Effect of using Trampoline on the development of functional efficiency of the vestibular apparatus on composite balance for One and Half Forward Somersault pike in diving sport

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Performance of diving player and its mastery are based on the player's enjoyment of high level of physical skills. The key physical skills include balance whether dynamic or motor balance that diving player always needs during the different phases of diving whether in the state of readiness, approach, jumping over stairs or in the phase of flying and breaking into water. (14:100)

When Trampoline was used in modern diving training as educational means of diving system, it is very important to the different skills in diving. Through it, many exercises and movements can be performed in flying. Concerning fall, it is one of the key means that maintain the element of danger when body meets the soft surface and controls the types of fall. (57:31)

Some specialists in diving add that trampoline fosters the development of some special physical characteristics such as agility, symmetry and balance, in addition to learning juniors on how to keep the proper position of his body while on air. It shall be combined with mental concept before performance of the different skills. (59:22) (46:158) (31:9-22)

Abu El Ela Abdelfattah and Mohamed Sobhy Hassanein (1997 AD) believe that the vestibular system plays a key role in some sports activities distinguished with complicated technical skills where player loses his relation to land. Importance of balance in physiological terms appears and lies in the development of nervous adjustment and training of the systems of restoration of balance in the high channels in the central ears which by itself is reflected on the performance of most movements where player loses his confidence in the diving stairs. Ability of sportsman to feel body directions, movements and positions in space in the surrounding space and maintaining his balance and all types of movements and rotations require specific type of balance. (1:169) (29:41) (29:63)

Balance is affected by gravity. Its importance is not attributed only to prevention of body fall or restoration of balance after losing it; it is also attributed to the fact that it helps player to achieve muscular efficiency and control of directions and movements. (49:38)

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During performance of his different movements in diving, diving player shall maintain balance. It is certain that body doesn't become in state of balance unless all internal and external forces that affect it are equal. (49:64)

Therefore, the forms of balance vary by the capacities and conditions where body exists either in case of stability or movement. Scientists defined the factors that affect balance, including the visual, physical, vestibular and central nervous system. Purposeful dynamic performance in different activities relies on the efficiency of these physiological factors, and their important role appears in particular when there is need to achieve accurate dynamic balance and indication of body position in space, and when there is need to resist gravity. (62:48)

Due to the nature of some requirements of one and half forward somersault pike skill, figure (1), where player loses his relation to the diving stair, the nervous and sensory systems that control the body during the phases of skill in space have critical role in direction of body movement. The individual's perception of his movement in air will be achieved by the information transmitted by these sensory systems. (50:102, 103)

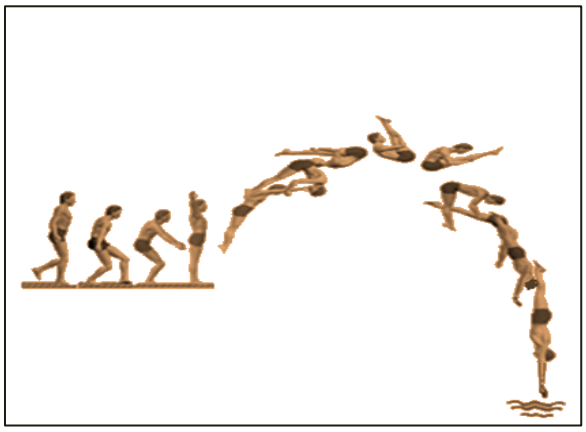


Figure (1)

Technical performance of One and Half Forward Somersault pike

Ehsan Sharaf and Kamal Mera (1995 AD) note that ability of constant or dynamic balance relies on the efficiency of vestibular system in the

internal ears, and the sensorimotor centers in muscles, tendons and joints, so feeling of composite balance relies on (vestibular apparatus) in the internal ears which consists of Utricle and Saccule and semicircular canals. Body balance in space is maintained through the movement of internal lymphatic fluid in the utricle and the semicircular channels of the vestibular system. If head moved or changed its position for the body, this would be followed by change of directions of movement of this fluid, which results in alert of the sensory nervous receptors in the utricle and semicircular canals through the sensory system of the cortex and cerebellum, then to the motor nerves. Therefore, man perceives the position of head for the body that directly responds to these alerts in the way that leads to maintenance of balance in the new position in space. (18:305)

The vestibular system is responsible for giving information to the central nervous system on the distinguished speed and inclination and deviation of the body as well as helping in the visual direction by control of eye muscles, and support of the position that controls the tone of skeletal muscles and maintenance of body position in stability, movement and full control of the organic systems in the muscular and nervous terms without exposure to fall in water (41:413) (12: 42) (28:10).

