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A comparative study of kinematical variables of snatch technique between men and women of Elite Indian weightlifters

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Abstract

The main purpose of this study was purposive selected from the relative strength among the different weight categories of 70th Men & 33rd women senior national weight lifters. Men and women weightlifters participated in various weight categories, acted as the subjects. The age of the subjects ranged from 18-35 years. The total subjects were selected one ninety (N=80) forty (40) men and forty (40) women subject were selected. And first group were men weight categories (56 kg, 62 kg, 69 kg, 77 kg, 85 kg, 94 kg, 105 kg, & +105 kg). The second group women weight categories (48 kg, 53 kg, 58 kg, 63 kg, 69 kg, 75 kg, 90 kg & +95 kg.), The sum of the best one lift for (snatch and clean & jerk) of respective events was considered as the scores of the lifters. The analysis of data was using Statistical Package for the (SPSS) version 21 computing Mean, S.D. and t-ratio were compare the significant difference between “70th MEN & 33rd Men and Women” weightlifters of kinematical variables like Angle of Ankles Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet's, Central of gravity (C.G.) for the different weight category and deferent position of snatch lift performance (1.initial position, 2. First pull, 3.transition phase, 4. Second pull, 5. Turnover under the barbell, 6. The catch phase) It was discovered there was significant difference between the mean scores of Comparative kinematical variables between men and women senior national weight lifters.

Keywords: Senior national, mangalore, karnataka weight categories, kinematics, men, women

Introduction

The sport or activity of lifting barbells or other heavy weights. There are two standard lifts in modern weightlifting: the single-movement lift from floor to extended position (the *snatch*), and the two-movement lift from floor to shoulder position, and from shoulders to extended position (the clean and jerk).

Kinematics

In classical mechanics, we are ultimately interested with understanding the motion of objects. However, before we can even begin to discuss the causes of such motion (i.e. before we study the dynamics of physical systems) we must first find a way of describing the motion of objects. In other words, we want to develop a mathematical formalism that allows us to represent the position, velocity, and acceleration of moving objects, and to express how these quantities are related to each other in time.

Biomechanical Analysis

Biomechanical Knowledge is a “Must” for Coaching. All movements of men and animals are determined by the laws of mechanics. It is the first task of science (but only the first) to understand movements of athletes. Teachers and coaches of human movement, safety equipment designers, rehabilitation specialists, and students performing advanced research in the area of human biomechanics will appreciate the scientific and mathematical focus in the text. This focus allows readers to gain an understanding of human biomechanics that will enhance their ability to estimate or calculate loads applied to the body as a whole or induced in individual structures.

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Biomechanical Analysis of Fundamental Human Movements begins with a discussion of the principles of biomechanics and then continues into more advanced study involving the mechanical and mathematical bases for a range of fundamental human activities and their variations, including balance, slipping, falling, landing, walking, running, object manipulation, throwing, striking, catching, climbing, swinging, jumping, and airborne maneuvers. Each activity is analyzed using a specific seven-point format that helps readers identify the biomechanical concepts that explain how the movements are made and how they can be modified to correct problems. The seven points for analysis are aim, mechanics, biomechanics, variations, enhancement, safety, and practical examples that move from the simple to the more complex. More than 140 figures illustrate the points of analysis throughout the text, providing readers with a clear depiction of both the mechanics and mathematics involved in human movements. Biomechanical Analysis of Fundamental Human Movements provides a complete understanding of this branch of human biomechanics using mechanical, mathematical, and biological definitions and concepts. Its focus on fundamental human activities develops advanced analytical skills and provides a unique and valuable approach that facilitates mastery of a body of information and a method of analysis applicable to further study and research in human movement.

Objective of the study

1. To describe the kinematical analysis for the snatch technique between men and women of Elite Indian weightlifters.
2. To compare the kinematical analysis for the snatch technique between men and women of Elite Indian weightlifters.

Methodology

Participants

The main purpose of this study was purposive selected from the “70th Men and 33rd women senior national weightlifting championship held at Mangalore, Karnataka 21st to 25 January 2018. Men and women weightlifters participated in various weight categories, acted as the subjects. The age of the subjects ranged from the 18- 35 years. The total subjects were selected one ninety (N=80) forty (40) men and forty (40) women subject were selected. And first group were men weight categories (56 kg, 62 kg, 69 kg, 77 kg, 85 kg, 94 kg, 105 kg, & +105 kg). The second group women weight categories (48 kg, 53 kg, 58 kg, 63 kg, 69 kg, 75 kg, 90 kg & +95 kg.)

