Biomechanical of lower extremity athletic stress and its relationship with performance effectiveness of compound skills for Soccer junior players

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Abstract

This research aims to identify the impact of athletic stress on the biomechanics of the movements of the joints in the lower extremity during performing compound skills by the junior soccer player. The researcher used the descriptive method through using kinematographic analysis. The research was applied to a sample of (6) junior soccer players selected intentionally from Mansoura Sports Club. The researcher used the following physical tests: Standing Balance Test - Illinois Agility Test - Quadrant Jump Test - Vertical Jump Test Isometric Leg Strength Test, in order to identify the level of stress in addition to skill tests as well (receive&kick). This study used kinematographic analysis by using Simi Motion System. The researcher used the pre- and post- measurement before and directly after the match and before the players could recover. The most important results were that the averages values of the biomechanical variables and the physical measurements confirm a decrease in the post-measurement test than the pre-measurements in all the skill performance phases. Also, the time of performing the two skills under study was shorter in the pre-measurements, which confirms in general that the research sample was significantly influenced by stress. There is a significant correlation between the physical and the biomechanical variables expressing stress. In addition, there is a correlation between physical and biomechanical variables and the skill performance phases in terms of post-measurement, which influences the effectiveness of the skillful performance skills in soccer for the research sample.

Keywords: Athletic Stress, Biomechanicalal, Lower Extremity, Compound Skills, Soccer.

Introduction:

The state of stress is one that is a common occurrence in all forms of athletic performance.

Stress is a term employed in three distinct contexts in sports science. Physical stress is the expression used to describe either musculoskeletal fatigue or a general inability to physically continue to perform at the desired level due to all energy stores having been consumed. Physical stress is most common in those sports where the activity occurs over a longer period of time, as in distance events of all types; it may also arise through prolonged training for shorter duration events .

Physical stress is also used to describe the testing processes used to calculate skillful performance measures which is a powerful indicator of endurance sport fitness. It can arise in a number of circumstances in relation to both training and competitive circumstances.

The immediate, short-term athletic goal in each of these mechanisms is to train to physical stress; the long-term objective is to extend the prior physical limits.

Scott k. et. All. (2018) indicated that the development of the physical abilities is closely linked to the development of the basic kinetic skills relevant to the type of activity practiced. The athlete can never master the basic kinetic skills essential to the type of activity practiced in case he lacks the necessary physical abilities for this activity. (21)

Robert L. (2015) believe that physical fitness and skilful performance are basic components of soccer practice. If the player does not possess high physical fitness, this negatively affects his level of skilful performance, especially near the end of the match. (19)

Deji Badiru (2014) and Hyunwook Lee (2018) explains that the physical requirements of a soccer player are important and essential to elevate his level of skilful performance. It is essential to possess the components of both fitness and skills in soccer, because physical fitness contributes to raise the performance effectiveness. We can evaluate the soccer player by observing his performance throughout the (90)-minutes match and sometimes more, where he is being under the physical pressure or fatigue, thus reflecting his real level. (5) (12)

Brian Sharkey (2002) and Frederic Delavier (2006) agree that early detection of the causes of stress, and training to elevate the physical efficiency both help the player to endure more physical overload, improve the kinetic performance, improve the neural-muscular pathways, and act as a proper qualification for the player's requirement to play during trainings and competitions. (4) (7)

Anthony Blazevic (2007) and Roger Bartlett (2007) indicate that biomechanics can be advantageous to all kind of sports during training and the improving the kinetic performance according to the objective of the relevant activity performance. Biomechanics provides the right foundation for the coach when coaching athletic skills, as it provides us with information relevant to the performance and athletic achievement aspects, as well as the players' physical aspects for various athletic performing compound skills by the junior soccer players.

The impact of the athletic stress of lower extremity on the efficiency of movements. This undoubtedly helps in the learning skills and improves the accurate kinetic performance.(3) (20)

Therefore, the use of biomechanical research methods contribute to the improvement of training (technical and physical) in many ways by making a biomechanical analysis of the actual performance; then evaluating the physical exercises in terms of their objectives. Susan J. (2012) (22).

The research problem becomes clear; which is to identify the effect of athletic stress on biomechanics of the movements for the lower extremity when performing compound skills in soccer (receive & kick).

