

The Effect of Using Cross Training on Improving Some of the Physical abilities of Basketball players and its Relationship to the Biochemical Variables .

Prof. Dr. Mohamed Abdelreheem Esmail , Prof. Dr. Ayman Ali Ahmed Alkiki , Dr. Falah Hachoush Al-Khalidi

Abstract : The research aims to know the effect of Cross training on some of the physical abilities (muscle power of legs and arms – transition speed – accuracy – circulatory - respiratory endurance.– agility) and also on other biochemical measurements (Beta endorphin – lactic acid – lactate dehydrogenase) of under 18 year basketball players .

The researchers applied the experimental methodology on a sample consists of (8) under 18 basketball players . Some of the research tools : physical tests – Biochemical measurements – cross training program .

The following statistical devices have been used: Mean – Standard Deviation – Media in – Skewness – Correlation Coefficients – T .Test – Progress Ratios .

The present research revealed that the Cross training has a positive effect with the significant level of 0.05 on the physical abilities (muscle power of legs and arms – transition speed – accuracy – circulatory-respiratory endurance .– agility) for under 18 year basketball players . The physical abilities (under study) of Under 18 year basketball players have significant improvement ranging between (12.23 % and 27.12 %) .

Cross training has a positive effect with significant level of 0.05 also on the biochemical variables (Beta endorphin – lactic acid –lactate dehydrogenase) of under 18 year basketball players , it helps to improve the biochemical variables (under study) with a percentage ranging between (4.56 % and 6.23 %) .

Key words : Cross training, Beta endorphin, lactate dehydrogenase, physical abilities, biochemical variables .

Introduction :

The physical preparation is considered one of the most important standards of basketball sport . It's the first step to reach high athletic levels , because the physical preparation is considered also as one of the most important success standards for the

basketball player to have a professional performance in matches , the special physical preparation aims to improve the necessary physical abilities considered important specially for playing basketball sports , the mentioned abilities have to be improved and developed to the highest level for the player to reach the best technical performance .

The process of Improving physical abilities is considered the most important training duties for facing the requirements of basketball sport. The most important special physical abilities are muscle power -transition speed – accuracy – circulatory-respiratory endurance .– agility according to (Wissel ,1995 ; Liberman & Cline 1996 ; Marcus , 1996 ; Edjacob , 1997) , they also added that the physical preparation is the basis of preparing and building a player .

A new organizational form called Cross Training which aims to improve the physical and psychological abilities of the activity through using sports , exercises and multiple means with using tools , machines and techniques related to the professional activity , the thing which makes players enjoyed and excited , improves their psychological state and their achievement motivation for practicing their due trainings . This has effects also on the performance level in matches , that Cross training avoids standard repeated performance which affects the components of player training status badly . (Zakie Mohamed Hassan, 2004). Cross training is a training style which add two exercises or more in the same program . Cross training was formed specially for improving fitness and providing relaxation to the tired muscle groups (Werner & Sharon , 2011) . introduced the definition of Cross training as the use of different exercises to achieve general adaptation of the professional athletic activity , as he did exercises which didn't belong to the professional trainings for providing relaxation after the training of a specific sport . The thing which helps muscles , tendonitis , bones , joints and ligaments to be relaxed shortly , and it also helps achieving muscular balance for the player . The Cross Training includes weight training , plyometric training as bouncing on boxes and ballistic training which help building bodies and improving strength and the muscle power of arms and legs , it also includes the exercises of endurance for a long duration as trainings of water running , stationary bike training and trade mill running training , besides endurance for a short duration exercises as speed trainings (Brad Walker, 2007) .The performance level of a player may be affected by many physical , psychological and physiological factors , but the physiological factors come at the first because they are related basically to the training load and the different adaptation processes of the body organs and their endurance for assisting tiredness and continuing the performance during the match time or during the training unit .

Muscle fatigue is considered one of the most important problems which affect a player's performance . Muscle fatigue is a multi-faced problem because we have different types of physical work , so we have different types of muscle fatigue , that muscle fatigue is resulted by desk duty is different from the muscle fatigue which is

resulted by works require movement . Fatigue differs according to the type of physical work , its duration , breaks during work and how this work is performed .

