A Predictive Statistical Model in the Light of some Biomechanical Indicators for Shot Put Players

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Abstract of the research:

The research aims to arrive at a predictive statistical model in the light of some biomechanical indicators of the shot put players. This is achieved through: identifying the correlation between some of the biomechanical indicators of the shot put players, identifying the proportions of the contribution of the biomechanical indicators in the digital level of the shot put players, arriving at predictive equations based on some biomechanical indicators in the shot put, the researcher used the descriptive approach and the sample of the research was better (4) players in the shot put in terms of the digital level. Filming was done at the Faculty of Physical Education, Kafr El-Sheikh University, on 10/28/2019, with (12) attempts, and the performance of the players was photographed and analyzed to extract the biomechanical variables and measure the digital level, and through transactions. The following statistical results were obtained: The presence of indicators for the moment of the beginning of the thrust phase: the resultant force, acceleration, velocity of the center of gravity of the body, the result of the wheel, the momentum of the center of gravity of the right leg thigh, the resultant velocity of the center of gravity of the humerus of the thrusting arm, the amount of movement of the center of gravity of the forearm of the thrust arm Momentum of movement for the humeral center of gravity of the thrusting arm, indicators that contributed to the mid-phase moment of the thrust: Momentum of movement of the center of gravity of the trunk, the resultant force, the amount of movement of the center of gravity of the right leg thigh, the result of the acceleration of the center of gravity of the humerus The thrust arm, the resultant force of the center of gravity of the body, the resultant velocity of the center of gravity of the forearm of the thrust arm, indicators that contributed to the moment of disposal in the thrust of the shot: the amount of movement, the net acceleration of the center of gravity of the trunk, the net acceleration of the center of gravity of the thrust arm humerus, the result of the wheel for the center of gravity of the right leg leg, The resultant velocity, the net force of the center of gravity of the body, the net force of the center of gravity of the right thigh.

Keywords: statistical model, biomechanical indicators

The introduction:

The study and analysis of sports skills and the identification of the ideal technique for the player helps him to achieve the optimal use of sports movements during the performance technique, and thus the competition today is not only between athletes but also between scientists and researchers in every country in the world, where there will be no list of sports without

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the use of scientific methods Modern. (14:10,11)

The knowledge of those in charge of the process of training and teaching sports skills with the rules of kinetic analysis that depend on the basic principles of kinesiology, anatomy, biomechanics and other sciences related to movement, and technical information about any skill, which means understanding how to perform in the light of a set of information that helps determine the required kinetic procedures. To achieve this performance with the highest possible efficiency and with the least effort. (11: 197)

Oleg Kolodai (1986) and Suleiman Hassan and others (1984) indicate that the shot put competition is one of the important field competitions. , physical and kinetic, it is affected by the shape of the competition, and the general shape of the athlete to increase the effectiveness of performance(6:189) ،(1:24) .

"Klodecka-Raxalska" (1989) states that it is necessary to use the desired behavior of the shot put contest performance art, and to improve the digital level to reduce the performance deviation through the necessary muscle work in the right timing in the appropriate sequence to the extent necessary for performance to achieve the maximum possible effort and improve the digital level . (17:336)

And Hana Hassan (1990 AD) adds that it is known that the level of performance of the shot put competition globally has reached an amazing quantitative and qualitative level, and a high degree of proficiency and effectiveness in achieving motor duties, which is due to the use of scientific methods in education and training. (15:102)

The shot put competition is one of the important competitions that have been affected by the development of sports movement science technology, and the analysis of the performance of champions to identify the ideal technical performance methods to advance the education and training program. Since the level of performance of the shot put globally has reached an amazing quantitative and qualitative level, and a high degree of proficiency in achieving motor duties, which may be due to the use of advanced scientific methods in education and training, but we are still doing our best to reach the highest levels, By preserving the achievements of high-level players and spawning new elements by adopting modern techniques in selection, education and training, such as the biomechanical analysis of champions to benefit from it in developing a predictive biomechanical-statistical model based on the biomechanical indicators of the shot put players and the correlation between these indicators and the digital level.

Through some studies carried out in this direction, such as the study of Menzel (1995) (18), and its topic "The ideal mechanical model of javelin throwing movements during the transmission and disposal stages", the study of "Vodickova" (2003 AD) (19) and its topic "Study of the center of gravity of the body For the shot put players, the study of "Gideon Ariel" (2004 AD) (16) and its topic

"Biomechanical analysis of the shot put competition at the Olympic Games in Athens 2004 AD", the study of Tariq Jamal Alaa Al-Din (2005 AD) (8) and its topic is "a biomechanical statistical model of the shot put in Athletic performance", the study of Ayman Mahrous Sayed, Mohamed Dakrouri (2008 AD) (2), and its topic is "The Kinematic Characteristics of the Disposal Stage in Some Throwing Competitions (Pell, Disc, Spear) as a determinant for improving the digital level".

Through the reference survey, none of the previous studies or scientific references dealt with the study of predictive equations in light of some biomechanical variables in the shot put, which called the researcher to conduct: "a predictive statistical model in the light of some biomechanical indicators of the shot put players".

Research goal:

Reaching a predictive statistical model in the light of some biomechanical indicators for shot put players. This is achieved through:

1- To identify the correlation between some biomechanical indicators of shot put players.

2- Identifying the proportions of the contribution of biomechanical indicators in the digital level of the shot put players.

3- Reaching predictive equations based on some biomechanical indicators in the shot put.

Research hypotheses:

1- There is a correlation between some biomechanical variables and the digital level of the shot put players.

2- There are contribution ratios of biomechanical indicators in the digital level of shot put players.

3- Predictive equations can be reached based on some biomechanical indicators of the shot put players.

Search procedures

Research Methodology:

The researcher used the descriptive method due to its relevance to the nature of the research.

The research sample:

-The research sample was chosen by the intentional method, and they numbered (7) players, (3) players for the pilot experiment, (4) players for the basic experiment, and they are the best players in the shot put in terms of the digital level. Filming was done at the Faculty of Physical Education, Kafr El-Sheikh University, on 28 /10/2019 AD, and the best number of (3) attempts was selected for each contestant, and thus the research sample became (12) attempts.

Table (1)

Statistical significance of the research sample in chronological age, height, weight and training age. n=4

S	varaiables	measure unit	SMA	mediator	standard deviation	flatness	skewness
1	age	year/month	18.9800	19.0000	0.2140	1.8840	0.6420
2	height	cm	175.6400	176.0000	6.4220	-1.0870	0.0280
3	weight	Newtn	73.7200	73.0000	6.0520	-1.2710	0.3370
4	training age	year/month	7.3200	7.0000	1.9730	-0.6130	0.1150

Standard error of skew modulus = 0.637

The limit of the skew coefficient at the level of significance is 0.05 = 1.249

Table (1) shows the arithmetic mean, median, standard deviation, and skew coefficient of the research sample members in the variables of growth indices rates. It is clear that the skew coefficient values ranged between (±3) and it is less than the skew coefficient limit, which indicates the moderation of the data and the similarity of the data under the moderation curve this gives a direct indication that the data are free from defects in non-equilibrium distributions.