In this respect, vestibular feeling appears in compound form with other senses, which achieves the individual's feeling of body position in air, particularly in the compound rotation and air skills like the skill under research.(56:51) (26:114)

The role of vestibular system is very important in the sports activities, particularly the activities distinguished with complicated technical sports skills as in the sports of diving. The player's ability to feel body directions, movements and positions in the surrounding space and maintenance is related to body balance. (1:169)

When the vestibular system suffers disorders, gymnasium player appears in state of imbalance, including involuntary fast oscillation (nystagus). Disorders often result from rotation movements as in the skill under research, which is similar to the diving player, so balance of this movement is very difficult, and player loses control of his movements and body. This results in reduction of skill efficiency and lost of aesthetic form of skill. Therefore, the player loses parts of the specific points of skills. (58:201) (1:196)

Accordingly, specialists turned to divide balance as follows:

- Regular balance where the form of balance doesn't change, but is classified in accordance with the trunk position and support leg

which is either vertical, front, side and back. This type is related to body connection with the jumping stairs.

- Composite balance in which the form of balance changes for the trunk position or free leg position or both of them. In both cases, leg can't change its position, but can perform slight movement by change between lifting the two heels or by flexing and extending the knee of pivot leg. This type is related to the player's loss of connection to the jumping stairs. (15:130)(22 : 214)

In addition, the level in development of composite balance allows the player to possibly master the complicated technical sides for the types of motor skills, and their easy and smooth performance. In addition, no success in sport can be achieved without growth of the functional side of composite balance in the individual. (8:420)

Alert of external ear receptors by continuous training leads to changes in functional physiology, which affects the motor control and direction in terms of time, space and accurate determination of the muscular effort to maintain balance. (56:36)

Training regulated as rated regular training program and performed in short range of time leads to functional adaptation of the vestibular system that controls the composite balance (stability – movement) in space (19:78) (37:416).

Diving is one of the sports that require high capacities in skill performance, as it is distinguished with particular nature. It contains many skills that are different in their requirements from each other. (47:7)

One and half forward somersault pike skill is one of the combined tracks that require connection of the motor track between the body parts that participate in movement to position the muscles and joints that work on them, so that muscular flexion produces high impetus consistent with the motor track without falling in different track to the one to be collected from force sources that affect the force yield of the working muscle group. (52: 214- 216) (21:13)

The player's enjoyment of sufficient degree of motor balance leads to economization of the effort required when that skill is performed at high skill performance. If the composite balance doesn't directly affect the successful skill performance of such skill, the player's failure to have such physical characteristic will indirectly lead to unrated and poor performance. (35:7)

Tony (1982) indicates that player's existence in air for relatively long period of time constitutes one of the important factors for development and

increase of difficulty of the skills taught to players as player needs composite balance to proficiently perform this skill. (54:32)

Diving experts agreed that work on diving systems requires special physical characteristics of the player represented in (ability, force, flexibility, speed and balance), and these characteristics are among the cornerstones of development of motor performance in diving.

Mohamed Hassan Allawy (1994) confirms that combination of muscular force and motor speed and composite balance is one of the requirements of successful sports performance in the high levels and that this is the key characteristic of superior sportsmen. They have large deal of force and balance, and ability to combine them in integrated form to create the strong fast movement for achievement of superior performance. (40:97)

Objectives of the research:

This research aims at identifying:

1. Effect of proposed training program using trampoline for the development of functional efficiency of the vestibular system on composite balance.
2. Effect of proposed training program using trampoline for development of functional efficiency of the vestibular system and improvement of the skill performance of the one and half forward somersault pike skill.

Hypotheses of the research:

1. The proposed training program using trampoline positively affects the development of functional efficiency of the vestibular system on the composite balance.
2. The proposed training program using trampoline positively affects the development of functional efficiency of the vestibular system on the improvement of the one and half forward somersault pike skill.

Terms:

Functional efficiency:

Ability of organ to perform work more than ordinary at the lowest effort for longer period and ability of speedy recovery after stop of work. (48:211)

Vestibular apparatus:

One of the vital systems in the body and one of the internal ear parts. It consists of three semicircular canals. The vestibule that consists of utricle

and succle. It is primarily responsible for maintaining balance in the body space. (27:516)

Composite balance:

The degree of balance calculated from the individual body fluctuation through the six test conditions of senses, referred to as “G. Composite” (56:373)

Research procedures:

Research methodology:

The two researchers used the experimental methodology because it is suitable to the nature of the research. The two researchers applied one of the experimental applications, the experimental design of the same group using the pre-post measurement of the same group.

Fields of the research:

Human field:

Male players under 11, 12 and 13 years of Sporting Club, Semouha Club and the Sports Foundation in Alexandria.