Lactic acid is considered one of the basic reasons which cause muscle fatigue related to tiredness , so blood lactic measurement refers basically to tiredness that the good level of blood lactic refers to high endurance . The response of blood lactic is very sensitive , so training programs need to be more professional and more related to the response of blood lactate .

lactate dehydrogenase (LDH) assists in the disposition of lactic acid . The more concentrated the enzyme , the more lactic acid is disposed , as it is dehydrogenase , that lactic acid becomes pyruvic acid , Beta – endorphins also works as a chemical vector , it interferes with many physiological processes , it helps increasing some hormones as insulin and glucagon (Gold Farb , et al., 1995) All players and trainers aim basically to improve the physical performance and to delay fatigue . Fatigue is a physiological problem which affects the physical and professional performance badly , it may also preclude the improvement of physical and professional performance besides plans during matches , that fatigue may disrupt the decided game plans during matches because of fatigue which affects skills and concentration of players badly during matches (Hamdy El- Sayed ; Abd -Al Hameed 2012)The researchers found the research problem while noticing the lower level of under 18 basketball players at the end of the first half and at the end of the second half because of the lower performance level and signs of muscle fatigue .

The Cross training is a training program which was designed to introduce a lot of variables in the training program , the program helps achieve great improvements at the levels of endurance for a long or a short duration and some of the physical abilities as flexibility , fitness and muscle strength , each of them helps improving the professional performance of the professional athletic activity . (Moran ; Meglynn 1997 & Raul 2005) Therefore , the importance of the research and the problem under discussion are underscored , though the researchers attempt to design a training program using Cross training for improving the professional athletic abilities (muscle power of legs and arms – transition speed – accuracy – circulatory-respiratory endurance – agility) and finding its effect on biochemical variables (Beta endorphin – lactic acid –lactate dehydrogenase) of under 18 year basketball players . The researchers assume that Cross training has positive effect on some physical abilities and also on some chemical variables of under 18 year basketball players .

Methods :

Subjects :

Non-random sampling method was used for selecting the subject from under 18 basketball players of Qatar national team during year 2012/2013 training season ,(8) under (18) basketball players as a core subject (one group) , other (8) under (18) basketball players were selected from the same society of the research as an exploratory subject which is outside the core subject , for confirmation of the scientific factors (credibility and stability) for the tests under discussion .

The moderated distribution of the core subject individuals was counted according to physical and biochemical variables under discussion besides growth rates , as listed in schedules no. 1 , 2 .

**Table 1.The moderated distribution of the subject according to growth rates
(age- length-weight – age of training)**

variables	Unit of measure	Mean	Standard deviation	Mediation	Skewness
age	year	16.90	0.64	16.70	0.94
Body total length	cm	184.50	5.21	182.50	1.15
weight	kg	75.00	4.86	73.50	0.93
Age of training	year	5.70	0.55	5.60	0.55

Values of the subject skewness for growth rates (age- body total length- weight – age of training) range between (1.15-0.55) that it is limited in (± 3) , this refers to the moderation of core sample individuals distribution according to the variables .

Table 2.The moderated distribution of the subject according to the physical and biochemical variables under discussion

Variables	Unit of measure	Mean	Standard deviation	Mediation	Skewness
Muscle power of legs	Cm	39.50	4.27	38.00	1.05
Muscle power of arms	Meter	4.15	0.63	3.95	0.95
Transition speed	Second	4.73	0.38	4.62	0.87
Accuracy	Degree	10.10	1.96	9.50	0.92
circulatory-respiratory endurance .	Degree	15.00	3.59	13.50	1.25
agility	Second	7.11	1.27	6.83	0.66
Beta endorphin	Picomole /liter	9.89	0.24	9.82	0.88
Lactic acid	Mmol/liter	5.74	0.11	5.71	0.82
lactate dehydrogenase	Unit/liter	593.38	21.75	588.92	0.62

Values of the subject skewness for physical and biochemical variables range between (1.25 - 0.62) that it is limited in (± 3) , this refers to the moderation of core sample individuals distribution according to the variables .

Experimental design

Experimental design was used for one group with pre and post measurement , after defining the most important special physical abilities for basketball players , the most important tests which evaluate the under discussion physical abilities are attached according to the opinions of experts :

Table 3. The percentages of the special physical abilities for basketball players according to the opinions of experts

The physical abilities	Number of the concurring opinions	percentages
Muscle power of legs	5	100%
Muscle power of arms	5	100%
Coordination	3	60%
agility	4	80%
Transition speed	5	100%
Accuracy	5	100%
Balance	3	60%
circulatory-respiratory endurance .	4	80%
Flexibility	3	60%
Right / left grip strength	2	40%

As in Table no.3 , the opinions of experts about the special physical abilities of basketball players were limited between (40.0 – 100 %) , the researcher defined the percentage of 80% or above for the most important abilities , so the following physical abilities were defined (the muscle power of legs and arms – transition speed – accuracy – circulatory-respiratory endurance – agility) .