Table (2)

Statistical significance of the research sample individuals in the numerical level variable to show the moderation of the data n=12

S	varaiables	measure unit	SMA	mediator	standard deviation	flatness	skewness
1	digitl level	m	12.7917	12.8200	0.6238	-1.2204	-0.0599

Standard error of skew modulus = 0.637

The limit of the skew coefficient at the level of significance is 0.05 = 1.249

Table (2) shows the arithmetic mean, median, standard deviation, and skew coefficient of the research sample in the numerical level variable. It is clear that the skew coefficient values ranged between (±3) and it is also less than the skew coefficient limit, which indicates the moderation of the data and the similarity of the data under the moderation curve, which It gives a direct indication that the data are free from defects in non-equilibrium distributions.

Data collection tools and devices:

Tools and equipment for imaging and kinematic analysis, tools and equipment for shot put and some anthropometric measurements were used.

Survey study:

The exploratory study was conducted on three players from outside the research sample and was photographed at the Faculty of Physical Education, Kafr El-Sheikh University, on October 27, 2019 AD, with the aim of adjusting and determining the variables of the shooting process, the dimensions of the imaging camera from performance, and locating the calibration model.

Basic study:

The players were photographed for the purpose of kinetic analysis at the Faculty of Physical Education, Kafr El-Sheikh University, on October 28, 2019 AD. The part to be analyzed was determined on the kinetic analysis device using the (Dmas 7) program.

Then choose three moments (the moment of the beginning of payment, the moment of mid-payment, the moment of disposal), then conduct the analysis and study process, and then extract the results for conducting statistical operations.

Videography procedures for the purpose of kinetic analysis:

-According to the results of the survey, one (1) high-speed camera was installed on a tripod, on the right side of the players (the direction of the push arm), and away from the middle of the shot put circle (the field of study) by a distance of (6.30) meters, and the middle of the camera lens is higher than the middle of the camera lens The ground (1.25 meters) was placed perpendicular to the middle of the thrust circle.

Connecting the camera with the kinematic analysis device (Dmas 7) to record the video (live) directly on the kinematic analysis device, where the camera frequency speed was set to 120 frames/sec.

-The calibrator was photographed in the middle of the thrust circle, and then removed.

-Photographing and recording the attempts of all the players in the shot put, in accordance with the International Law of Athletics.

-Choosing the best number of (3) attempts for each contestant in terms of numerical level, to be subjected to biomechanical analysis procedures using the (Dmas 7) program, then conducting the analysis process and extracting the results.

Presentation and discussion of the results:

Table (3)

The matrix of the interrelationship between the biomechanical variables and the digital level at the moment of the beginning of the push in the shot put n=12

Push-arm crank center of gravity					
net force	Motion	resultant acceleration	net speed	المتغيرات	
				محصلة السرعة	مركز ثقل ساعد ذراع الدفع
			0.132	محصلة العجلة	
		0.446	-0.094	كمية الحركة	
	0.260	0.138	0.603	محصلة القوة	
0.477	0.379	0.247	0.266	محصلة السرعة	مركز ثقل عضد ذراع الدفع
0.285	0.587	0.664	-0.078	محصلة العجلة	
0.055	-0.349	-0.275	0.620	كمية الحركة	
-0.077	0.187	0.169	0.294	محصلة القوة	
0.072	-0.170	-0.192	0.617	محصلة السرعة	مركز ثقل فخذ الرجل اليمنى
0.647	-0.074	0.178	0.979	محصلة العجلة	
0.078	0.254	0.280	0.648	كمية الحركة	
0.567	0.733	0.063	0.414	محصلة القوة	
0.642	-0.053	0.184	0.973	محصلة السرعة	مركز ثقل ساق الرجل اليمنى
0.633	-0.124	0.128	0.292	محصلة العجلة	
0.536	0.524	0.770	0.024	كمية الحركة	
0.605	-0.144	0.198	0.978	محصلة القوة	
0.623	0.326	0.620	0.312	محصلة السرعة	مركز ثقل قدم الرجل اليمنى
0.683	-0.034	0.270	0.972	محصلة العجلة	
0.281	0.354	0.900	0.158	كمية الحركة	
0.586	-0.173	0.050	0.974	محصلة القوة	
0.668	0.132	0.357	0.819	محصلة السرعة	مركز ثقل الجذع
0.650	-0.114	0.178	0.981	محصلة العجلة	
0.594	-0.199	0.059	0.977	كمية الحركة	
0.218	0.538	0.432	0.379	محصلة القوة	
0.190	0.362	0.908	0.197	محصلة السرعة	مركز ثقل الجسم
0.637	-0.089	0.160	0.978	محصلة العجلة	
0.581	-0.055	0.179	0.714	كمية الحركة	
0.638	-0.089	0.168	0.979	محصلة القوة	
0.266	*0.793	-0.094	0.132	المستوى الرقمى	

The tabular value of t at the level of significance 0.05 = 0.579 D at 0.05*

Table (3) shows the correlation coefficients between the digital level and some biomechanical variables at the moment of the beginning of the push in the shot put among the members of the research sample. It is clear that there is a significant statistical correlation at the level of significance of 0.05 in the number of (8) variables that ranged between (0.981 to 0.701), while there is no significant correlation Statistical in (20) variables.

Table (4)

Regression analysis of biomechanical variables at the digital level from the moment of the beginning of the push in the shot put

Contribution percentages R2 Adjusted	regression coefficients								fixed amount	standard error	q value	Contributing Indicators
84.034								0.0013	49.0779	2.6195	557.9016	The net force of the body's center of gravity
92.215							0.0097	0.0012	246.5402	61.4825	402.3909	The resultant force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right thigh
95.039						0.0651	0.0129	0.0039	277.8795	52.5529	384.2368	The net force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right thigh + the resultant velocity of the center of gravity of the body
97.422					0.0063	0.0613	0.0124	0.0037	251.9838	48.3464	359.5285	The resultant force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right leg thigh + the resultant velocity of the center of gravity of the body + the resultant velocity of the center of gravity of the humerus of the thrust arm
98.523				0.1059	0.0094	0.0716	0.0163	0.0040	312.6211	41.6650	467.3050	The resultant force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right leg thigh + the resultant velocity of the center of gravity of the body + the resultant velocity of the center of gravity of the thrust arm humerus + momentum of the center of gravity of the forearm of the thrust arm
99.304			0.0333	0.1507	0.0114	0.0982	0.0174	0.0050	311.4124	37.6064	478.9595	The resultant force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right leg thigh + the resultant velocity of the center of gravity of the body + the resultant velocity of the center of gravity of the thrust arm humerus + momentum of the center of gravity of the thrust arm humerus + momentum of the center of gravity of the thrust arm humerus
99.690		0.0009	0.0469	0.1334	0.0111	0.1023	0.0155	0.0051	281.2876	35.0750	536.6936	The resultant force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right leg thigh + the resultant velocity of the center of gravity of the body + the resultant velocity of the center of gravity of the thrust arm humer + momentum of the center of gravity of the forearm of the thrust arm + the momentum of the center of gravity of the center of gravity of the thrust arm + the resultant of the acceleration of the center of gravity of the body
99.856	0.1622	0.0020	0.0303	0.0347	0.0096	0.1212	0.0069	0.0060	121.8753	38.8354	1177.3698	The resultant force of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the right leg thigh + the resultant velocity of the center of gravity of the body + the resultant velocity of the center of gravity of the thrust arm humer + momentum of the center of gravity of the thrust arm humerus + momentum of the center of gravity of the center of gravity of the thrust arm + the resultant of the acceleration of the center of gravity of the body + quantity Movement of the center of gravity of the right thigh

After the availability of the theoretical conditions for conducting the regression coefficient in terms of the logic of the signs and the value of the regression coefficients, where the constant part achieved a positive value greater than zero, in addition to the fact that the regression coefficient has a positive value and ranges between (zero and the right one.)