Collection of Data

In order to measure the kinematic analysis for snatch lift of

elite Indian weightlifters of different weight category men & women, the data was collected from the results for the 70th Men and 33rd women senior national weightlifter” for the 21st to 25 January 2018 held at Mangalore, Karnataka, India. The sum of the best 3 lifts for each weight category of respective events was considered as the scores of the lifters.

Filming protocol

Siliconcoach 7 and Kinovea software’s were used for Kinematical analysis of snatch technique in weightlifting. High speed camera Casio Exilim.EX-F1 which was position at 7.70m from the subject at a front of the subjects and second camera was position at 6.50m from right side of the subject on an extension of restricted area line. 300 Frames per second were obtained. The subject was got 3 trails. The kinematical variables of the body were calculated at the different phases of snatch skill which is listed below.

Analysis of film

- a) The 300 frames per second as obtained by the use of high speed video grapey was analyzed (the best trail) by Siliconcoach Pro-7 and Kinovea software’s. Only one selected frame obtained and investigator developed the stick figures from which various kinematical measurements were taken. The stick figures were developing by using joint point method in which the body projections at the joints facing the camera was considered.
- b) The videos of technique of subjects were captured at National Weightlifters from “70th Men and 33rd women senior national weightlifting championship held at Mangalore, Karnataka 21st to 25 January 2018. The videos were captured under controlled conditions.

Data Analysis

The data thus collected were statistically treated by using Statistical Package for the (SPSS) version 21 computing Mean, S.D. and t-ratio were compare the significant difference between “70th Men and 33rd women senior national weightlifter of the kinematical variables like Angle of Ankle, angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet’s, Central of gravity (C.G.) for the different weight category and deferent position of snatch lift performance (1.initial position, 2. First pull, 3. transition phase, 4. Second pull, 5. Turnover under the barbell, 6. The catch phase) for the different weight category. The results have been presented in the following table:

Results and Findings

Table 1: Independent t-test of initial position between men and women of snatch lift performance of selected kinematics variables of elite Indian weightlifters.

S. N.	Variables	Groups	M	SD	MD	Calculated t-ratio	Tabulated t-ratio
1.	Performance	Men	140.02	12.25	55.37	25.899917	
		Women	84.65	5.92			
2.	Angle of Ankle	Men	72.4250	7.46578	-5.225	-3.2700188	
		Women	77.6500	6.81081			
3.	Angle of Knee	Men	62.2750	12.33088	-3.55	-1.6086003	
		Women	65.8250	6.53938			
4.	Angle of Hip	Men	39.5250	6.39306	2.7	1.6062664	
		Women	36.8250	8.49400			
5.	Angle of shoulder	Men	47.1500	5.54954	0.7	0.667618	

		Women	46.4500	3.63000			
6.	Angle of Elbow	Men	178.0250	6.01062	-1.6	-1.56895	1.990
		Women	179.6250	2.33905			
7.	Angle of Wrist	Men	166.9000	4.83470	-5.175	-3.45869	
		Women	172.0750	8.13472			
8.	Angle of Head Inclination	Men	63.5250	12.06391	-5.275	-1.34351	
		Women	68.8000	21.70454			
9.	Angle of Trunk Inclination	Men	47.7000	4.21353	1.3	1.415395	
		Women	46.4000	3.99872			
10.	Distance between both Feet	Men	.4290	.01374	-41.946	-149.151	
		Women	42.3750	1.77861			
11.	Centre of gravity	Men	.5820	.03539	0.028	4.197982	
		Women	.5540	.02296			

*significant set at 0.05 level (2,78), 1.990

Table-1 reveal that the angular kinematic variables included Angle. Performance, Angle of ankle, Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet and Centre of gravity Initial Position, were found superior to calculated, t- value performance (25.37), Angle of ankle (-3.27), Angle of Wrist (-3.45), Distance

Between both feet (-149.151) and Centre of gravity (4.19) were less than tabulated t- value (1.990) hence it is concluded that there is no significant difference between all five (7) kinematic variables Angle of knee, hip, shoulder, elbow, head inclination, trunk inclination between Men and women elite Indian weightlifters the level of significant set at 0.05level.