Based on the above, the researcher have studied the physical aspects and the biomechanical variables related to the two research skills for juniors to determine the relationship between the physical abilities and the biomechanics of the movements of the lower extremity when increasing the training overload, and the occurrence of stress for the players during competition. This is in order to take advantage of this relationship in directing the training load properly to raise the physical and skillful efficiency of the players. Therefore, the researcher believe that athletic stress may affect the performance of lower extremity movements during performing compound skills by the junior soccer player.

Research objectives:

The research aims to identify:

- Biomechanical of the athletic stress of the lower extremity during performing compound skills by the junior soccer players.
- The impact of the athletic stress of lower extremity on the efficiency of performing compound skills by the junior soccer players.

Research Hypotheses:

- There are statistically significant differences between pre- and post-tests of the physical and biomechanical research variables as an indicator of athletic stress.
- There are correlation between the physical with the biomechanical variables under study and the efficiency of the skillful performance of compound skills in soccer.

Research Procedures:

Research Methodology:

Study used the descriptive method through using 3D biomechanical analysis, and the kinematographic analysis.

Research Sample:

The sample was selected intentionally from Mansoura Sports Club. It consisted of (6) junior players, in addition to (3) junior players to conduct the pilot study. It was conducted the homogeneity of the study sample in terms of the research variables (basic measurements- physical tests- skillful performance effectiveness tests). Look at Table (1)

Table (1) The homogeneity of the study sample. N = 6

	Variables	Unit of Measure	Average	Std. D ±	Medium	skewness Coefficient
Basic measure	Height	Cm	175.133	2.405	175.3	0.054
	Weight	Kg	69.860	1.195	70	0.887
	Age	Year	18.506	0.945	18.3	0.835
	Training Age	Year	7.466	1.125	8	-0.078
Physical Variables	Standing Balance Test	Second	3.002	0.267	2.9	1.698
	Isometric Leg Strength	Kg	106.133	2.474	106	0.019
	Quadrant Jump Test	Second	2.988	0.115	3	-0.942
	Vertical Jump Test	Cm	66.133	0.915	66	-0.937
	Agility Test	Second	12.148	0.862	12	0.101
Skill Tests	Kicking Accuracy	Point	4.363	0.394	4.39	-0.460
	Time (receive & kick)	Second	0.875	0.046	0.856	1.531

Table (1) indicates that skewness Coefficients for the selected variables are between (±3), which indicates that they are evenly distributed.

Data Collection Methods & Tools:

- Basic Measurements by digital scale to measure (height, weight), and recording age and training age data.
- Physical tests: (Standing Balance Test - Isometric Leg Strength Test - Quadrant Jump Test - Vertical Jump Test - Illinois Agility Test)
- Skill tests (receive & kick) to know efficiency of the skillful performance.
- Skill tests (receive & kick) to know efficiency of the skillful performance.
- Videotaping by using 250 Frame/second SportsCam.
- kinematographic analysis by using the Simi Motion system.
- Dynamometer, Digital Stopwatch.
- Some of matches were analyzed videos in World Cup (Russia 2018) to identify the most important compound skills in soccer.

The Pilot Study:

The Pilot study was on Tuesday January 5, 2021 on pilot sample (3 junior soccer)..

Research implementation:

Implemented the research procedures was on Friday, January 8, 2021, was the day for match of Mansoura team, as follows:

Pre-measurements:

1. Basic Measurements for sample.
2. Physical testing.
3. Skillful performance effectiveness tests, as follow:

- The player stands 7 meters away from the goal area, then runs quickly to receive the ball passed to him, then kicks ball by upper arch of foot (receive & kick) towards the goal which is divided into (9) squares, on distance of (18) meters from the goal line and perpendicular to the penalty area. Hamada H. (2018) (11) indicate that The distance affecting the goal is within the distance created by an angle of 45 degrees inside the playground and for 18: 30 yards.
- The players' points are recorded according to performance on both tests in the registration cards

4. Videotaping: takes place during the skilful performance test as a pre-measurement test directly before the actual game as follows:
   - Two cameras have been put in the field of motion during the players' performance of the two skills (receive & kick) towards the goal.
   - The frequency was adjusted to 120 Frame /sec. and a Trigger was used for synchronization between two cameras. Yasser N., Ahmed T. (24) (2015).
   - Each player performed (3) trials of (receiving and kicking), therefore number of trails were (18) trials.
5. Kinematographic Analysis was used (Simi Motion software), to extract following variables:

- Time of performance.
- biomechanical variables: (displacement- velocity - Anglers - Angular velocity - center of gravity - Force - Momentum) for the lower extremity.