Table (4) shows the results of the analysis of the multiple regression variance of the eight models, and it is clear that there is a significant statistical effect of the independent variables. The table also shows the coefficients of the multiple regression equation, which are represented in the value of the B coefficient and the value of (q) and its significance, as well as the value of the fixed amount. The multiple regression equations can be formulated as Predicting the degree of the dependent variable given the degrees of the independent variables as follows:

y = dependent variable A = constant

B = regression coefficient X = independent variable

Y=a+B1x1+ B 2x2+ B 3x3+ B 4x4+ B 5x5+ B 6x6+ B 7x7+ B 8x8

Numerical level = 121.8753 + (0.0060 x net force of center of gravity of the body) + (0.0069 x net of acceleration of center of gravity of the right leg thigh) + (0.1212 x net force of center of gravity of body) + (0.0096 x net of velocity of center of gravity of thrust arm humerus) +) 0.0347 x momentum of the center of gravity of the thrust arm humerus) + (0.0303 x momentum of the center of gravity of the thrust arm humerus) + (0.0020 x the sum of the acceleration of the center of gravity of the body) + (0.1622 x the momentum of the center of gravity of the right leg thigh)

Table (4) shows a summary of the multiple regression models in a stepwise manner. The table shows the square of the multiple correlation coefficient or the determination coefficient Adjusted R2 in eight cases of biomechanical variables on the digital level at the moment of the beginning of the push in the shot put.

It also appears from Table (4) a summary of the multiple regression models in a stepwise manner. The table displays the square of the multiple correlation coefficient or coefficient of determination in six cases. It is clear that the first case has determined the resultant force variable for the center of gravity of the body at a rate of (84.034%), while the second step has achieved the outcome variables. The force of the center of gravity of the body and the resultant acceleration of the center of gravity of the right leg thigh combined, an explanation ratio of (92.215%) of the total variance, thus achieving the resultant acceleration of the center of gravity of the right leg thigh a contribution rate of (8.181%), as the case or the third step of the variables of the resultant force of the center of gravity of the body shows. The resultant acceleration of the center of gravity of the right leg thigh and the resultant velocity of the center of the body and combined an interpretation ratio of (95.039%) of the total variance, and thus the total velocity of the center of gravity of the body achieved a contribution of (2.824) as illustrates the case or the fourth step of the variables of the net force of the center of gravity and the result of the wheel For the center of gravity of the right leg thigh and the resultant velocity of the center of gravity of the body and the resultant velocity of the center of gravity of the humerus of the thrust arm combined an interpretation ratio of (97.422%) of the total variance, thus achieving the net velocity of the center of gravity of the humerus of the tambourine arm A contribution of (2.383%), as illustrates the case or the fifth step of the variables of the net force of the center of gravity of the body and the resultant acceleration of the center of gravity of the thigh of the right leg and the resultant velocity of the center of gravity of the body and the resultant velocity of the center of gravity of the humeral thrust arm and the amount of movement of the center of gravity of the forearm of the thrust arm combined an interpretation ratio of (98.523%) of the total variance, and thus the amount of movement of the center of gravity of the forearm of the thrust arm achieved a contribution of (1.101%), as the case or the sixth step shows for the variables of the net force of the center of the body and the resultant acceleration of the center of gravity of the right leg thigh and the resultant velocity of the center of gravity of the body and the resultant velocity of the center of the body The thrust arm humeral weight and the momentum of the thrust arm humeral center of gravity and the motion of the thrust arm humeral center of gravity combined have an interpretation ratio of (99.304%), from the total variance, thus achieving the motion of the thrust arm humeral center of gravity a contribution of (0.781%), as illustrated by the case or The seventh step of the variables of the net force of the center of gravity of the body and the resultant acceleration of the center of gravity of the right leg thigh and the resultant velocity of the center of gravity of the body and the resultant velocity center of gravity of the humeral thrust arm and the amount of motion of the center of gravity of the forearm of the thrusting arm and the amount of movement of the center of gravity of the humerus The thrust arm and the resultant acceleration of the center of the body combined combined an interpretation ratio of (99.690%) of the total variance, thus achieving the resultant acceleration of the center of gravity of the body a contribution of (0.386%), as the case or the eighth step of the variables shows the net force of the center of gravity of the body and the resultant wheel of the center of gravity of the right leg thigh The sum of the velocity of the center of gravity of the body and the sum of the velocity of the center of gravity of the humerus of the thrusting arm and the amount of motion of the center of gravity of the forearm of the thrusting arm and the amount of movement of the center of gravity of the humerus of the thrusting arm and the sum of the acceleration of the center of gravity of the body and the amount of movement of the center of gravity of the thigh of the right leg combined an interpretation ratio of (99.856%) of the total variance and thus The amount of movement of the center of gravity of the right leg thigh achieved a contribution of (0.166%), and this may be due to the fact that the center of gravity of the player’s body at the beginning of the push stage (the moment of the beginning of the push in the push) is located above the right leg, which bears the greatest burden in pushing the ground quickly, which leads to Increasing the acceleration, which in turn leads to an increase in the force, as the acceleration is the rate of change of velocity with respect to time ( ), and the force is the product of the mass multiplied by the acceleration ( ) (7: 228, 156), (9: 27, 26), (13: 93, 157, 189), and the effect of momentum y The push sponsor, this may be because the player in order to achieve the goal of movement requires the use of motor transfer from the limbs to the body and from the leg to the pelvis and then the trunk to the push arm, as the amount of movement is the product of mass multiplied by speed (), and motor transfer means the participation of non-essential muscle groups Basic muscle groups during performance, and both Sawsan Abdel Moneim and others (1991), Bastawissi Ahmed (1997), Muhammad Bariqa' and Khayriyah Al-Sukari (2002) pointed out the importance of motor transport from all body connections from the trunk to the limbs and from the limb to the body, where the use of different parts of the body by moving Rapid synchronous locomotion from the legs to the buttocks to the torso and to the thrusting arm during this phase (7:228,156), (3:493), (13:189)

Table (5)
Interrelationship matrix between biomechanical variables and the digital level for the mid-push moment in the shot put n=12