Geographic Field:

Hall of Alexandria Sports Club (Sporting) because it has the requirements of the experiment, including the systems and tools because all members of the sample are in Sporting Club because the training center of Alexandria Team under supervision of the Egyptian Diving Federation.

Time field:

Sports season of 2014 and 2015 AD for the competitions of the Republic Championship.

Research Sample:

The research sample was chosen by the purposeful method of players under 11, 12 and 13 years of males because of selected skill is within the mandatory requirements of the technical committee that was created by the Egyptian Diving Federation for the sports season 2014/2015. The sample included (23) players divided as follows:

- 9 players under 11 - 8 players under 12 - 6 players under 13

Three players were chosen for reasons that varied between injury and repeated absence, so the sample of the research became (20) players. Pilot sample of (10) players was taken to conduct the pilot study on them, so the n umber of the main research sample became (10) players.

Experimental design of the same group was conducted using the pre-post measurement of the same group.

- The researcher found consistency of the research sample in all variables, attachment (1)

Skewedness coefficients appeared to be close to zero, and oblation coefficients between (±3), which indicates the fair values and consistency of the members of the sample in all variables under research. The sample members of diving players.

Data collection tools: These tools are divided as follows:

First: Tools and instruments applied in the research: attachment (2)

- Restameter system for measurement of length
- Medical scale
- Trampoline connected to the hole and another small one
- Test of the sense system using the balance measurement system (Equi test system)
- Digital dynamometer for measurement of muscular power (Nicholas Manual Muscle Tester) of the composite flexor muscle of pronation position, and for the knee exterior muscles from the high sitting position and the two legs.
- Balance measurement system MFT 1.7 system for the two legs combined, and for each leg singly in the two pivots in front, back, right and left. After test, the system gives final score of each test with maximum five marks (lack of balance).

Second: Applicable physical tests: Attachment (3)

Third: Evaluation of Skill Performance:

The players the sample of the research were shot by video camera and the video tape was sent to six approved examiners of international and first division referees in the records of the Egyptian Diving Federation to evaluate the skill performance of players. The researchers divided the skill into basic phases after review of scientific references in diving. The phases were divided as follows (development phase, flying and rotation, fall into water). Each phase of performance was assigned part of overall degree. Therefore, evaluation of this skill is based on the technical and formal performance and combination of both, so the degree was distributed as indicated in table (1).

Table (1) distribution of scores of evaluation of the one and half forward somersault pike skill

Phases	Technical performance	Formal performance	Combination	Partitioning of skill
Development	1.00	--	--	
Flying and rotation for performance of the semicircular cycle, front half air and curve cycle	5.00	1.00	--	
Fall in water	1.00	1.00	1.00	
Total	7.00	2.00	1.00	10

Pilot studies:

First pilot study attachment (4)

- Identification of the validity of systems and devices used in the research.
- Assurance of reliability and credibility

Second pilot study attachment (5)

The researchers conducted the second pilot study from 26/08/2014 to 30/08/2014 to the pilot sample members to identify:

- The maximum repetitions of trainings used in the proposed training program.
- The groups of repetitions of each exercise separately.
- Time of performance of each exercise in the training module.
- Determination of the starting dose of each exercise based on the results of pilot study, and the gradual progress in increase of the number of repetitions using the following equation:

$$\frac{(\text{Maximum Repetition} + 1)}{2} \quad \text{Or} \quad \frac{(\text{Maximum Repetition} + 2)}{2}$$

- Overall time of exercises applied in training module

Proposed training program: attachment (6)

After review of the specialized scientific references and research such as: Mohamed Othman (1990 AD) (37:528-530); Zaki Darwish and Ali Abdelhafez (1994 AD) (61:114, 115); Mohamed Shehata (1985) (1992 AD) (41:135) (42:66); Hazem Hassan Mahmoud (30:7-8); Saeed Sallam et al (1991 AD) (50: 85-95); Mohamed Hassan Allawy and Abu El Ela Abdelfattah (1984 AD) (38); Ehab Mohamed Al-Sadek (2001) (17); Adly Hassan Bayoumi(1998 AD) (4 : 84-120) ; Fathy Mohamed Ibrahim (1991 AD) (24); Yahia Zakaria and Ahmed Mahmoud (1993) (58); Usama Abu Tabl (2003 AD) (55); Burksman Othman and Amal Sayed Morsi (2000 AD) (13); Khaled Sadek (2000 AD) (34) Ahmed Fouad Al-Shazly(6)(7); and Ahmed Al-Aqqad (2003 AD) (9), the researchers managed to determine the following points to set the proposed training program:

- Using the results of pilot studies and pre measurement under research as a reference, in relation to the determination of training doses and time of its units and overall time of the program.
- Following the principle of gradual motor performance of the proposed exercises from the easy to the difficulty and from the simple to the composite.
- Following the availability of safety and security factors during the implementation of the program modules.
- Following the principle of diversity of means of development of job efficiency of vestibular system using the free exercises and ancillary systems.
- The proposed training program included package of different exercises implemented on the different axes of the body (cross, vertical, arrow) with high rhythm.
- The load intensity was determined based on the number of frequencies of each exercise in the proposed training program.
- Use of the periodic training method in its two sides of high and low intensity during the program units because of its advantages that are in line with the objectives and nature of the research.