The tests which measure the most important physical abilities according to references and the opinions of experts

The test of the Vertical jump from rest .

The test of spiking 3 kilogram medical ball.

The test of 30 meter from the beginning .

Shooting the ball in the basket inside the crossing rectangles .

Carlson fatigue curve test for measuring circulatory-respiratory endurance .

Parrou 3 x 4.75 meter agility test .

The biochemical measurements under discussion A (3) cm³ blood sample was taken from each individual of the subject individuals , after performing the first training unit

in the training program suggested by a medical analysis specialist , from Antecubital vein using sterile plastic injections (one use only) , 6 cm³ was taken from each player during applying the pre and post measurement .

This is for measuring the concentration of Beta endorphin , Lactic acid and lactate dehydrogenase in blood by a medical analysis specialist in a genetics lab . Centifuge 3000 cycle / minute was used to isolating plasma , gamma counter was used to measure beta endorphin in blood , Spectro photometer enzymes and blood lactate analyzer was also used .

the scientific factors (credibility and stability) for the tests under discussion .

first : credibility factor :

credibility of differentiation was measured through applying the physical tests under discussion on the exploratory subject including (8) under 16 basketball players (undistinguished group) which consists of 8 players , the differences significance was measured between the distinguished group and other group , as in Table 4

Table 4. the differences significance between the distinguished group and the undistinguished group for the physical variables under discussion

tests	Unit of measure	Distinguished group		Undistinguished group		"t" value
		mean	St.dev.	mean	St.dev.	
Vertical jump from rest	cm	39.19	3.72	34.88	3.21	2.63*
spiking 3 kilogram medical ball	Meter	4.00	0.46	3.55	0.30	2.49*
Running 30 meter from the beginning	Second	4.69	0.31	5.25	0.38	3.52*
Accuracy	Degree	10.40	1.43	8.60	1.26	2.86*
Carlson fatigue curve	degree	15.10	2.68	18.50	2.41	2.81*
parrou agility	second	7.08	0.52	7.62	0.44	2.36*

*refers to level no 0.05 "t" value in the Table on 0.05 = 2.101 N= 8

As in Table 4 , there are differences with a statistical significance on level 0.05 between the distinguished and the undistinguished group , for the good of the distinguished group in the physical tests under discussion , the thing which refers to the credibility of the tests used in the research .

Second: the stability factor :

The stability factor of the physical tests under discussion with using the way of applying the test , then the test has to be applied again on the exploratory subject individuals after 3 days , as in Table 5

Table 5. Stability factor of the physical tests under discussion

tests	Unit of measure	Distinguished group		Undistinguished group		"R" value
		mean	St.dev	mean	St.dev	
Vertical jump from rest	cm	39.19	3.72	40.00	3.51	0.796*
spiking 3 kilogram medical ball	Meter	4.00	0.46	3.95	0.37	0.831*
Running 30 meter from the beginning	Second	4.69	0.31	4.61	0.29	0.902*
Accuracy	Degree	10.40	1.43	10.50	1.57	0.896*
Carlson fatigue curve	degree	15.10	2.68	14.80	3.25	0.853*
Parrou agility	second	7.08	0.52	6.91	0.46	0.899*

*refers to level no 0.05 "R" value in the Table on 0.05 = 0.632 N= 8

As in Table no. 5 , all the counted correlation coefficient values were higher than the correlation coefficient in schedules on level no.0.05 , the thing which refers to the stability of the physical tests under discussion .

Experimental sessions

The training program content was divided into three main parts as in Table 6

Table 6. The three main parts of the suggested training program

part	Number of units	Type of level	time of the main part	Endurance	Relaxation	Cross training done exercises
General preparation	8	Physical preparation	65 min	Medium	stable	Weight training – volleyball - basketball
		Technical preparation	25 min			
Special preparation	8	Physical preparation	40 min	Higher than medium	stable	Weight training – swimming pool - basketball
		Technical preparation	50 min			
Pre - competition	16	Physical preparation	25 min	Less than the highest	stable	Weight training swimming pool – basketball
		Technical preparation	65 min			

The daily training unit parts :

Physical warm up : The time of this part is 15 minutes done by the individuals of the research core subject , for warming the respiratory and circulatory systems of the body with concentration on stretching and flexibility exercises .