مركز ثقل الجسم				trunk center of gravity				Right foot center of gravity				The center of gravity of the right leg				The center of gravity of the right thigh				Push-arm humerus center of gravity				Push-arm crank center of gravity				المتغيرات	
محصلة القوة	كمية الحركة	محصلة العجلة	محصلة السرعة	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	كمية الحركة	محصلة العجلة	محصلة السرعة		
																												محصلة السرعة	مركز ثقل ساعد ذراع الدفع
																											0.178	محصلة العجلة	
																										0.374	0.194	كمية الحركة	
																									0.283	0.901	-0.021	محصلة القوة	
																								-0.032	0.210	0.180	0.998	محصلة السرعة	مركز ثقل عضد ذراع الدفع
																							-0.030	0.599	0.766	0.618	-0.045	محصلة العجلة	
																						0.537	0.408	0.472	0.619	0.470	0.420	كمية الحركة	
																					0.583	0.562	0.364	0.700	0.551	0.609	0.377	محصلة القوة	
																				0.540	0.449	0.024	0.963	0.158	0.179	0.319	0.970	محصلة السرعة	مركز ثقل فخذ الرجل اليمنى
																			0.323	0.357	0.379	0.192	0.174	0.321	0.109	0.429	0.200	محصلة العجلة	
																		0.282	0.979	0.431	0.417	-0.118	0.968	0.024	0.110	0.179	0.979	كمية الحركة	
																	0.435	0.801	0.534	0.448	0.494	0.316	0.403	0.455	0.205	0.665	0.410	محصلة القوة	
																0.129	0.674	-0.007	0.715	0.786	0.476	0.282	0.647	0.496	0.415	0.451	0.655	محصلة السرعة	مركز ثقل ساق الرجل اليمنى
															0.843	0.361	0.522	0.248	0.629	0.947	0.417	0.405	0.451	0.648	0.328	0.538	0.464	محصلة العجلة	
														0.603	0.344	0.748	0.087	0.597	0.236	0.732	0.532	0.668	0.041	0.887	0.430	0.909	0.049	كمية الحركة	
													0.471	0.753	0.738	0.662	0.889	0.412	0.961	0.697	0.535	0.247	0.878	0.371	0.294	0.515	0.883	محصلة القوة	
												0.994	0.432	0.746	0.732	0.643	0.903	0.414	0.968	0.691	0.496	0.201	0.889	0.311	0.299	0.464	0.893	محصلة السرعة	مركز ثقل قدم الرجل اليمنى
											-0.078	-0.103	0.335	-0.100	-0.097	0.221	-0.212	0.092	-0.190	0.182	0.354	0.427	-0.159	0.084	0.688	0.197	-0.176	محصلة العجلة	
										0.498	0.366	0.340	0.609	0.672	0.451	0.284	0.038	0.186	0.165	0.802	0.366	0.554	0.042	0.478	0.672	0.402	0.035	كمية الحركة	
									0.544	0.355	0.254	0.308	0.694	0.493	0.443	0.279	-0.039	0.130	0.096	0.629	0.627	0.963	0.034	0.719	0.743	0.701	0.022	محصلة القوة	
								0.319	0.348	-0.141	0.986	0.996	0.494	0.774	0.725	0.667	0.858	0.403	0.943	0.702	0.493	0.262	0.848	0.402	0.258	0.538	0.851	محصلة السرعة	مركز ثقل الجذع
							0.428	0.754	0.514	-0.066	0.324	0.382	0.768	0.575	0.323	0.465	-0.031	0.376	0.146	0.607	0.370	0.744	0.001	0.771	0.379	0.734	-0.001	محصلة العجلة	
						0.191	0.945	0.180	0.217	-0.103	0.971	0.969	0.294	0.635	0.728	0.569	0.966	0.353	0.992	0.581	0.543	0.110	0.957	0.200	0.281	0.366	0.964	كمية الحركة	
					0.352	0.382	0.508	0.390	0.700	0.270	0.501	0.491	0.700	0.777	0.447	0.498	0.245	0.458	0.333	0.844	0.386	0.390	0.111	0.572	0.286	0.453	0.131	محصلة القوة	
				0.319	0.986	0.154	0.946	0.090	0.158	-0.211	0.968	0.960	0.227	0.628	0.709	0.527	0.973	0.307	0.999	0.528	0.415	0.020	0.963	0.153	0.162	0.321	0.968	محصلة السرعة	مركز ثقل الجسم
			0.997	0.306	0.977	0.098	0.927	0.018	0.116	-0.247	0.953	0.942	0.176	0.602	0.681	0.505	0.980	0.302	0.996	0.490	0.375	-0.049	0.961	0.101	0.101	0.264	0.968	محصلة العجلة	
		0.460	0.459	0.700	0.486	0.216	0.578	0.101	0.286	0.262	0.576	0.573	0.641	0.378	0.072	0.895	0.409	0.764	0.471	0.455	0.379	0.160	0.308	0.327	0.065	0.457	0.324	كمية الحركة	
	0.530	0.891	0.910	0.421	0.965	0.222	0.892	0.304	0.303	0.091	0.925	0.929	0.406	0.625	0.727	0.616	0.904	0.416	0.927	0.649	0.714	0.232	0.886	0.289	0.439	0.436	0.897	محصلة القوة	
*0.736	0.255	0.162	0.268	0.407	*0.976	0.227	0.346	0.127	0.282	-0.119	0.170	0.264	0.348	0.260	0.383	*0.933	*0.815	0.416	0.473	0.203	0.507	*0.850	0.310	0.241	0.209	0.379	*0.718	المستوى الرقمي	

The tabular value of t at the level of significance 0.05 = 0.579

Table (5) shows the correlation coefficients between the digital level and some biomechanical variables at the moment of the mid-push in the shot put among the research sample members. It is clear that there is a statistically significant correlation at the level of significance of 0.05 in the number of (6) variables that ranged between (0.976 to 0.718) while there is no correlation Statistical function in (22) variables.

Table (6)
Regression analysis of biomechanical variables at the numerical level for the mid-push moment in the shot put.

Contribution percentages R2 Adjusted	regression coefficients						fixed amount	standard error	q value	Contributing Indicators
88.096						0.0629	4.8912	0.37471	446.9731	Momentum of the trunk center of gravity
93.825					0.0007	0.0588	3.5152	0.71445	264.9538	Momentum of movement of the center of gravity of the torso + the net force of the center of gravity of the right thigh
96.578				0.0004	0.0009	0.0581	7.9894	1.99457	217.3991	Momentum of the torso center of gravity + net force of the center of gravity of the right leg + net acceleration of the center of gravity of the humerus of the thrust arm
98.278			0.2235	-0.0003	0.0008	0.0406	15.9051	2.24161	329.0987	Momentum of movement for the center of gravity of the torso + net force of the center of gravity of the right leg thigh + the resultant of the acceleration of the center of gravity of the humerus of the thrusting arm + momentum of the center of gravity of the right thigh
99.303		-0.1967	0.2132	0.0002	0.0003	0.0380	16.7319	1.99866	445.1390	Momentum of movement for the center of gravity of the torso + net force of the center of gravity of the right leg thigh + net force of the center of gravity of the humerus of the thrusting arm + momentum of the center of gravity of the right thigh + net force of the center of gravity of the body

Follow Table (6)
Regression analysis of biomechanical variables at the numerical level for the mid-push moment in the shot put.