Hanafy Mukhtar (1998) and Adel Abdelbassir (1999) add some precautions that shall be considered on implementation of the training program as follows:

- Graded load of training
- Application of the principle of continuity in training

- Avoiding non-investigated acceleration of implementation
- Consideration of loads before starting the main part. (29:11) (3:87)

The researchers presented the content of training program to experts in the field of diving, sports physiology and sports training (attachment 7) to make benefit of their opinions in choice of the suitable exercises and the suitable training component (intensity, volume, frequency, breaks) and the applied training method as indicated in detail in attachment (6). According to the above, the content of training program was defined as follows:

- The period of time for application of the proposed training program for (8) eight weeks.
- Time of daily training module (55:70) minutes
- Number of training modules per week (5)
- Table of time distribution of the program (attachment 8)
- Content of the proposed training program using trampoline for development of the functional efficiency of vestibular system and the composite balance in the members of the sample as indicated in attachment (6)

Division of the parts of the daily training module:

Ali Al Bek (1995) divided the parts of the daily training module into three main parts as follows:

1- Warming up

This aims at preparing the player's body to admit the effort that will be made during the main part of the training module. It is divided into:

- General warm up: To raise readiness degree and body systems in general in the daily training module.

- Special warm up: To prepare the player physically, technically, functionally and mentally to the effort expected in the main part of the module. The researchers defined the general and special warm up time to (20) minutes.

2- Main Part:

This part of the training module contains the exercises that achieve the purpose of module and contribute to development of the player's training condition. It time is approximately 75%: 85% of the module time. It is preferred to start with the exercises that need high effort in the first main part. The time of the main part is (30:45) minutes.

3- Final Part:

This part aims at restoring the player to the normal condition as much as possible. Exercises of this part shall help remove tiredness, revive the players and warm down their biological systems. The researchers fixed the time of the final part to (5) minutes (45:85) (10:98) (43:25)

Pre measurements

Pre measurements of the research group were conducted from 01/09/2014 AD to 05/09/2014 AD.

Application of the proposed training program

Modules of the proposed training program were implemented from 07/09/2014 AD to 01/11/2014 AD to members of the sample of the research in the hall of Alexandria Sporting Club for (8) consecutive weeks.

Post measurements

Post measurements of the research group were conducted from 02/11/2014 AD to 06/11/2014 AD using the same pre measurement tests in the same order and with the same tools, devices and conditions.

Statistic treatment:

Statistic treatments suitable to the research were conducted by IBM SPSS Statistics 20 to extract the following treatments:

- Arithmetic means
- Standard deviation
- Percentage
- Skewedness coefficient
- Oblation coefficient
- “T” test of differences
- Pearson correlation coefficient “R”
- “T” test of dual views
- Analysis of variance of repeated measures
- Amount of effect

Presentation and discussion of results

Table (2) statistical significance of physical measurements and tests and vestibular system test

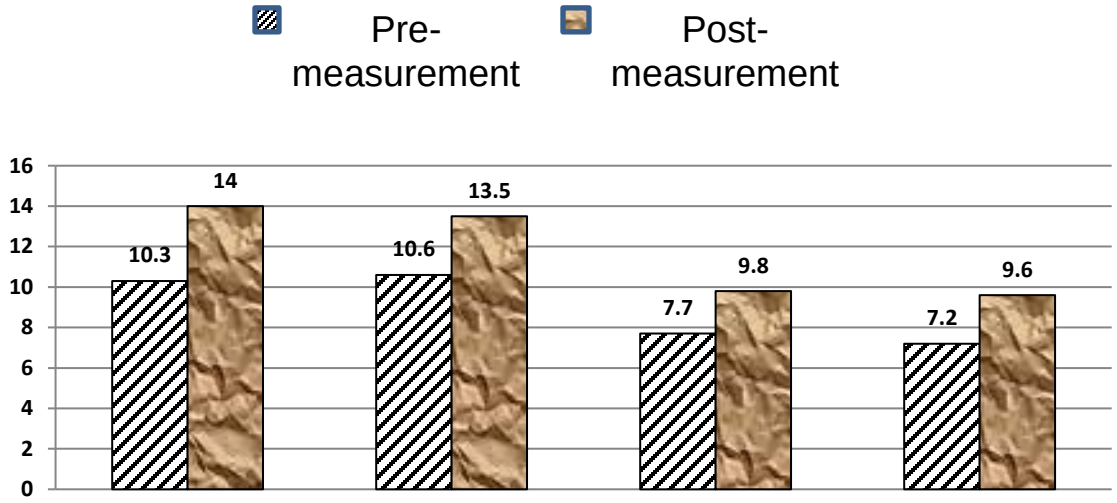
Evaluation of skill performance between the pre and post measurements (n=10)