Post-measurements:

Its was conducted on the same day; Friday, January 8, 2021 immediately after the game and before the players recover from stress. The Measurements were taken in the same sequence to be compared to the pre measurements to determine effect of stress on the mechanical performance of the lower extremity for soccer junior.

Statistical Analysis:

was using (Excel & SPSS) to extract: (average - standard deviation – medium - skewness Coefficient – Simple correlation coefficient of person – T-Test).

Results and Discussion

Table (2) The significant differences between the averages of pre- and post-measurements of the physical variables and the effectiveness of kicking of the study sample n = 6

S	Variables	Unit of Measure	Pre-Measurement		Post-Measurement		T-Test
			Mean1	Std. D ±	Mean2	Std. D ±	
1	**Standing Balance Test**	Second	3.002	0.267	3.004	0.342	0.01
2	**Isometric Leg Strength Test**	Kg.	106.133	2.474	101.127	1.653	-3.76
3	**Quadrant Jump Test**	Second	2.988	0.115	3.812	0.503	3.57
4	**Vertical Jump Test**	Cm	66.133	0.915	63.971	0.658	-4.29
5	**Agility Test**	Second	12.148	0.762	12.969	0.014	2.41
6	**Kicking Accuracy**	Point	4.463	0.394	4.021	0.131	-2.38
7	**Time (receive & kick)**	Second	0.875	0.046	0.932	0.185	0.67

(T) Indexed at 0.05 = 2.015 when n-1 = 5

Table (2) shows that there is a statistically significant negative differences between pre- and post-measurements regarding (Isometric Leg Strength test - Vertical Jump test - accuracy of kicking) for the pre-measurements. This indicates a decrease in the values of these variables in post-measurements. On the other hand, the significant differences were positive for the following variables (Quadrant Jump Test - Illinois Agility Test) for the post measurements. But they were not real because they depend on the time, in addition an increase in the post-measurements means an increase in the time of performing the test which indicates the slow performance of the research sample. There are no statistically significant differences in terms of (Standing Balance Test - receive & kick time).

Table (3) The averages of skill performance time in the pre- and post-measurements

	skill	phase	Different moments	Time 1	Time 2
Receive & Kick	Receive	Preliminary	Beginning of Receive	0.092	0.112
		Basic	Impact	0.075	0.097
		Overlap	End of Receive	0.197	0.214
	Kick		Maximum Backswing	0.235	0.230
		Basic	Impact	0.173	0.170
		Final	End of Follow-up	0.103	0.109
	Overall skill performance time (Second)			0.875	0.932

Table (4) The averages of the center of gravity in the pre- and post-measurements

	skill	phase	Different moments	X	Y	Z	R. 1	X	Y	Z	R. 2
Receive & Kick	Receive	Preliminary	Beginning of Receive	1.929	1.18	0.814	0.47	1.563	1.189	0.708	0.364
		Basic	Impact	1.778	1.221	0.97	0.697	1.412	1.23	0.864	0.591
		Overlap	End of Receive	1.563	1.239	1.172	1.006	1.197	1.248	1.066	0.900
	Kick		Maximum Backswing	1.239	1.255	1.424	1.458	0.873	1.264	1.318	1.352
		Basic	Impact	0.968	1.195	1.599	1.817	0.602	1.204	1.493	1.711
		Final	End of Follow-up	0.871	1.223	1.637	1.937	0.505	1.232	1.531	1.831

Table (3) shows that time1 of the (receive & kick) skill was 0.875Sec. which is slightly longer than time2 was 0.932 Sec. by comparing the pre- and post-measurements of time, we find that the time of the kicking skill in post-measurements increased by .057 seconds. This confirms that the players in the study were under the influence of physically stress, therefore, the time for performing the skill increased, due to the longer kinetic path, the greater force, and strength to kick the ball to come out strongly, accurately and with high velocity.