Contribution percentages R2 Adjusted	regression coefficients						fixed amount	standard error	q value	Contributing Indicators
99.918	0.0009	0.1843	0.2091	0.0001	0.0003	0.0337	21.8991	2.16885	526.8306	Momentum of movement of the center of gravity of the torso + net force of the center of gravity of the thigh of the right leg + the result of the acceleration of the center of gravity of the humerus of the thrusting arm + momentum of the center of gravity of the thigh of the right leg + the net force of the center of gravity of the body + the net of velocity of the center of gravity of the forearm of the thrust arm

After the availability of the theoretical conditions for conducting the regression coefficient in terms of the logical signs and the value of the regression coefficients, where the constant part achieved a positive value greater than zero, in addition to the fact that the regression coefficient has a positive value and ranges between (zero and the right one.)

Table (6) shows the results of the analysis of the multiple regression variances of the six models, and it is clear that there is a significant statistical effect of the independent variables. The table also shows the coefficients of the multiple regression equation, which are represented in the value of the B coefficient and the value of (F) and its significance, as well as the value of the fixed amount. Multiple regression equations can be formulated that help in forecasting The degree of the dependent variable given the degrees of the independent variables as follows:

y = dependent variable

A = constant amount

B = regression coefficient
X = the independent variable
Y=a+B1x1+ B 2x2+ B 3x3+ B 4x4+ B 5x5+ B 6x6
Numerical level = 21.8991 + (0.0337 x momentum of the center of gravity of the torso) +) 0.0003 x sum of force of the center of gravity of the right thigh + (0.0001 x the sum of the acceleration of the center of gravity of the thrust arm humerus) + (0.2091 x the sum of motion of the center of gravity of the right thigh) + (0.1843 x the resultant force of the center of gravity of the body) + (0.0009 x the net force of the center of gravity of the thrust arm crank.)

Table (6) shows a summary of the multiple regression models in a stepwise manner. The table shows the square of the multiple correlation coefficients or the determination coefficient Adjusted R2 in eight cases of biomechanical variables at the digital level for the mid-push moment in the shot put.

It also shows a summary of the stepwise multiple regression model, and the table displays the square of the multiple correlation coefficient or coefficient of determination in six cases. It is clear that the first case has determined the momentum variable for the center of gravity of the trunk at a rate of (88.096%), while the second step has achieved the momentum variables for the center of gravity of the stem and the result The force of the center of gravity of the right leg thigh combined, an explanation ratio of (93.825%) of the total variance, thus achieving the net force of the center of gravity of the right leg thigh a contribution rate of (5.729%), as the case or the third step shows for the variables of momentum of the center of gravity of the trunk and the net force of the center of gravity The right leg thigh and the resultant acceleration of the center of gravity of the humerus of the thrusting arm combined, an explanation ratio of (96.578%) of the total variance, and thus the result of the acceleration of the center of gravity of the humerus of the thrusting arm combined a contribution of (2.753%), as illustrates the case or the fourth step of the movement variables of the center of gravity of the trunk and the result The force for the center of gravity of the thigh of the right leg, the resultant acceleration of the center of gravity of the humerus of the thrusting arm, and the amount of motion for the center of gravity of the thigh of the right leg combined, an interpretation ratio of (98.278%), from the total variance, thus achieving the amount of motion for the center of confidence The right leg thigh has a contribution of (1,700%), as the case or the fifth step shows for the variables of the momentum of the center of gravity of the trunk, the net force of the center of gravity of the right leg thigh, the resultant acceleration of the center of gravity of the humerus of the pushing arm, the amount of motion of the center of gravity of the right leg thigh, and the total force of the center of gravity of the body combined. An explanation ratio of (99.303%) of the total variance, and thus achieved the net force of the center of gravity of the body, a contribution of (1.025%), as the case or the sixth step shows for the variables of the momentum of the center of gravity of the trunk and the net force of the center of gravity of the right leg thigh + the result of the wheel for the center of gravity of the arm humerus The thrust + the amount of movement of the center of gravity of the right leg thigh + the net force of the center of gravity of the body + the sum of the velocity of the center of gravity of the forearm of the thrusting arm combined, an interpretation ratio of (99.918%), from the total variance, thus achieving the resultant velocity of the center of gravity of the forearm of the thrust arm a contribution of (0.615%) This may be due to the importance of the horizontal displacement and the angle during the thrust phase in the thrust of the shot, especially the moment of the middle of the thrust phase. Here, through the contribution of momentum to the center of gravity of the trunk, and the links of the thrust arm, and the connections of the right leg, and therefore the force and speed of the center of gravity of the body, and this is confirmed by what Muhammad Jaber Bariqa and Khairiya Al-Sukari (2002 AD), that the force of the reaction of the earth, the strong and fast thrust through The foot to the ground up and forward This step is to maintain the generated momentum ( ) and transfer it to the rest of the body where M = momentum, m = mass, v = speed, (13: 196, 197)

Increasing the exertion of force leads to an increase in velocity, which means the rate of change in displacement with respect to time, and an increase in the velocity variable leads in turn to an increase in the acceleration (), and when the acceleration increases, it affects the increase in force, which is equal to the product of mass multiplied by the acceleration in which the body moves (). (4:46) (7:228,156), (10:27,26)

Table (7)
The matrix of the interrelationship between the biomechanical variables and the digital level at the moment of disposal in the shot put n=12