riables	Post measurement		Pre measurement		Difference between the two	Percentage of improvement	“T” calculated value	Eff	
	S-	±A	S-	±A				Value	Si

						averages	%			
Lower back muscles		10.3	1.337	14	0.667	3.70	35.92	**10.09	3.197	
Upper back muscles		10.6	0.966	13.5	0.850	2.90	27.36	**8.33	3.182	
Lower abdomen muscles		7.7	0.823	9.8	0.632	2.10	27.27	**4.85	2.882	
Upper abdomen muscles		7.2	1.033	9.6	0.516	2.40	33.33	**6.47	2.952	
Flexor muscle	Right	14.5	1.269	20.6	0.966	6.10	42.07	**12.09	5.408	
	Left	14.8	0.789	19.7	0.823	4.90	33.11	**12.04	6.079	
Exterior muscle	Right	16.6	0.843	20.6	1.075	4.00	24.10	**7.75	4.158	
	Left	17	0.667	21.1	0.876	4.10	24.12	**11.78	5.269	
Right leg	Front	2.64	0.320	1.86	0.184	0.78	29.55	**6.22	3.017	
	Side	2.75	0.314	1.85	0.178	0.90	32.73	**6.44	3.626	
Left leg	Front	2.87	0.267	1.92	0.181	0.95	33.10	**8.82	4.180	
	Side	2.94	0.232	1.93	0.157	1.01	34.35	**9.64	5.160	
Both legs	Front	3.17	0.254	1.94	0.190	1.23	38.80	**12.43	5.481	
	Side	3.07	0.263	1.97	0.149	1.10	35.83	**12.85	5.044	
ar system test		70.3	1.681	85.25	3.349	14.95	21.27	**13.63	5.525	
ation of skill mance level		5.31	0.166	8.55	0.327	3.24	61.02	**26.92	12.579	

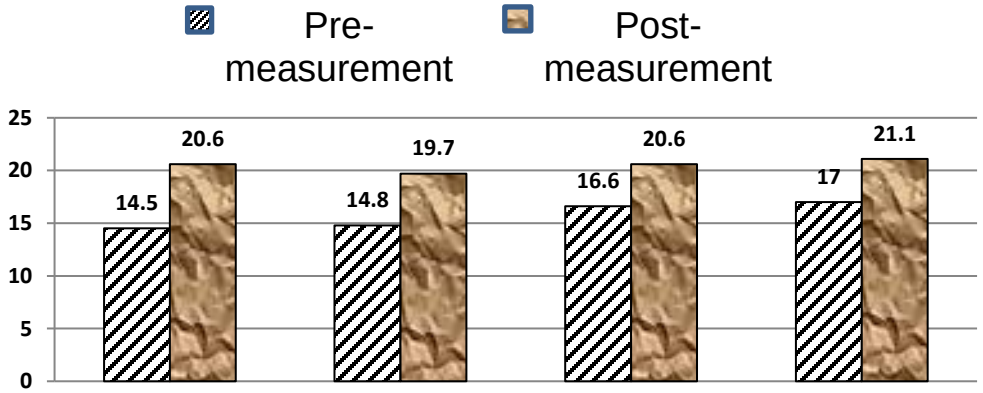
* Table significance “T” at 0.05= 2.262

Table (2) and graphs (2,3,4,5,6) on the statistic significances of physical measurements and tests and the vestibular system test as well as evaluation of the skill performance between the pre and post measurements indicates statistically significant differences in the physical measurements and tests and test of vestibular system as well as evaluation of skill performance level. The measurements of this group improved after the experiment than before it in all physical measurements and tests and the test of vestibular system and evaluation of skill performance, with statistically significant differences at 0.05. “T” value ranged between (** 4.85, ** 26.92) with improvement ratios between (21.27%, 61.02%) for the post measurement, and the effect values ranged between (2.882, 12.579) all are high values over 0.8 with high significance for the diving players.