Table 2: Independent t-test of first pull between men and women of snatch lift performance of selected kinematics variables of elite Indian weightlifters

S.N.	Variables	Groups	M	SD	MD	t	Tabulated t
1.	Angle of Ankle	Men	91.8250	5.73736	-1.83750	-7.525	
		Women	93.6625	14.22231			
2.	Angle of Knee	Men	119.3000	7.75986	4.60000	2.802	
		Women	114.7000	6.89928			
3.	Angle of Hip	Men	74.2500	6.39611	3.15000	2.559	
		Women	71.1000	4.43645			
4.	Angle of shoulder	Men	47.2500	4.14327	-1.22500	-1.176	
		Women	48.4750	5.12404			
5.	Angle of Elbow	Men	175.8750	16.91030	-3.45000	-1.278	1.990
		Women	179.3250	2.32476			
6.	Angle of Wrist	Men	167.7500	13.51685	-2.20000	-.920	
		Women	169.9500	6.77458			
7.	Angle of Head Inclination	Men	56.9250	20.53688	-8.57500	-2.539	
		Women	65.5000	5.85728			
8.	Angle of Trunk Inclination	Men	41.7750	4.07926	.70000	.720	
		Women	41.0750	4.60428			
9.	Distance between both Feet	Men	.4293	.01439	-40.71825	-157.047	
		Women	41.1475	1.63973			
10.	Centre of gravity	Men	.8190	.03455	-7.17725	-2.038	
		Women	7.9963	22.26847			

*significant set at 0.05 level (2,78), 1.990

Table-2 reveal that the angular kinematic variables included Angle. Performance, Angle of ankle, Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet and Centre of gravity first pull, were found superior to calculated, t- value Angle of ankle (-7.525), Angle of knee (2.06), Angle of hip (2.559), Head inclination (-2.539)

Distance Between both feet (157.047) and Centre of gravity t value (-2.038) were less than tabulated t- value (2.000) hence it is concluded that there is no significant difference between all four (4) kinematic variables Angle of shoulder, Elbow, wrist, trunk inclination between Men and women elite Indian weightlifters the level of significant set at 0.05level.

Table 3: Independent t-test of Transition phase between men and women of snatch lift performance of selected kinematics variables of elite Indian weightlifters

S. N.	Variables	Groups	M	SD	MD	t	Tabulated t
1.	Angle of angle	Men	89.8250	5.87863	-2.85	-2.179	1.990
		Women	92.6750	5.81945			
		Men	120.4250	8.07937			
2.	Angle of Knee	Women	111.2750	9.67150	9.15000		
3.	Angle of Hip	Men	102.0500	8.15224	-.62500	-2.42	
		Women	102.6750	14.13196			
4.	Angle of shoulder	Men	31.0000	6.32861	3.12500	2.287	
		Women	27.8750	5.88430			

5.	Angle of Elbow	Men	172.2750	8.80264	-11.42500	-7.430	
		Women	183.7000	4.13366			
6.	Angle of Wrist	Men	171.8250	5.30548	1.32500	1.235	
		Women	170.5000	4.23054			
7.	Angle of Head Inclination	Men	73.0000	9.10058	-4.32500	-2.479	
		Women	77.3250	6.23632			
8.	Angle of Trunk Inclination	Men	62.4500	5.62481	-8.17500	-5.952	
		Women	70.6250	6.62043			
9.	Distance between both Feet	Men	.4303	.01544	-40.54475	-184.932	
		Women	40.9750	1.38652			
10.	Centre of gravity	Men	7.6390	23.95315	-3.21625	-.566	
		Women	10.8553	26.79685			

*significant set at 0.05 level (2,78), 1.990

Table-3 reveal that the angular kinematic variables included Angle. Angle of ankle, Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet and Centre of gravity Transition phase, were found superior to calculated, t- value Angle of ankle (-2.179), Angle of knee (4.592), Angle of shoulder (2.287), Elbow (-.7.430), Head

inclination (-2.479), trunk inclination (-5.952) and Distance Between both feet (184.932) were less then tabulated t- value (1.990) hence it is concluded that there is no significant difference between all three (3) kinematic variables Angle of Hip, wrist, and Centre of gravity between Men and women elite Indian weightlifters the level of significant set at 0.05level.

Table 4-5: Independent t-test of second pull between men and women of snatch lift performance of selected kinematics variables of elite Indian weightlifters

S.N.	Variables	Groups	M	SD	MD	T	Tabulated t
1.	Angle of Ankle	Men	106.2500	9.87810	-10.6	-5.15	1.990
		Women	116.8500	8.44150			
2.	Angle of Knee	Men	135.3750	10.14178	1.22500	.661	
		Women	134.1500	5.87716			
3.	Angle of Hip	Men	157.8000	8.63564	-1.47500	-.992	
		Women	159.2750	3.72096			
4.	Angle of Shoulder	Men	25.1250	7.37003	-21.20000	-2.724	
		Women	46.3250	48.66441			
5.	Angle of Elbow	Men	173.6250	8.80468	-5.26500	-2.986	
		Women	178.8900	6.84138			
6.	Angle of Wrist	Men	164.7000	10.94790	-3.23250	-1.648	
		Women	167.9325	5.83295			
7.	Angle of Head Inclination	Men	80.5750	8.24275	-1.90000	-1.140	
		Women	82.4750	6.56325			
8.	Angle of Trunk Inclination	Men	81.9750	4.03502	1.97500	1.919	
		Women	80.0000	5.10907			
9.	Distance between both Feet	Men	.4400	.04925	-41.01000	-157.330	
		Women	41.4500	1.64784			
10.	Centre of gravity	Men	1.0683	.04851	-18.82985	-3.085	
		Women	10.8553	26.79685			