مركز ثقل الجسم				trunk center of gravity				Right foot center of gravity				The center of gravity of the right leg				The center of gravity of the right thigh				Push-arm humerus center of gravity				Push-arm crank center of gravity				المتغيرات	
محصلة القوة	كمية الحركة	محصلة العجلة	محصلة السرعة	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	Motion	resultant acceleration	net speed	net force	كمية الحركة	محصلة العجلة	محصلة السرعة		
																												محصلة السرعة	مركز ثقل ساعد ذراع الدفع
																											0.129	محصلة العجلة	
																										0.227	0.591	كمية الحركة	
																									0.630	0.222	0.978	محصلة القوة	
																								0.952	0.517	0.069	0.990	محصلة السرعة	مركز ثقل عضد ذراع الدفع
																							0.499	0.523	0.527	0.504	0.510	محصلة العجلة	
																						0.593	0.465	0.520	0.554	0.016	0.501	كمية الحركة	
																					0.507	0.518	0.976	0.996	0.603	0.181	0.991	محصلة القوة	
																				0.344	0.232	0.115	0.180	0.409	0.637	0.280	0.304	محصلة السرعة	مركز ثقل فخذ الرجل اليمنى
																			0.506	0.227	0.283	0.273	0.066	0.284	0.193	0.469	0.149	محصلة العجلة	
																		0.396	0.112	-0.136	0.014	-0.119	-0.239	-0.093	-0.136	0.435	-0.209	كمية الحركة	
																	-0.100	0.267	0.438	0.991	0.525	0.518	0.949	0.993	0.646	0.251	0.981	محصلة القوة	
																0.633	0.332	0.664	0.883	0.557	0.364	0.303	0.382	0.623	0.710	0.493	0.494	محصلة السرعة	مركز ثقل ساق الرجل اليمنى
															0.536	0.419	0.024	-0.038	0.709	0.380	0.133	-0.027	0.333	0.402	0.483	-0.163	0.384	محصلة العجلة	
														0.505	0.589	0.558	-0.139	0.304	0.618	0.536	-0.035	-0.012	0.450	0.565	0.260	0.089	0.506	كمية الحركة	
													0.545	0.393	0.575	0.994	-0.163	0.235	0.379	0.995	0.519	0.512	0.972	0.991	0.624	0.181	0.994	محصلة القوة	
												0.942	0.407	0.307	0.275	0.911	-0.344	-0.036	0.110	0.944	0.452	0.474	0.990	0.912	0.476	-0.016	0.971	محصلة السرعة	مركز ثقل قدم الرجل اليمنى
											0.983	0.983	0.472	0.349	0.428	0.963	-0.236	0.109	0.238	0.981	0.482	0.499	0.996	0.960	0.551	0.094	0.996	محصلة العجلة	
										0.538	0.459	0.608	0.230	0.572	0.719	0.644	0.016	0.201	0.642	0.594	0.562	0.668	0.512	0.625	0.933	0.371	0.581	كمية الحركة	
									0.547	0.111	-0.032	0.264	0.496	0.668	0.885	0.333	0.414	0.580	0.934	0.243	0.267	-0.008	0.060	0.317	0.523	0.259	0.181	محصلة القوة	
								0.467	0.576	0.266	0.190	0.374	0.195	0.094	0.577	0.403	-0.130	0.615	0.564	0.341	0.688	0.659	0.224	0.390	0.563	0.367	0.314	محصلة السرعة	مركز ثقل الجذع
							0.297	0.320	0.264	0.021	-0.076	0.119	0.290	-0.054	0.477	0.193	0.228	0.312	0.418	0.097	-0.176	0.227	-0.018	0.140	0.193	0.885	0.062	محصلة العجلة	
						0.073	0.320	0.203	0.580	0.990	0.960	0.996	0.519	0.373	0.520	0.986	-0.168	0.189	0.312	0.998	0.502	0.515	0.986	0.989	0.589	0.153	0.997	كمية الحركة	
					0.340	-0.155	-0.044	0.607	0.273	0.313	0.277	0.367	0.527	0.742	0.477	0.376	-0.084	-0.011	0.616	0.350	0.042	-0.425	0.290	0.370	0.425	-0.392	0.344	محصلة القوة	
				0.366	0.985	0.187	0.399	0.330	0.637	0.963	0.904	0.994	0.567	0.400	0.647	0.996	-0.087	0.301	0.432	0.989	0.509	0.518	0.948	0.992	0.646	0.257	0.980	محصلة السرعة	مركز ثقل الجسم
			0.892	0.281	0.951	-0.128	0.176	-0.047	0.453	0.978	0.997	0.931	0.402	0.313	0.256	0.895	-0.367	-0.041	0.096	0.934	0.444	0.470	0.986	0.899	0.475	-0.059	0.963	محصلة العجلة	
		0.176	0.479	0.787	0.377	0.457	0.170	0.794	0.471	0.309	0.197	0.427	0.660	0.630	0.804	0.481	0.149	0.291	0.836	0.405	-0.043	-0.180	0.264	0.455	0.561	0.238	0.365	كمية الحركة	
	0.329	0.968	0.970	0.325	0.991	0.094	0.276	0.151	0.582	0.997	0.972	0.986	0.478	0.376	0.468	0.967	-0.196	0.128	0.267	0.984	0.506	0.514	0.992	0.966	0.590	0.105	0.996	محصلة القوة	
*0.736	0.324	0.443	*0.837	0.272	*0.981	*0.778	0.351	0.180	0.453	0.374	0.352	0.272	0.471	*0.842	0.489	*0.769	-0.204	0.134	0.315	0.179	0.222	*0.912	0.270	0.368	0.125	0.190	0.479	المستوى الرقمي	

The tabular value of t at the level of significance 0.05 = 0.579

Table (7) shows the correlation coefficients between the numerical level and some biomechanical variables at the moment of disposal of the shot put among the members of the research sample. It is clear that there is a statistically significant correlation at the level of significance 0.05 in the number of (7) variables that ranged between (0.981 to 0.736), while there is no statistically significant correlation In the number (21) variables.

Table (8)
Regression analysis of biomechanical variables at the digital level at the moment of disposal in the shot put

R2 Adjusted	regression coefficients							fixed amount	standard error	q value	Contributing Indicators
90.539							0.1395	8.9947	0.1419	726.1434	Momentum of the trunk center of gravity
94.045						0.0009	0.1200	33.3403	9.4060	652.9183	Momentum of the trunk center of gravity
96.68					0.0005	0.0009	0.1062	46.6049	9.5456	562.5806	Momentum of movement of the center of gravity of the trunk + the resultant of the acceleration of the center of gravity of the thrust arm humer + the resultant of the acceleration of the center of gravity of the right leg

Follow Table (8)
Regression analysis of biomechanical variables at the digital level at the moment of disposal in the shot put

R2 Adjusted	regression coefficients							fixed amount	standard error	q value	Contributing Indicators
97.891				0.0012	0.0004	0.0008	0.0903	54.5856	8.0939	638.8657	Momentum of motion for the center of gravity of the trunk + the resultant of the acceleration of the center of gravity of the thrust arm humer + the result of the acceleration of the center of gravity of the right leg + the resultant of the velocity of the center of gravity of the body
98.912			0.0001	0.0011	0.0004	0.0008	0.0805	57.6261	5.9326	967.7955	Momentum of motion for the center of gravity of the trunk + the resultant of the acceleration of the center of gravity of the thrust arm humer + the result of the acceleration of the center of gravity of the right leg leg + the resultant of the velocity of the center of gravity of the body + the result of the acceleration of the center of gravity of the trunk
99.593		0.0041	0.0001	0.0009	0.0003	0.0008	0.0739	54.6587	5.2883	1060.2543	Momentum of motion for the center of gravity of the trunk + the resultant of the acceleration of the center of gravity of the humerus of the thrusting arm + the result of the acceleration of the center of gravity of the right leg + the resultant of the velocity of the center of gravity of the body + the resultant of the acceleration of the center of gravity of the trunk + the net force of the center of gravity of the right leg

Follow Table (8)
Regression analysis of biomechanical variables at the digital level at the moment of disposal in the shot put

R2 Adjusted	regression coefficients							fixed amount	standard error	q value	Contributing Indicators
99.691	0.0020	0.0030	0.0001	0.0005	0.0003	0.0007	0.0711	50.9143	4.8066	1199.7199	Momentum of motion for the center of gravity of the trunk + resultant of the acceleration of the center of gravity of the humerus of the thrust arm + the result of the acceleration of the center of gravity of the right leg + the resultant of the velocity of the center of gravity of the body + the result of the acceleration of the center of gravity of the trunk + the net force of the center of gravity of the thigh of the right leg + the net force of the center of gravity of the body

After the availability of the theoretical conditions for conducting the regression coefficient in terms of the logical signs and the value of the regression coefficients, where the stator achieved a positive value greater than zero, in addition to the fact that the regression coefficient has a positive value and ranges between (zero and the right one.(

Table (8) shows a summary of the stepwise multiple regression models. The table shows the square of the multiple correlation coefficients or the determination coefficient Adjusted R2 in seven cases of biomechanical variables at the digital level at the moment of disposal in the shot put.