The time of kicking ball was reached 0.173 Sec. its surpass receiving time 0.197Sec., and backswing time reached 0.235 Sec. in kick skill. This is true in terms of mechanical activity because the player needs to kick the bigger part of the ball to it the Force and velocity required to reach the difficult area of the goal and out of the goalkeeper's reach. This is consistent with the view of Hamada H. (2018) (11) who believes that in order to achieve a high degree of accuracy in kicking the ball, the player should estimate properly the temporal and spatial aspects as well as the dynamic aspects of the critical stages of the movement, on which the accuracy of kicking depends, this is consistent with Luiz H. et. All. (2018) (15)

The results in tables (4) and showed that during the performance of the study skills (receive & kick) the center of gravity moves forward and up during the phase of receive, but during kicking, we found that the center of gravity moves forward and down, this indicates the impact of fatigue and the physical stress on the research sample.

The researcher attributed that to the fact that the player during performing the receiving skill adjusts his body in the right place for receiving the ball. But during the kicking, the center of gravity moves down even further to increase the balance the body and finish the kinetic force transfer process from all parts of the body to the kicking leg then to the ball without losing this force, and with as smooth and balance as possible.

The maximum displacement of lower extremity was during kicking which reached1.81m. and Follow-up which reached 1.93 m. and phases of the kicking skill. The researcher attributed this to that the kicking (right) leg makes a maximum Backswing then kicks the ball at full speed and power to hit the goal.

This is consistent with Pekkua (2002) (17) that often when kicking a soccer, the trunk tends to lean back if the goal of kicking is Force or the distance is long between the center of the ball and the movement of the joint during kicking increase the leverage work and consequently increases the velocity of the ball and the kick. Generally, the full extent of the kicking leg al the moment of kicking and its leaning away from the ball makes the player increase the final velocity of the foot.

Table (5) The significant differences between of pre- and post-measurements of the values of the angles of the lower extremity during performing the study skills. n = 6

Angles (θ)	Complex skill	skill	Skill phases	Angle of the right (kicking) Leg (θ)					Angle of the Left (fixed) Leg (θ)				
				Pre-measure		Post-measure		T-Test	Pre-measure		Post-measure		T-Test
				Mea n1	Std. D ±	Mea n2	Std. D ±		Mea n1	Std. D ±	Mean 2	Std. D ±	
Hip Angle (θ)	Receive & Kick	Receive	impact	154.6	-0.15	150.7	0.028	-57.15	156.	0.03	158.2	-0.17	23.16
		Kick	backswi	155.4	0.74	151.4	0.63	-9.20	153.	0.92	155.3	0.432	3.94
			kicking	171.7	0.537	170.5	0.727	-2.97	153.	0.72	155.6	0.529	4.49
			Follow-	145.4	-	141.3	-	-44.08	157.	0.00	159.7	-	13.74
Knee Angle (θ)	Receive & Kick	Receive	impact	142.6	0.37	140.4	0.395	-10.74	124.	2.92	126.5	0.197	1.37
		Kick	backswi	73.7	-	93.4	-	28.44	158.	0.55	160.1	-	6.01
			kicking	141.8	-0.14	138.2	0.813	-9.76	138.	-	140.3	0.615	6.54
			Follow-	173.6	-	160.7	0.786	-26.81	143.	0.04	145.4	0.588	6.82
Ankle Angle (θ)	Receive & Kick	Receive	impact	64.8	3.667	66.4	4.665	0.60	61.4	3.42	60.7	4.467	-0.28
		Kick	backswi	95.6	0.923	97.6	0.258	4.67	80.9	0.68	80.2	0.06	-2.29
			kicking	81.7	1.46	84.8	0.524	4.47	77.6	1.21	76.9	0.326	-1.24
			Follow-	103.5	1.697	101.4	1.476	-2.09	75.8	1.45	75.1	1.278	-0.81

(T) Indexed at 0.05 = 2.015 when n-1 = 5

The results of Table (5) show that value of maximum hip angle at the kicking stage was 171.7 Rad. During performing the kicking skill, While during the backswing, it reached 73.7 Rad. This is what gives the leg the Angular velocity necessary in the stage of returning to the front after kicking the ball forward at the maximum power possible.

The angles values of the fixed leg decreases gradually when performing the receive skill in order to maintain the balance of the body more approaching the center of gravity of the earth due to directing the kicking leg outside. On the other hand, the values of the angles are very close when performing the kicking skill, indicating the speed of kicking without approaching very close to the center of gravity of the earth. The researcher attributed that to the movement around the axis of the hip joint and the rotation of the point of cruelty to direct the foot outside in the (receive & kick) skill. And also to the maximum backswing of the knee joint in the (receive & kick) skill gives performance the power, speed, and high accuracy through the transfer of motion of the hip to the leg then to the kicking foot, and then to the ball.