The main part : The time of the main part is (90) minutes , the individuals of the research core subject do the exercises of the cross training for improving the special physical abilities , it also includes a group of skills exercises for keeping the technical performance level .

The end (calm down) : The time of this part is (5) minutes and it is done by all the individuals of the research core subject , this includes relaxation inside water , calm down exercise and light stretching .

Statistical analysis : The following statistical techniques were used for statistical analysis of data : Mean - Standard Deviation – Mediation – Skewness - Correlation coefficients – T. Test - Progress Rations

Results:

Table 7. The significance of the differences between the pre measurement and the post measurement for the individuals of the research subject according to the physical variables under discussion

variables	Unit of measure	The pre measurement mean	St.dev	The post measurement mean	St.dev	"T" value
Muscle power of legs	Cm	39.50	4.27	44.33	3.69	2.94*
Muscle power of arms	Meter	4.15	0.63	4.90	0.45	3.51*
Transition speed	second	4.73	0.38	4.21	0.29	3.74*
Accuracy	degree	10.10	1.96	12.00	1.42	2.92*
circulatory-respiratory endurance	Degree	15.00	3.59	11.80	2.57	2.59
agility	second	7.11	1.27	6.27	0.94	2.33*

*refers to level no 0.05 "T" value in the Table on 0.05 = 2.262 N= 8

As in Table 7 , there are differences with a statistical significance on the level of 0.05 between the pre measurement and the post measurement for the individuals of the core subject on the basis of the physical variables (the muscle power of arms and legs- transition speed – accuracy - circulatory-respiratory endurance- agility) , the post measurement was better than the pre measurement .

Table 8. The rate of improvement according to the difference between the pre measurement and the post measurement for the individuals of the subject on the basis of the physical variables under discussion

variables	Unit of measure	pre	Subject post	Rate of improvement
Muscle power of legs	Cm	39.50	44.33	12.23%
Muscle power of arms	Meter	4.15	4.90	18.07%
Transition speed	second	4.73	4.21	12.35%
Accuracy	degree	10.10	12.00	18.81%
circulatory-respiratory endurance	Degree	15.00	11.80	27.12%
agility	second	7.11	6.27	13.39

As in Table 8. there is a rate of improvement that the post measurement is better than the post measurement for the subject individuals on the basis of the physical variables under discussion ranges between (12.23%-27.12%) .

Table 9. The significance of the differences between the pre measurement and the post measurement for the subject individuals on the basis of the biochemical variables under discussion

Variables	Unit of measure	Pre test		Post test		"T" value
		mean	St.dev	mean	St.dev	
Beta endorphin	P /liter	9.89	0.24	9.31	0.19	6.17*
Lactic acid	M/liter	5.74	0.11	5.46	0.10	5.94*
lactate dehydrogenase	Unit/liter	593.38	21.75	567.51	18.63	3.38*

*refers to level no 0.05 "T" value in the Table on 0.05 = 2.262 N= 8

As in Table 9 . there are differences with a statistical significance on the level of 0.05 between the pre measurement and the post measurement of the core subject individuals for the biochemical variables (Beta endorphin – lactic acid - lactate dehydrogenase), the post measurement is better than the pre measurement.

Table 10. The under discussion biochemical variables improvement rates of the post measurement than the post measurement for the core subject individuals

variables	Unit of measure	Subject		
		pre	post	Improvement rates
Beta endorphin	P /liter	9.89	9.31	6.23%
Lactic acid	M/liter	5.74	5.46	5.13%
lactate dehydrogenase	U/liter	593.38	567.51	4.56%

As in Table no.10 , there are improvement rates for the post measurement than the pre measurement happened to the core subject individuals according to the biochemical variables under discussion , the improvement rates range between (4.56%-6.32%) ,that the post measurement was better than the pre measurement .

Discussion :

The results in Table no.7 refer to differences with a statistical significance on the level of 0.05 between the pre measurement and the post measurement of the core subject individuals according to the physical variables (the muscle power of legs and arms – transition speed – accuracy - circulatory-respiratory endurance – agility) for the post measurement (the post measurement is better than the pre measurement).

As in Table no.8 , there are rates of improvement of the core subject individuals for the post measurement than the pre measurement according to the physical variables under discussion which range between (12.23%-27.12%) .