The table also shows the results of the analysis of the multiple regression variances of the seven models, and it is clear that there is a significant statistical effect of the independent variables. The table also shows the coefficients of the multiple regression equation, which are represented in the value of the B coefficient and the value (q) and its significance, as well as the value of the fixed amount. Multiple regression equations can be formulated that help predict the degree of The dependent variable, given the degrees of the independent variables, is as follows:

y = dependent variable

A = constant amount

B = regression coefficient

X = the independent variable

Y=a+B1x1+ B 2x2+ B 3x3+ B 4x4+ B 5x5+ B 6x6+ B 7x7

Numerical level = 150.9143 + (0.0711 x momentum of the center of gravity of the torso) + (0.0007 x the sum of the acceleration of the center of gravity of the thrust arm humerus) + (0.0003 x the sum of the acceleration of the center of gravity of the right leg of the leg) + (0.0005 x the sum of the acceleration of the center of gravity of the body) +) 0.0001 x the resultant acceleration of the center of gravity of the trunk) + (0.0030 x the net force of the center of gravity of the right leg + (0.0020 x the net force of the center of gravity of the body(

Table (8) also shows a summary of the stepwise multiple regression model, and the table displays the square of the multiple correlation coefficient or coefficient of determination in six cases. The center of gravity of the trunk and the resultant acceleration of the center of gravity of the thrust arm humer combined have an explanation ratio of (94.045%) of the total variance, and thus the result of the acceleration of the center of gravity of the thrust arm humerus has a contribution rate of (3.506%), as the case or the third step of the movement variables of the center of gravity of the trunk shows. And the resultant acceleration of the center of gravity of the humerus of the thrusting arm + the sum of the acceleration of the center of gravity of the right leg leg and combined, an interpretation ratio of (96.680%) of the total variance, and thus the resultant acceleration of the center of gravity of the right leg leg achieved a contribution of (2.635), as the case or the fourth step of the motion variables shows. The center of gravity of the trunk and the resultant acceleration of the center of gravity of the humerus of the thrusting arm and the result of the acceleration of the center of gravity of the right leg leg + the resultant velocity of the center of mass of the body combined an interpretation ratio of (97.891%) of the total variance, thus achieving the resultant velocity of the center of gravity of the palpation A contribution of (1.121%), as illustrates the case or the fifth step of the momentum variables for the center of gravity of the trunk, the resultant acceleration of the center of gravity of the humerus of the thrusting arm, the net acceleration of the center of gravity of the right leg leg, the resultant velocity of the center of gravity of the body and the resultant acceleration of the center of gravity of the trunk combined, an interpretation ratio of (98.912). %) of the total variance, and thus achieved the resultant acceleration of the center of gravity of the trunk, a contribution of (1.021%), as the case or the sixth step of the variables of motion of the center of gravity of the trunk and the resultant acceleration of the center of gravity of the humer of the pushing arm and the result of the wheel of the center of gravity of the right leg leg and the resultant velocity of the center of gravity of the body and the resultant acceleration of the center of gravity of the body The acceleration of the center of gravity of the trunk and the net force of the center of gravity of the right leg thigh combined, an explanation ratio of (99.593%) of the total variance, and thus the net force of the center of gravity of the right leg thigh achieved a contribution of (0.681%), as illustrates the case or the seventh step of the variables of the amount of motion of the center of gravity of the trunk and the result The acceleration of the humeral center of gravity of the thrust arm and the resultant of the acceleration of the center of gravity of the right leg leg and the resultant velocity of the center of gravity of the body and the resultant of the acceleration of the center of gravity of the torso and the net force of the center of gravity of the right leg thigh and the net force of the center of confidence The body combined has an explanation ratio of (99.691%) of the total variance, and thus achieved the net force of the center of gravity of the body, a contribution of (0.098%), and this may be due to the fact that this moment is the sum of all the previous moments from the beginning of the movement from the first stage to the last moment in the Propulsion, and the continuation of exerting effort, especially the elements of force and speed, in the same motor path in the direction of the center of gravity of the body during the moments of performance, so most of the body's connections moved quickly, and because the relationship is direct between speed and acceleration, and as a result of the improvement in the level of speed obtained in most of the body connections, the wheel of the center of gravity of the humeral improved The thrust arm, at the center of gravity of the humerus of the thrust arm, at the center of gravity of the humerus of the thrust arm the trunk, and since the force variable is the product of the product of mass multiplied by the acceleration, the force variable contributed to the center of gravity of the right leg thigh, the net force of the center of gravity of the body, and the momentum variable contributed the product of mass In speed, therefore, the variable of the amount of movement contributed to the center of gravity of the trunk, so the variables of the total force of the thigh, torso and the body, the amount of movement of the forearm, thigh and trunk, and the center of gravity of the body improved.

(5:46), (7:154-156, 291-295), (10:98), (12:176, 189, 203)

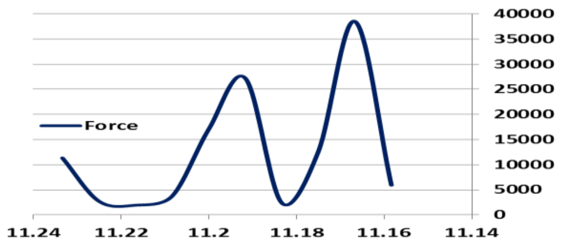


Figure (1) The dynamics of the net force of the center of gravity of the body from the beginning of the thrust phase to the disposal

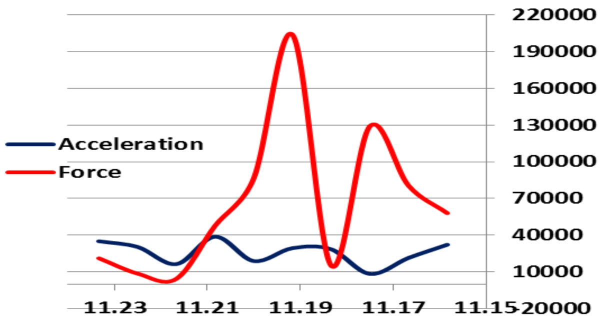


Figure (2) The dynamics of the wheel and force of the center of gravity of the right leg from the beginning of the thrust phase to the disposal

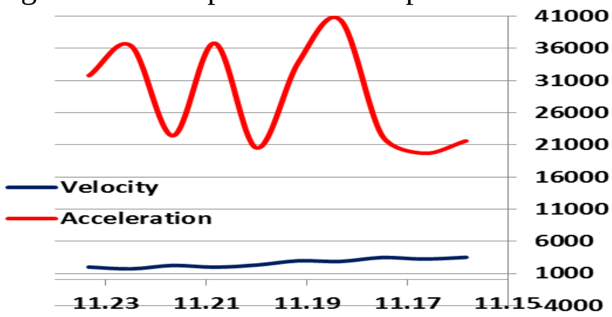


Figure (3) The dynamics of the resultant velocity and acceleration of the center of gravity of the body from the beginning of the thrust phase until disposal