This is consistent with the view of Nicholas P. et al. (2006) (16) who believes that in cases of strong kicking, the axis of rotation is transmitted to the kicking leg to the top of the hip joint while this falls to the knee joint axis in the weak kicking.

The results indicate that the values of hip angles during performing the study skills decrease in the post-measurements, On the other hand, the values of the knee angles increases, which reduces the back bending during the backswing. This causes the leg and foot to lose a larger momentum of movement during kicking because of stress of the muscles of the legs. which causes the kicking foot to lose impact with the largest part to achieve accurate and strong kicking. . This is consistent with the results of a study by Geir Jordet et al. (2007) (8) and Tomas M. et. All. (2018) (23)

Table (6) The significant differences of the averages of pre- and post-measurements of the kinematic variables (lower extremity joints) during performing the study skills.

Joints	The kinematic variables	skill	Skill phases	Pre-measure		Post-measure		T-Test
				Mean1	Std. D ±	Mean2	Std. D ±	
Hip	**Resultant Displacement** (m) (S^R)	**Receive**	impact	1.038	0.611	0.868	0.593	-0.45
		kick	backswing	1.763	0.03	1.461	0.022	-18.15
			kicking	2.987	0.101	2.417	1.011	-1.25
			Follow-up	2.543	0.006	2.289	0.984	-0.58
	Resultant velocity (V^R) (m/s)	**Receive**	impact	2.313	0.107	2.011	0.003	-6.31
		kick	backswing	2.721	0.985	2.223	0.123	-1.12
			kicking	1.901	0.064	1.503	0.046	-11.29
			Follow-up	3.102	0.801	2.652	0.502	-1.06
	Angular velocity (ώ) (Rad./s)	**Receive**	impact	148.30	3.908	122.231	4.863	-9.34
		kick	backswing	-69.612	1.164	-71.410	0.456	-3.22
			kicking	71.817	1.701	64.257	0.722	-9.15
			Follow-up	-184.20	1.938	-194.23	1.674	-8.76
knee	**Resultant Displacement** (m) (S^R)	**Receive**	impact	1.134	1.553	1.127	2.495	-0.01
		kick	backswing	1.573	0.972	1.213	1.914	-0.82
			kicking	2.762	1.043	2.132	1.985	-0.91
			Follow-up	3.41	0.948	3.12	1.89	-0.44
	Resultant velocity (V^R) (m/s)	**Receive**	impact	2.602	1.049	2.282	1.991	-0.68
		kick	backswing	2.561	1.927	2.316	2.869	-0.28
			kicking	2.211	1.006	1.911	1.948	-0.66
			Follow-up	3.214	1.743	2.674	2.685	-0.65
	Angular velocity (ώ) (Rad./s)	**Receive**	impact	258.21	4.85	236.21	5.792	-7.07
		kick	backswing	110.34	2.106	131.34	3.048	21.50
			kicking	229.54	2.643	200.74	3.585	-23.21
			Follow-up	-270.71	2.88	-210.32	3.822	39.78
Ankle	**Resultant Displacement** (m) (S^R)	**Receive**	impact	1.432	1.043	1.031	1.156	-0.58
		kick	backswing	2.691	0.462	2.321	0.585	-1.11
			kicking	4.433	0.533	4.023	1.574	-0.55
			Follow-up	5.780	0.438	5.310	1.547	-0.65
	Resultant velocity (V^R) (m/s)	**Receive**	impact	3.943	0.539	3.214	0.566	-2.09
		kick	backswing	7.390	1.417	6.760	0.686	-0.89
			kicking	16.431	0.496	14.542	0.609	-5.38
			Follow-up	4.710	1.233	3.980	1.065	-1.00
	Angular velocity	**Receive**	impact	-176.91	4.34	-245.76	5.426	-22.16

(ώ) (Rad./s)	kick	backswing	152.40	1.596	123.51	1.019	-34.12
		kicking	231.46	2.133	211.31	1.285	-18.09
		Follow-up	-71.603	2.37	-92.450	2.237	-14.30

