0.57	0.77	0.13	6.13	0.00	13.59

(t) Value on P≤0.05 = 1.83

Table (12) indicates statistically significant differences between the pre- and post-measurement of agility variables for the experimental group in favor of the post-measurements as the improvement percentages ranged from 13.95% as the least improvement for ability to adapt and change and 18.80% as the highest improvement for ability to direct.

Table (13) shows the Differences between Pre- and Post-Measurements of the Control and Experimental Group on agility Variables.

Table (13) Difference significance between Post-Measurements of the Control and Experimental Groups on Agility Variables (n1=n2=10)

Variables	Measurement	Pre-		Post-		Means difference	(t)	Significance	Improvement percentage (%)
		Mean	SD	Mean	SD				
Ability to learn	sec	4.41	0.34	3.79	0.33	0.62	4.15	0.00	10.33
Ability to direct	sec	9.05	0.24	7.70	0.51	1.35	7.54	0.00	15.46
Ability to adapt and change	sec	5.60	0.39	4.92	0.57	0.68	3.13	0.00	9.15

(t) Value on P≤0.05 = 1.73

Table (13) indicates statistically significant differences between the post-measurement of agility variables for the control and experimental groups in favor of the experimental group as the improvement percentages ranged from 9.15% as the least improvement for ability to adapt and change and 15.46% as the highest improvement for ability to direct.

Discussion

Table (11) shows that all differences are in favor of post-measurements, the researcher thinks that these results are due to the punctuality of the control group members in regular training that led to these improvements as regular training is gradual and continuous. This is consistent with Esam Amin and Mohamed Berekaa (1997) and Esam Abd El-Khalek (2003) who indicated that continuous and gradual training improves agility of athletes. (Helmy, E. & Berekaa, M. 1997) (Abd El-Khalek, E. 2003)

Table (12) indicated that (t) calculated value ranging from 6.13 to 13.17 were higher than its table value (1.83). Improvement percentages ranged from 13.95% as the least improvement for ability to adapt and change and 18.80% as the highest improvement for ability to direct. The relative order of agility variables was as follows: ability to adapt and change – ability to learn – ability to direct. All differences are in favor of post-measurements. The researcher thinks that these results are due to the punctuality of the experimental group members in the recommended training program that led to these improvements. Bahaa El-Din Salama (1999) and Peter Janssen (2001) indicated that rest intervals are critical for recovery. During recovery phosphate and glycogen in muscles are replenished and myoglobin is full of oxygen. In addition, lactic acid is removed from muscles and blood. Therefore, coaches should consider rest intervals between repetitions and exercises. (Salama, Bahaa El-Din I. 1999) (Peter Janssen 2001)

Table (13) indicates statistically significant differences between the post-measurement of agility variables for the control and experimental groups in favor of the experimental group as the improvement percentages ranged from 9.15% as the

least improvement for ability to adapt and change and 15.46% as the highest improvement for ability to direct. The relative order of agility variables was as follows: ability to adapt and change – ability to learn – ability to direct. The researcher thinks that these improvements are due to the recommended training program as rest intervals were 2-3 minutes and individual differences are considered when planning the program. This led to positive effects on all agility variables in favor of the experimental group. This is consistent with the results of Al-Kadoumy, Abd El-Nasser A. (1996), Ahmed, Faeza, A. (2005), Bahy El-Din, Medhat M. (2006), Heba, Naira M. (2011) and Abd El-Rahman, Mohamed S. (2012).

The researcher thinks that rest intervals have positive effects on improving agility variables for junior handball players especially when these intervals are long enough. Each of the three agility variables has a different role as "the ability to direct" helps junior players to control technical performance and to perceive motor links. This enables junior players to acquire new skills faster. In addition, "the ability to learn" helps junior players to perform skills correct and as required according to various game situations. Furthermore, "the ability to adapt and change" helps junior athletes to adapt with changing game situations and to change their behaviors accordingly.

Agility variables for handball are considered one insuperable unit each one of them has a distinct role due to several factors like age, training experience, psychological status, health status … etc. Coaches should consider these variables due to their importance.

Conclusions

The recommended training program improved the agility variables of experimental group as improvement percentages were 9.15%, 10.33% and 15.46% for the ability to adapt and change the ability to learn and the ability to direct respectively. Relatively longer rest intervals (2-3 min) led to improvements of all agility variables for the experimental group.

Recommendations

The recommended training program should be used to improve agility variables of junior handball players less than 14 years. The recommended training program should be used with elite teams of other age groups. Rest intervals should be considered in all sports activities. Similar studies should be conducted on other physical variables and various age groups

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