*significant set at 0.05 level (2,78), 1.990

Table-3 reveal that the angular kinematic variables included Angle. Angle of ankle, Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet and Centre of gravity Second pull, were found superior to calculated, t- value Angle of ankle (-5.15), Angle of shoulder (-2.724), Angle of Elbow (2.986), Distance Between both feet

(-157.330) and Centre of gravity (-3.085) were less then tabulated t- value (1.990) hence it is concluded that there is no significant difference between all six (6) kinematic variables Angle of Knee, Hip, wrist, Head inclination, and trunk inclination between Men and women elite Indian weightlifters the level of significant set at 0.05level.

Table 6: Independent t-test of Turnover under the barbell between men and women of snatch lift performance of selected kinematics variables of elite Indian weightlifters.

S. N.	Variables	Groups	M	SD	MD	t	Tabulated t
1.	Angle of Ankle	Men	74.5750	7.32011	0.6	0.469	1.990
			73.9750	3.42934			
			70.1250	5.05958			
2.	Angle of Knee	Women	76.4625	6.43821	-6.33750	-4.895	
		Men	104.7000	13.41297			
3.	Angle of Hip	Women	117.6000	14.28070	-12.90000	-4.164	
		Men	110.3500	20.94872			
4.	Angle of shoulder	Women	137.9500	11.09389	-27.60000	-7.364	
		Men	118.0500	15.66959			

		Women	122.4500	17.73733		
5.	Angle of Elbow	Men	171.5000	13.78777	-4.40000	-1.176
		Women	162.2250	7.94690		
6.	Angle of Wrist	Men	73.8750	18.02589	9.27500	3.686
		Women	71.3250	16.04223		
7.	Angle of Head Inclination	Men	80.9000	5.94332	2.55000	.668
		Women	83.7250	3.53726		
8.	Angle of Trunk Inclination	Men	2.4218	12.41855	-2.82500	-2.583
		Women	45.6250	6.00294		
9.	Distenve between both Feet	Men	1.0683	.04851	-43.20325	-19.810
		Women	10.8553	26.79685		
10.	Centre of gravity	Men	0.819	0.03455	.04363	2.654
		Women	7.9963	22.26847		

*significant set at 0.05 level (2,78), 1.990

Table-3 reveal that the angular kinematic variables included Angle. Angle of ankle, Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet and Centre of gravity turnover under the barbell phase, were found superior to calculated, t- value Angle of Knee (-4.895), Angle of Hip (-4.164), Angle of shoulder (-7.364), Wrist

(3.686), Trunk inclination (-2.583), trunk inclination (-5.952), Distance Between both feet (19.810) and Centre of gravity (2.654) were less then tabulated t- value (1.990) hence it is concluded that there is no significant difference between all three (3) kinematic variables Angle of ankle, Elbow, and Head Inclination between Men and women elite Indian weightlifters the level of significant set at 0.05level.

Table 7: Independent t-test of the catch phase between men and women of snatch lift performance of selected kinematics variables of elite Indian weightlifters

S. N.	Variables	Groups	M	SD	MD	t	Tabulated t
1	Angle of Ankle	Men	68.4250	6.11802	-4.475	-3.52	1.990
			72.9000	5.20256			
			32.2250	4.19699			
	Women	34.6250	9.49949				
2	Angle of Knee	Men	49.4250	7.27090	-2.40000	-1.462	
	Women	49.6500	3.41603				
3	Angle of Hip	Men	165.5750	9.36685	-.22500	-.177	
	Women	168.7750	52.35064				
4	Angle of shoulder	Men	163.7000	13.26495	-3.20000	-.381	
	Women	162.0500	8.32959				
5	Angle of Elbow	Men	142.0250	7.38844	1.65000	.666	
	Women	141.1750	5.51867				
6	Angle of Wrist	Men	39.5750	9.97918	.85000	.583	
	Women	39.0125	6.59301				
7	Angle of Head Inclination	Men	59.5750	3.68564	.56250	.297	
	Women	60.2250	1.74661				
8	Angle of Trunk Inclination	Men	.4593	.00888	-.65000	-1.008	
	Women	45.2750	2.85538				
9	Distance between both Feet	Men	.5858	.03679	-44.81575	-99.265	
	Women	.5238	.05319				
10	Centre of gravity	Men	0.819	0.03455	.06200	6.063	
	Women	7.9963	22.26847				