(T) Indexed at 0.05 = 2.015 when n-1 = 5

Table (6) shows that the kicking foot reaches a maximum velocity in the kicking phase 16.431 m / sec during the kicking skill. The Angular velocity (ώ) Rad./Sec confirms it has achieved 231.46 Rad./sec during the kicking skill, while the joints of the knee and the thigh reaches the maximum velocity during the backswing, and in the Angular velocity (ώ) Rad. / Sec of the knee surpasses the thigh at the stage of kicking to 229.54 Rad./sec during the kicking skill. The researcher attributed that to the continuation of swinging the kicking leg with angle and speed until kicking the ball depends upon the knee joint, while the thigh joint is fixed to some extent to be able to direct the Force of the kicking foot and to the ball to be kicked quickly and with high accuracy.

Gongbing S. & Peter W. (2005) (9) confirm that the kicking skill designed to give the ball the largest momentum of linear velocity so the part responsible for kicking must move at the highest rotary speed. When the parts move as an open string, the near part will affect the far parts.

This is also in line with (Pekkua2002) (17) who believes that the speed of kicking the ball have a strong relationship with the maximum rotary momentum from the thigh, and the extension of the knee. The tightening of the ankle during kicking, and the linear velocity of the kicking foot directly proportionate with each of the Angular velocity (ώ) Rad. / Sec and momentum of inertia of the body joints in sequence. The results indicate that the Angular velocity during the kicking skill is affected by muscle Force and Force with velocity in the post-measurement, this refers to the stress of the research sample, and is confirmed by the results of accuracy of kicking as well, which has achieved a statistically negative significance for the pre-measurement. this is consistent with the results of a study by Pilar Baranda & David Riquelme (2012) (18).

Table (7) The significant differences of the averages of pre- and post-measurements of the kinetic variables (lower extremity Segments) during performing receive & kick.

Segments	**The kinematic variables**	**skill**	**Skill phases**	**Pre-measure**		**Post-measure**		**T-Test**
				Mean1	**Std. D ±**	**Mean2**	**Std. D ±**	
Thigh	**Momentum (Kg. m/s) (M)**	**Receive**	impact	17.115	0.824	12.885	0.481	-9.91
		kick	backswing	21.697	0.243	17.903	-0.09	-32.74
			kicking	12.709	0.314	11.001	0.899	-4.01
			Follow-up	11.342	0.219	11.990	0.872	1.61
	Force (F) (N)	**Receive**	impact	-15.39	0.32	-17.50	-0.109	-13.96
		kick	backswing	5.86	1.198	4.99	0.011	-1.62
			kicking	-12.23	0.277	-13.10	-0.066	-6.83
			Follow-up	17.80	1.014	15.94	0.39	-3.83
	Impulse (Ft) (N/Sec.)	**Receive**	impact	2.58	4.121	2.11	4.751	-0.17
		kick	backswing	2.54	1.377	1.90	0.344	-1.01
			kicking	-6.90	1.914	-7.87	0.61	-1.08
			Follow-up	3.21	2.151	2.79	1.562	-0.35
Leg	**Momentum (Kg. m/s) (M)**	**Receive**	impact	38.070	0.94	20.720	0.921	-29.48
		kick	backswing	49.871	0.359	45.201	0.35	-20.83
			kicking	23.037	0.43	18.911	1.339	-6.56

			Follow-up	15.870	0.335	13.602	1.312	-3.75
	Force (F) (N)	**Receive**	impact	3.11	0.436	2.91	0.331	-0.82
		kick	backswing	12.59	1.314	11.67	0.451	-1.48
			kicking	-3.90	0.393	-4.39	0.374	-2.02
			Follow-up	-2.12	1.13	-3.72	0.83	-2.55
	Impulse (Ft) (N/Sec.)	**Receive**	impact	0.79	4.237	0.34	5.191	-0.15
		kick	backswing	3.21	1.493	2.73	0.784	-0.64
			kicking	-0.49	2.03	-0.78	1.05	-0.28
			Follow-up	-0.22	2.267	-0.91	2.002	-0.51
Foot	**Momentum (Kg. m/s) (M)**	**Receive**	impact	68.874	1.952	54.870	0.593	-15.35
		kick	backswing	38.083	1.371	35.984	0.022	-3.42
			kicking	74.845	1.442	65.503	1.011	-11.86
			Follow-up	13.128	1.347	10.608	0.984	-3.38
	Force (F) (N)	**Receive**	impact	-5.33	1.448	-5.80	0.003	-0.73
		kick	backswing	-1.67	2.326	-1.85	0.123	-0.17
			kicking	-15.49	1.405	-17.12	0.046	-2.59
			Follow-up	-3.22	2.142	-4.11	0.502	-0.90
	Impulse (Ft) (N/Sec.)	**Receive**	impact	-0.51	5.249	-0.89	4.863	-0.12
		kick	backswing	-0.39	2.505	-0.64	0.456	-0.22
			kicking	-2.90	3.042	-3.73	0.722	-0.59
			Follow-up	-0.32	3.279	-0.78	1.674	-0.28