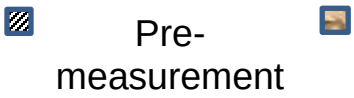
Lower back muscles	Upper back muscles	Lower abdomen muscles	Upper abdomen muscles
	Speed force		

Figure 2



Right	Left	Right	Left
Flexor knee muscles		Extensor knee muscles	
Muscle strength			

Figure 3



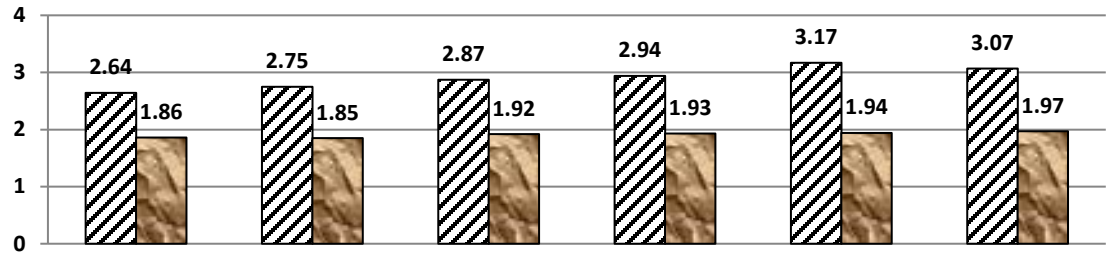
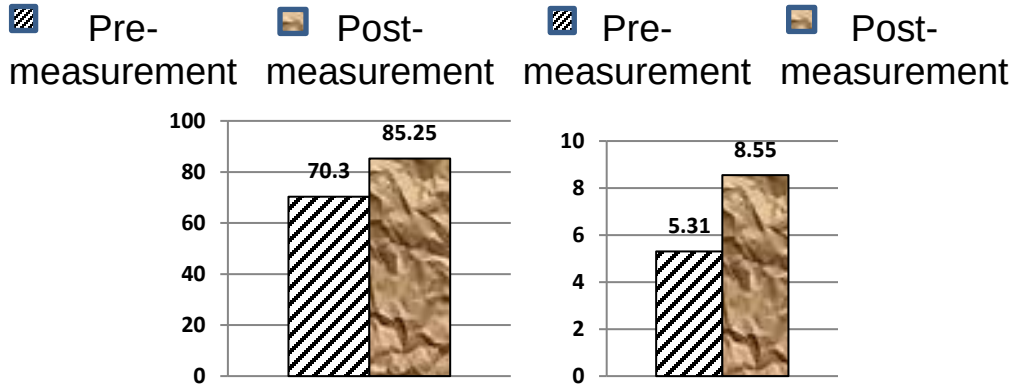


Figure 4



Evaluation of the skillful performance level

Figure 6

Vestibular system test

Figure 5

Table (3) arithmetic means and standard deviation of the frequent measurements (pre, inter, post) in the evaluation of skill performance of diving players (N= 10)

Skill	Pre measurement		Intermediate measurement		Post measurement	
	S-	±A	S-	±A	S-	±A
Evaluation of the performance of one and half forward somersault pike skill	5.31	0.166	7.07	0.736	8.55	0.327

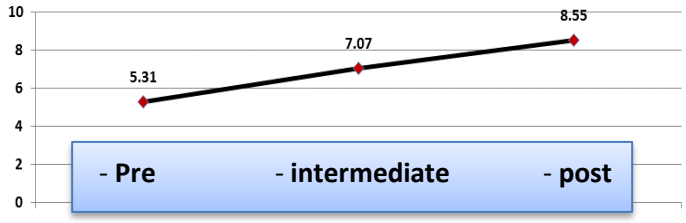


Figure (7) arithmetic means of frequent measurements (pre, intermediate, post) in the evaluation of skill performance of diving players

Table (3) and figure (7) indicate the arithmetic means of repeated (pre, intermediate, post) measurements in the evaluation of skill performance of diving players. The post measurement was the highest in value followed by the intermediate measurement.

Table (4) Variance analysis of frequent measurements (pre, intermediate, post) in the skill performance of diving players (n=10)

Measurements	Sources of variance	Statistical significance			Calculated "F" Value	Level of significance	Amount of effect "Eta2"
		Total of squares	Degree of freedom	Average squares			
Evaluation of skill performance level	Effect between measurements	52.62	2	26.309	122.64**	0.00	0.932
	Mistake of coefficient between measurements	3.86	18	0.215			
	Effect in measurements	1460.22	1	1460.2	5883.6**	0.00	0.998
	Mistake of coefficient between measurements	2.23	9	0.248			

* "F" Table value at 0.05 between measurements= 3.55 and in measurements = 5.12

Table (4) indicates significant differences in the calculated “F” value for the repeated (pre, intermediate, post) measurements in the evaluation of skill performance level of diving players. The effect of “Eta^2” between measurements was 0.932 and in measurements 0.998, which are high values that confirm the strong effect of the training program.