The researcher found that the reason of the improvement of the physical abilities (the muscle power of legs and arms – transition speed – accuracy - circulatory-respiratory endurance – agility) for the core subject individuals was the effectiveness of the cross training program content including weight trainings for arms , legs and the trunk of the body which aims to build strong muscles , this finding is consistent with the research results of (Mohamed Hassan Mohamed, 2002; Kassey

, et ., al ,2003 ; Mohamed Hamed Shaddad ,2006 ; Maha Mohamed Al-Hagrasy ,2007 ; Yasser Mohamed Hagar, 2007 ; Mohmoud Al-Hofy & Ahmed Amin Al-Shafay , 2008 ; Yasser Othman Mohamed 2009 ; Rabea Othman Al-Hadedy 2011 ; Hamdy El-Sayed Al-Nawasry ,2012 ; Mohamed Abd Al-Mawgod Al-Sayed ,2012, about the importance of the exercises and programs of Cross training for improving the various physical abilities of athletes .

This finding is in consistent with what was mentioned by Eric & Linda (2002) , Zaky Mohamed Hassan (2004) that Cross training is most important for improving the level of fitness components through Cross training exercises as swimming , bikes , running , water walking , going up a ramp and blasphemy , this is not true to do an exercise instead of another in the training Table , it is considered an athletic performance-enhancing way for building muscles , coordination , balance, speed and the explosive force .

Jack Wilmore et., al added that Cross training is to train using more than one sport in the same time or to train the various elements of fitness as endurance , strength and flexibility in the same time , that players are trained doing exercises as weight , ballistic exercises , swimming , running and bikes to be prepared for athletic competitions .

The preceding shows that Cross training has a positive effect on some physical abilities (muscle power of legs and arms – transition speed – accuracy – circulatory-respiratory endurance .– agility) for under 18 basketball players .

This was shown through the results of Table no.9 which refer to differences with a statistical significance on the level of 0.05 between the pre and post measurements on the basis of the biochemical variables for the post measurement (Beta endorphin – lactic acid –lactate dehydrogenase) .

The results in Table no.10 showed that there are improvement rates of the post measurement than the pre measurement according to the biochemical variables under discussion (4,56%-6,23 %) for the post measurement .

The researchers found that the reason of the low level of Beta endorphin in blood is the positive effect of doing the exercises of the Cross training , this was also the reason of the improvement of the physical abilities (muscle power of legs and arms – transition speed – accuracy – circulatory-respiratory endurance – agility) , this contributed to delay the signs of fatigue for basketball players , therefore the level of Beta endorphin -which is related to fatigue and stress- becomes lower.

This result is consistent with what was referred by Wilson (2001) that the Cross training contributes positively to improve the physical abilities in the form of the muscle strength , circulatory-respiratory endurance , speed and agility , it also works on improving the physiological sides of the athletic performance .

This result is also consistent with the results of the research of Mohamed Hassan Mohamed ,2002 ; Mohamed Abd Al-Mawgod El Sayed , 2012. about the effectiveness of Cross training programs for improving the functional different abilities of athletes .

Improvement to the elimination of Lactic acid , the thing which led to the improvement of the functional state which affected on lowering the level of Lactic acid concentration in blood positively for the subject individuals , in addition to the increased efficiency of lactate dehydrogenase enzyme which converts lactic acid into Pyruvic acid , so the basketball players obtain the ability of muscle fatigue resistance .

This is also consistent with the results of the research of Sahar Mohamed Gohar (2004) that the improvement of some physical abilities (speed endurance) led to decrease Beta endorphin hormone secretion average and the concentration of lactic acid in blood , in addition to increasing the efficiency of lactate dehydrogenase .

In this regard , Sawaka , et.,al (2004) refers to that the low concentration of Lactic acid in blood is a significance of the improvement of the functional state of athletes and their ability of physical endurance .

The preceding shows that the use of the Cross training has a positive effect on some biochemical variables (Beta endorphin – lactic acid –lactate dehydrogenase) for under 18 basketball players .

Conclusion :

The present study shows that the Cross training has a positive effect with a statistical significance at the level of 0.05 for the physical abilities (muscle power of legs and arms – transition speed – accuracy – circulatory-respiratory endurance – agility)of under 18 basketball players . An improvement of the physical abilities (under discussion) was happened to the under 18 basketball players with a percentage ranges between (12.23%-27.12%).

Besides that Cross training has a positive effect with a statistical significance also at the level of 0.05 on the biochemical variables (Beta endorphin – lactic acid –lactate dehydrogenase) for under 18 basketball players and an improvement of the biochemical variables (under discussion) with a percentage ranges between (4.56%-6.23%).