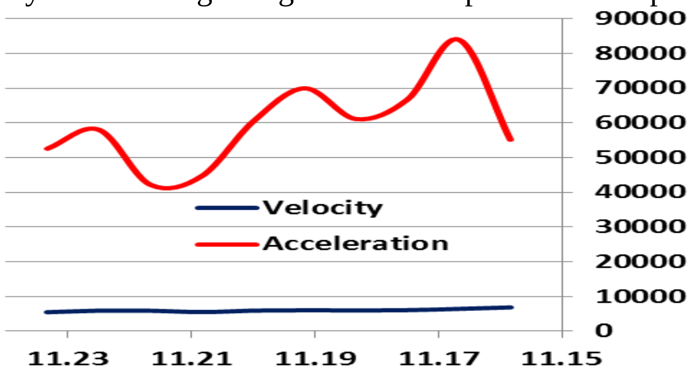


Figure (4) The dynamics of the resultant velocity and acceleration of the center of gravity of the thrust arm humerus from the beginning of the thrust phase to the disposal

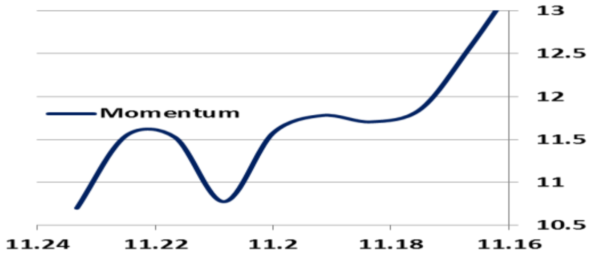
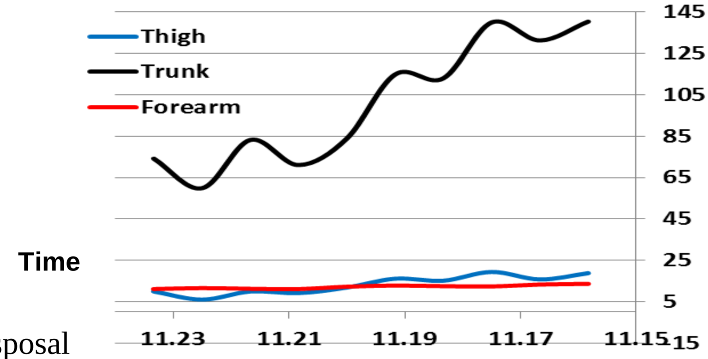


Figure (5) Momentum dynamics of the center of gravity of the thrust arm humerus from the beginning of the thrust phase to the



disposal

Figure (6) Dynamics of momentum of the center of gravity of the right thigh, trunk and forearm of the thrusting arm from the beginning of the thrust phase to the disposal

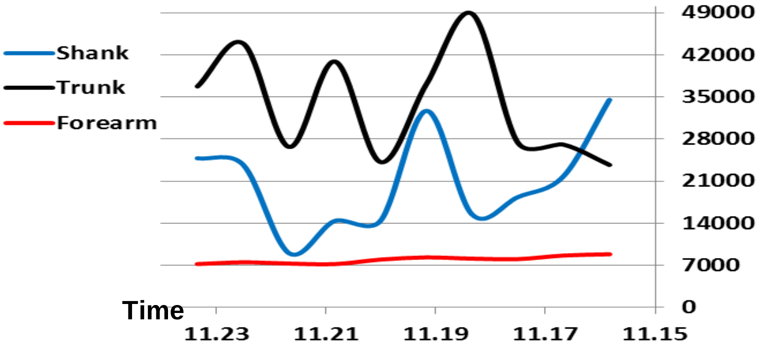


Figure (7) The dynamics of the wheel-sum of the center of gravity of the right leg and the torso and the net velocity of the forearm of the thruster arm from the beginning of the thrust phase to the disposal

Conclusions:

Based on the results of the statistical analysis of the data, the following conclusions were reached:

A- There are indicators that contributed to the numerical level at the moment of the beginning of the thrust phase: the net force of the center of gravity of the body, the net acceleration of the center of gravity of the right leg thigh, the resultant velocity of the center of gravity of the body, the net velocity of the center of gravity of the humerus of the thrust arm, the momentum of the movement of the center of gravity of the forearm of the thrust arm, the amount of movement The center of gravity of the humerus of the thrust arm, the resultant of the acceleration of the center of gravity of the body, the momentum of the center of gravity of the right thigh thigh.

Predictive equations:

Y = dependent variable, A = constant, B = regression coefficient, X = independent variable

Y=a+B1x1+ B 2x2+ B 3x3+ B 4x4+ B 5x5+ B 6x6+ B 7x7+ B 8x8

Numerical level = 121.8753 + (0.0060 x net force of center of gravity of the body) + (0.0069 x net of acceleration of center of gravity of the right leg thigh) + (0.1212 x net force of center of gravity of body) + (0.0096 x net of velocity of center of gravity of thrust arm humerus) +) 0.0347 x momentum of the center of gravity of the thrust arm humerus) + (0.0303 x momentum of the center of gravity of the thrust arm humerus) + (0.0020 x the sum of the acceleration of the center of gravity of the body) + (0.1622 x the momentum of the center of gravity of the right leg thigh(

B- The presence of indicators that contributed to the digital level at the moment of the middle of the payment in the payment of the repayment:

Momentum of movement for the center of gravity of the torso, the net force of the center of gravity of the right leg thigh, the resultant of the acceleration of the center of gravity of the humerus of the thrusting arm, the momentum of the center of gravity of the center of gravity of the thigh of the right leg, the net force of the center of gravity of the body, the net of velocity of the center of gravity of the forearm of the thrusting arm

Predictive equations:

Y=a+B1x1+ B 2x2+ B 3x3+ B 4x4+ B 5x5+ B 6x6

Numerical level = 21.8991 + (0.0337 x momentum of the center of gravity of the torso) +) 0.0003 x sum of force of the center of gravity of the right thigh + (0.0001 x the sum of the acceleration of the center of gravity of the thrust arm humerus) + (0.2091 x the sum of motion of the center of gravity of the right thigh) + (0.1843 x the resultant force of the center of gravity of the body) + (0.0009 x the net force of the center of gravity of the thrust arm crank.(

C- The presence of indicators that contributed to the digital level at the moment of disposal in paying the bill:

Momentum of motion for the center of gravity of the trunk, the result of the acceleration of the center of gravity of the humerus of the thrusting arm, the sum of the acceleration of the center of gravity of the right leg of the leg, the sum of the velocity of the center of gravity of the body, the result of the acceleration of the center of gravity of the trunk, the net force of the center of gravity of the thigh of the right leg, the net force of the center of gravity of the body.

Predictive equations:

Y=a+B1x1+ B 2x2+ B 3x3+ B 4x4+ B 5x5+ B 6x6+ B 7x7

Numerical level = 150.9143 + (0.0711 x momentum of the center of gravity of the torso) + (0.0007 x the sum of the acceleration of the center of gravity of the thrust arm humerus) + (0.0003 x the sum of the acceleration of the center of gravity of the right leg of the leg) + (0.0005 x the sum of the acceleration of the center of gravity of the body) +) 0.0001 x the resultant acceleration of the center of gravity of the trunk) + (0.0030 x the net force of the center of gravity of the right leg + (0.0020 x the net force of the center of gravity of the body(

Recommendations:

In light of the conclusions, the researcher recommends the following:

-Be guided by the biomechanical indicators under discussion that contributed to the digital level and predictive equations in selecting the shot put players.

-Developing educational and training programs to push the shot put in light of the indicators under discussion that contributed to the digital level and predictive equations.

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