Table (5) value of the least significant difference (LSD) between the average (pre, intermediate, post) measurements in the skill performance level of diving players (n=10)

	Measurements		Differences of averages	Significance	Percentages of improvement %
Evaluation of skill performance level	Pre	Intermediate	*1.760	0.00	33.15
	Intermediate	Post	*1.480	0.00	20.93
	Post	Post	*3.240	0.00	61.02

*significant at 0.05

Table (5) indicates significant differences in “LSD” value of the repeated (pre, intermediate, post) measurements in the evaluation of skill performance level of diving players. Differences between the pre, intermediate and post measurements were for the favor of intermediate measurement with improvement percentage of 33.15%; the difference between pre and post measurement for the favor of post measurement with improvement percentage of 61.02% and difference between the intermediate and post measurements for the favor of post measurement with improvement percentage of 20.93%.

Tables (2,3,4,5) and graphs (2,3,4,5,6,7) on the statistical significances of physical measurements and tests of the experimental group before and after the experiment. Statistically significant differences appear in the physical measurements and tests and the vestibular system test as well as evaluation of the skill performance that included set of exercises of nature most of which is distinguished with rotational movements that lead to high speed and stimulate the vestibular system. This results in actual performance of its functional efficiency and transcendence of the different threshold level, which lead to its different positions and directions (56:119) (16:120).

The nature of balance exercises covered by the proposed training program using trampoline is dominated by rotations and change of

directions, which helps the vestibular receptor to achieve inference and direction of body position in space and improvement of supply of information to the central nervous system on the increasing and decreasing speed and angular inclination and body deviation. Therefore, high efficiency of vestibular receptor is reflected on maintenance of the current position of the body by controlling the tone of skeletal muscle. (50:2) (36:35) (51:301) (32:225).

This is attributed to the fact that the proposed training program that contained exercises of particular type using trampoline leads to different positions and directions and on the three axes of movement (horizontal, vertical, arrow) with rhythms that aim at stimulating the vestibular system, which led to adaptation and improvement of the functional efficiency of vestibular system, and therefore improvement of the dynamic level of the members of research group. This result is in line with the results of studies of: Fathy Ibrahim (1991 AD) (24); Yahia Zakaria and Ahmed Mahmoud (1993 AD) (58); Usama Abu Tabl (1995 AD) (56); Burksan Othman and Amal Sayed Morsi (2000 AD) (13); Khaled Al-Sadek (2000 AD) (34); Ehab El Sadek (2001 AD) (17); Ahmed Al-Aqqad (2003 AD) (9) and Fadya Ahmed Abdulaziz (2004 AD) (23) emphasize the importance of using specific exercises for the development of functional efficiency of vestibular system, which leads to high level of composite balance.

Regular training loads in terms of frequent and continuous performance lead to adaptation of lymphatic fluid in the crescent canals of the internal ears, so relative stability of balance happens during the performance of sudden movements of rotation and tumbling (5:78) (8:65).

Continuous training for 6-8 weeks works on the development of vestibular system efficiency, and therefore improves the transmission of information to the central nervous system for the increasing speed, and inclination and deviation of the body as well as helping the visual direction for control of eye muscles, and help maintain the current position by controlling the skeletal and special muscle tone in all phases of composite motor skills in diving (20:311) (41:413).

This result is in line with the results of Khaled Al Sadek (2000 AD) that noted that training in specific type of rotation movements leads to repeated stimulation of the lymphatic fluid of internal ears, which results in adaptation of the balance maintenance system (vestibular system) and reduction of internal ears sensitivity and its use to perform this type of movements contributes to development of composite balance in the individuals. (34: 69)

Table (2) of the statistical significance of physical measurements and tests and the vestibular system test and evaluation of skill performance

level between the pre and post measurements show improvement of the measurements of this group after experiment before conducting it in all physical measurements and tests and vestibular system test and evaluation of skill performance, with statistically significant differences at 0.05. “T” value ranged between (** 4.85, ** 26.92) with improvement percentages of (21.27%, 61.02%) for the favor of post measurement, and the values of effect ranged between (2.882, 12.579) and all are values higher than 0.8 with high significance for diving players.

The researchers attribute this superiority to the proposed training program. This result is in agreement with the result concluded by Ehab Al Sadek (2001 AD) who noted that high level of endurance of balance maintenance system (vestibular system) works on reduction of dizziness reduction and reduction of the time of loss of balance after performance of movements and after period of training and exercise. (17:101)

Therefore, the validity of first hypothesis of the research that states “The proposed training program for development of functional efficiency of vestibular system positively affects the composite balance” is verified.