References:

- Abo El -Ela Ahmed Abd-Al Fattah (1999) : Hospitalization in the sports field – Dar Al Fekr Al Araby-Cairo,52 .
- Brad Walker(2007): The anatomy of sports injuries, North Atlantic Books, U.S.A,28.
- Dill, D., & Adams, W., (1981): Maximal oxygen uptake at scound level and in high school champion Runners, Journal of Apple. Physiology. Vol, 55•159.
- Edjacoboy , A. (1997) : Applied Techniques in Track and field, Leisure Press, New York , 37.

- Eric Small & Linda Spear(2002):Kids & sports: everything you and your child need to know about sports , New market Press, , U.S.A , 39.
- Gold Farb,et.,al.(1995):Response to Intensity and duration of Exercise,Med.,Science Sports,357.
- Hamdy El- Sayed Abd -Al Hameed (2012) : the effect of the Cross training on the special physical abilities and the digital level of the junior long jump players " Master's – Physical Education faculty in Demyat , Mansoura university.
- Jack Wilmore,et.,al.(2008): Physiology of sport and exercise , 4 ed , Human Kinetics, , U.S.A , 284.
- Jones,K.,(2000):Human Biochemistry,London, 172.
- Kassey, k., (2003):. Uuse cross training to development of concentric and eccentric strength difference of division in the lead and back leg. College level fencers, master theses, university of north California Chapel Hill.
- Librman & Cline (1996) Basketball for Women , Human Kinetics,29 .
- Mohamed Al-Hagrasy (2007) : The influence of a suggested Cross training program on some physical abilities and skills of volleyball female juniors , PhD . Physical Education faculty , Menia university
- Mahmoud Hassan Al-Hofy , Ahmed Amin Al-Shafaey (2008): Using of Cross training for improving the muscular balance for football players , the third International scientific conference , Physical Education faculty for girls , Zagazig university .
- Marcus,B.,(1996) :Basketball Basics, Contem Porary Books, 98.
- Mohamed Abd Al-Mawgod El-Sayed (2012): The influence of Cross training on some physical variables and the blood components for 400 meter runners , Sciences and arts of sports gazette , volume no.41 , Physical Education for girls , Helwan university .
- Mohamed Hamed Shaddad (2006): "The influence of Cross training during the transitional stage on the improvement of the physical performance of Judo players " , Theories and applications gazette , number (59) , Physical Education faculty for young men , University of Alexandria .
- Mohamed Hassan Mohamed (2002): Using Cross training for improving the muscle strength of junior swimmers and its influence on digital achievement , PhD , Physical Education faculty for young men , university of Alexandria ,30-34.
- Moran, T., & Mcglynn, H., (1997): Cross Training for Sports, Human Kinetics Books, San Francisco, U.S.A,30.
- Rabea Othman Al Hadedy (2011) : Cross training efficiency for some physical abilities , psychological endurance and the level of long jump sport performance " Physical Education researches gazette , volume no.45 , number .85, Physical Education faculty for young men ,Zagazig university .
- Raul, g.,(2005): Cross training For Endurance Athletes Building, Stability. Balance and Strength ,Peak Sports Press. Boulder, CO, Colorado, , U.S.A,132.
- Saad Kamal Taha , Ibrahim Yehya Khalil (2004) : The series of physiology basics , second part , Al Saada office , Cairo,89.

- Sahar Mohamed Gohar (2004) : "The effect of a suggested training program for improving endurance on of handball female players " sciences and arts of sports , volume no.20 , Number : 1 , Physical Education for girls , Helwan university .
- Sawka, M., Knowlton,R., & Miles, P., (2004): Competition Blood lactate concentration in collegiate swimmers Eur., Journal of Appl. Physiology, Vol. 62 ,99.
- Werner, W., & Sharon, A., (2011): Lifetime Physical Fitness and Wellness: A Personalized Program Cengage Learning 2ed, USA, 292.
- Wilson., (2001): Plyometric www.onlinesports.org/tw/new/plyos.htm ,36 .
- Wissl (1995): Basketball ,human kinetics , U.S.A. p35
- Yasser Mohamed Hagar (2007) : The influence of using Cross training on the efficiency of the attack performance of swordplay , PhD, Physical Education faculty for young men , university of Alexandria .
- Yasser Othman Mohamed (2009): the influence of using Cross training style on the physical abilities and skills of junior football players , Master's , Physical Education faculty for young men , Helwan university .
- Zaky Mohamed Hassan (2004) : Cross training is a recent trend for athletic training , Al Maktaba Al Masrya , Alexandria , 4-22.