(T) Indexed at 0.05 = 2.015 when n-1 = 5

Table (6) shows that in in the (receive & kick) skill, the foot reaches its maximum momentum of movement 74.85M in the kicking phase, also the three Segments reach maximum force at the phase of kicking. The thigh reaches maximum Momentum in the kicking phase 2.12 N / Sec. while in the (receive & kick) skill, the foot reaches Momentum of 81.40 M at the stage of kicking, and the thigh reaches maximum 17.80 N Momentum 3.21 N / Sec at the Follow-up phase.

The researcher explain that this is due to the kinetic transfer between the parts of the lower extremity smoothly and without interruption, where the transfer of Momentum from the trunk to the thigh than to the leg to give the kicking foot the Force required for kicking the ball during performing the study skills.

H.C. Dörge et. al (2002) (1٠) confirm that kicking depends on the strength and speed of the foot Segments and through the transfer of activity in compatible to the defenses of power within the kinematic chain of the body Segments with the larger muscle mass to push of give kinetic force in a timely manner.

This is consistent with what Roger Bartlett (2007) (٢٠) believes as the forces sufficient to bring about the desired change in velocity (so-called Momentum) cannot be available only if given the right time, accordingly, kicking the ball to long distances depends on the length of time to influence it strongly.

This is consistent with 1A.R. Ismail, et. all. (2010) (1٣) who believe that when performing the kicking a kinetic transfer occurs from part to another non-stop and overlapping. The parts consequently move behind each other according to their role. The transfer of Momentum from the trunk to the thigh, the leg, the foot, then to the ball causes the kicking to become more effective.

The results indicate that Momentum of the Segments of the kicking leg is affected by the Quadrant Jump Test and agility, which times have increased in the post-measurement as confirmed by the results of Table (2). While the Force is affected during the kicking skill in the post-measurement with the muscle Force and speed, the statistical significance was negative at the kicking and Follow-up phase for study skills, which well indicates stress of the muscle in the research sample. This is consistent with Amr ali (2016) (2) and Jasper V. et. All (2020) (14).

Table (8) The correlation coefficient between Biomechanical and physical variables in post-measurements during performing the study skills. N=6

Physical variables Tests	Biomechanical Variables							
	(S^R)	(V^R)	(ώ)	(θ)	(M)	C.G	(F)	(Ft)
Standing Balance	0.534	0.308	-0.485	0.414	0.4632	0.814	0.547	0.532
Isometric Leg Strength	0.317	0.354	0.065	0.153	0.431	-0.125	0.801	0.794
Quadrant Jump	0.822	0.781	0.350	0.561	0.414	0.731	0.496	0.397
Vertical Jump	0.476	0.503	0.145	0.548	0.744	0.272	0.854	0.736
Agility	0.669	0.879	0.610	0.561	0.561	0.469	0.463	0.453

T. spreadsheet at 0.05 = 1.761 when the degree of freedom n-1 = 14

Table (8) shows that there is a correlation between some of the biomechanical and the physical variables in the post-measurements. It was between the speed of changing the direction of the body and displacement, velocity, and center of gravity affecting heavily the study skills. There is a correlation between Isometric Leg Strength and the distinctive velocity and Momentum,which significantly affects the accuracy of the kicking, as well as the strength, accuracy and speed of kicking towards the goal. The balance is connected to the center of gravity, while agility is connected to speed. This is consistent with 1A.R. Ismail et. all. (2010) (13) and Dutta P. (2002) (6) who believes that the working muscles are the inner engine and the General cause of the intentional human movements. The Force and momentum resulting from the work of the muscles cannot be predicted and due to the intervention of a number of physiological influences and mechanical elements. This is confirmed by Alison M. et. (2012) & (1) Gongbing, Westerhoff (2005) (9) who believe that the dynamic nature of the study skills passing and kicking allows the player to benefit by about 70: 80% of the Biomechanical capabilities and the kinematic chain of movement to achieve the transfer of activity in the parts of the body when performing the research skills. Moreover, in order to achieve a model performance in passing and kicking. This confirms the impact of the correlation between the biomechanical variables and the physical variables of the study skills on the post-measurement of the skillful performance effectiveness.