In addition, according to tables (3, 4, 5) and graph (7) of the pre, intermediate and post measurements of the skill performance level of the skill under research that post measurement was the highest in value, followed by intermediate measurement, and that there are statistically significant differences in the calculated “F” value of repeated (pre, intermediate and post) measurements in the evaluation of skill performance of diving players. The effect of “Eta2” between the measurements was 0.932 and in measurements 0.998, which are high values that emphasize the strong effect. Differences between post and intermediate measurements were for the favor of intermediate measurement with improvement measurement of 33.15%; the differences between pre and post measurement for the favor of post measurement with improvement percentage of 61.02%; and differences between the intermediate and post measurement for the favor of the post measurement with improvement percentage of 20.93%.

The researchers attribute the improvement of skill performance level of the skill under study to the effect of the proposed training program that included exercises using trampoline for development of the functional efficiency of the vestibular system, which led to development of composite balance and positively affected the skill performance of the skill under research.

The sensory receptors contributed to maintenance of body balance and agree with the head movement and change of its position for the body

followed by the movement of internal lymphatic fluid in the crescent canals, saccule and fork. The movement of this fluid alerts the nervous receptors to brain where the player perceives the position of his head for the body that directly responds to these stimulations in the way that fosters its balance in the good position. Therefore, the individual's perception of dynamic skills in its disordered phases and his performance improves (16:301). Improvement of sensory receptors fixes the nervous passage between the situation and response, and becomes clearer and therefore brings the skill to the phase of stability (2:61) (36:380).

This result is in line with the results of studies of: Samira Al-Dardiry (1988 AD) (52); Mohsen Abu El Nour (1993 AD) (44); Usama Abu Tabl (1995) (56); Ehab Mohamed Al-Sadek (2001) (17); Ahmed Al-Aqqad (2003 AD) (9); Fadia Ahmed Abdulaziz (2004 AD) (23). Their results note that the more the vestibular efficiency is high by training, the better the composite balance, which contributes to increasing the skill performance of players in the different sports activities.

This result is in agreement with the notes of: Essam Abdulkhalek (1999 AD) (20); Carr (1997 AD) (15) that composite balance is a basic rule forward to the distinguished dynamic performance in the different sports activities.

By nature of their composition, sensory receptors work on transmission of material variables that happen around the player to his own consciousness. Therefore, the player's perception of his movement happens through the information transmitted by these receptors. It transmits the different sensory signals to the brain cortex that analyzes it and determines the difference that results from these changes; that is, the difference between what is and what shall be, and therefore issue the required orders to the respective muscles to achieve response suitable to the nature of situation (11:310) (53:9) (60:94) (33: 85).

This result is in agreement with the notes of: Mohamed Hassan Allawy and Mohamed Nasr El Din Radwan (2001 AD) that when sportsman has good composite balance, this contributes to improvement and development of motor performance level (38:307).

The researchers refer to the importance of using specific exercises with the use of trampoline for development of functional efficiency of one of the key sensory analytics (vestibular system) responsible for balance in its constant and movable parts, which led to development of composite balance during and after the skill performance which by itself has positive effect on the skill performance level.

Therefore, the validity of second hypothesis of the research that states "The proposed training program for development of functional efficiency of vestibular system positively affects the improvement of skill performance level of the skill under research" is verified.

Conclusions:

According to the research results, the researchers concluded the following:

1. There are statistically significant differences between the pre and post measurements in the sample of the research in all physical and physiological variables of the composite balance for the favor of post measurement due to the composite balance exercises set by the training program.
2. The skill performance of front curve dive improved and the functional efficiency and its impacts on the element of composite balance improved.
3. There are statistically significant differences in the level of skill performance in the pre and post measurements for the favor of post measurement.
4. There is exponent relation between the element of composite balance and development of functional efficiency of the vestibular system.

Recommendations:

In accordance with the conclusions and results of this study, the researchers conclude the following:

1. Attention to development of the vestibular system through the training programs applied to male and female players in the different age groups using trampoline.
2. Attention to introduce the exercises of vestibular system within the preparation program of diving players in the different sports entities using trampoline.
3. Conducting further physiological tests that measure the element of composite balance and conducting more relations between balance and the sensory factors that control it.
4. Reliance on the use of modern and rated lab systems to determine the level of composite balance and sensory analytics that control it such as equi test system.
5. Referencing the scientific bases that were used in design of the program of improvement of composite balance and reliance on the physiological and mechanical factors to determine the actual balance of the player.

6. Attention to conducting further common research in the fields of sports and medicine, including the design of rated training programs through the tests of vestibular system.
7. To foster the application of the proposed programs in all sports foundations in general and diving sports in particular because of their effective role in the improvement of skill performance level.
8. To conduct further research in the other sports activities that reply on the vestibular system as main factors that affect the skill performance level.

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