*significant set at 0.05 level (2,78), 1.990

Table-3 reveal that the angular kinematic variables included Angle. Angle of ankle, Angle of Knees, Angle of Hips, Angle of Shoulders, Angle of Elbow, Angle of Wrists, Trunk Inclination, Head Inclination, Distance Between both feet and Centre of gravity catch phase, were found superior to calculated, t- value Angle of ankle (-3.52), Distance Between both feet (-99.265) and Centre of gravity (6.063) were less then tabulated t- value (1.990) hence it is concluded that there is no significant difference between all seven (7) kinematic variables Angle of Knee, Hip, shoulder, elbow, wrist, Head inclination, and trunk inclination between Men and women elite Indian weightlifters the level of significant set at 0.05level.

Conclusion

After applying the independent t-test it was found to have a significant difference between men and women men groups

mean score was more than the women groups mean score for the deferent snatch lift technique position like initial position, first pull, transition, second pull, turn over under the barbell and the catch phase in their kinematical variables. Significance was set at 0.05 level. This is probably due to the perfect angle of the joint and follow to exact technique and may be more effect of muscular strength because make a good snatch position so must be perfect angle of joints then more perfect work through muscles groups. Hence kinematical variables good effective for the men weightlifters because good muscular strength provides good power of groups of muscles so that best performance of snatch lift technique that's why score of mean value and results of men weightlifters. And other aspect of effects snatch lift technique for the selected position vise kinematical variables may be center of gravity different nature of the training components and pre-requisite for lifters. These results may be due to

muscular strength according to individual differences male and female and other factors such as different types of body, differences in body composition, and may be psychological, and physiological variable etc.

- To compare the initial position for the snatch lift technique through kinematical variables between men and women elite Indian weightlifters therefor significant deference between men and women performance, Angle of ankle, Angle of Shoulders, Angle of Wrist, Distance Between both feet and center of gravity and no significant deference of Angle of knee, hip, elbow, head inclination and trunk inclination.
- To compare the first pull for the snatch lift technique through kinematical variables between men and women elite Indian weightlifters therefor significant deference between men and women snatch lift performance, Angle of ankle, Angle of knee, Angle of hip, Head inclination, Distance Between both feet and centre of gravity t value and centre of gravity and no significant deference of Angle of shoulder, Elbow, wrist, trunk inclination.
- To compare the transition phase for the snatch lift technique through kinematical variables between men and women elite Indian weightlifters therefor significant deference between men and women Angle of ankle, Angle of knee, Angle of shoulder, Elbow, Head inclination, trunk inclination, and Distance Between both feet and no significant deference of Angle of Hip, wrist, and centre of gravity.
- To compare the second pull for the snatch lift technique through kinematical variables between men and women elite Indian weightlifters therefor significant deference between men and women Angle of ankle, Angle of shoulder, Angle of Elbow, Distance Between both feet and centre of gravity (-3.085) and no significant deference of kinematic variables Angle of Knee, Hip, wrist, Head inclination, and trunk inclination
- To compare the turnover under the barbell for the snatch lift technique through kinematical variables between men and women elite Indian weightlifters therefor significant deference between men and women Angle of Knee, Angle of Hip, Angle of shoulder, Wrist, Trunk inclination, trunk inclination, Distance Between both feet and centre of gravity and no significant deference of Angle of ankle, Elbow, and Head Inclination
- To compare the catch phrase for the snatch lift technique through kinematical variables between men and women elite Indian weightlifters therefor significant deference between men and women value Angle of ankle, Distance Between both feet and centre of gravity and no significant deference of Angle of Knee, Hip, shoulder, elbow, wrist, Head inclination, and trunk inclination.

Significance of the study

The result of the study may provide an authentic understanding of role of selected kinematic variables of snatch in weight lifting even though there are numerous factors which will be responsible for the performance of the weight lifters including Biomechanics of human activity and the physique (Size and shape). The present study will be contributed to the physical educator, coaches and trainees in following ways;

1. The results of this study were indicate the variables which may considered as factors affecting the performance of snatch in weight lifting.
2. The result was provided a model for the teaching of

different phases in snatch in weightlifting.

3. The result of the study was helpful in preparation of training schedules for weight lifters more efficiently.
4. Finding of the study was used to identify the talented weight lifters.
5. Finding of the study was used to identify the talented weight lifters.

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