Table (9) Correlation coefficient between physical variables and skillful performance effectiveness in post-measurements during performing the study N=6

Physical variables Tests	Performance phases			
	Accuracy of kicking			
	Receiving	Backswing maximum	kicking	Follow-up
Standing Balance	0.810	0.841	0.850	0.690
Isometric Leg Strength	0.287	0.064	0.856	0.268
Quadrant Jump	0.781	0.807	0.070	0.332
Vertical Jump	0.369	0.840	0.886	0.327
Agility	0.812	0.694	0.111	0.264

Table (9) shows that in the research skills related to the phase of balanced receiving are Quadrant Jump and Agility, and the phase of kicking is linked to the balance and the strength of the muscles and the Isometric Leg Strength. Backswing is largely associated more with balance, which indicates that the study skills require good balance and velocity to receive the ball, in addition to muscle strength and balance when kicking, and then balance in the backswing in order for the leg to extend backward and return with the same kinetic energy for kicking the ball hard and fast.

This is consistent with Dutta P, Subramanium S (2002) (6) in that the muscles of the hip allow a large extent of activity and thus allow high efficiency in the movement of the bottom and provide it with the Force required during the movement as in kicking the ball .

This confirms the impact of the correlation between the physical variables and the stages of the performance of the study skills on the post-measurement of the skillful performance effectiveness.

Conclusions

- by comparing the pre- and post-measurements of time, we find that the time of the kicking skill in post-measurements increased by .057 seconds. This confirms that the players in the study were under the influence of physically stress.
- The results showed that during the performance of the study skills (receive & kick) the center of gravity moves forward and up during the phase of receive, but during kicking, we found that the center of gravity moves forward and down this indicates the impact of fatigue and the physical stress on the research sample.
- The results indicate that the values of hip angle during performing the study skills decrease in the post-measurements, and the values of the knee angles increases, which reduces the back bending during the backswing, this causes the leg and foot to lose a larger momentum of movement during kicking because of stress of the muscles of the legs.
- As for the bearing foot, we find that the Angles of the trunk and the knee increase in the post-measurement because the research sample due to stress cannot exchange the joints of the hip and the knee well and keep the balance.
- results of accuracy of kicking confirmed that the Angular velocity during the kicking skill is affected by muscle Force and Force with velocity in the post-measurement, this refers to the stress of the research sample.
- The results indicate that Momentum of the lower extremity Segments are affected by the Quadrant Jump Test and agility, which times have increased in the post-measurement, While the Force is affected in the post-measurement with the muscle Force and speed, statistical significance was negative at the kicking and Follow-up phase, which well indicates stress of the muscle in the research sample.

  The knee joint is effective in the performance of the kicking skill, angle of the knee of the kicking leg increases in Follow-up phase to 157.9 Rad., to give the ball the Force and velocity necessary for the kicking, while Angle of the ankle of the kicking leg during the kicking skill decreases at the moment of kicking to 81.7 Rad., in order to accurately guide the ball.
- For the fixed foot, a strong correlation exists between the angles of the knee and foot during performing skills throughout the three stages (backswing - kicking - Follow-up) which indicates that the movements of the vertically center of gravity are well for keeping the balance.
- Momentum significantly affects the backswing phase, while the force had a greater impact at the stage of kicking. Impulse affects the backswing and kicking phases in a balanced manner.

- The overlapping stage (the final stage of the receipt and the maximum backswing for kicking), which is characterized by the maximum Impulse.
- The proximal parts of the body (hip - knee) increases its velocity during the backswing, while the distant parts (leg - foot) increases its velocity during the main phase especially before the moment of kicking the ball directly.

The research results indicate that the values of averages of biomechanical variables, and physical measurements of performing the research skills recorded a decrease between pre- and post-measurements to favor of the pre- measurement, which confirms in general that research sample was influenced by stress significantly.

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