CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

Coaches can no more afford to waste their time with athletes who fail to excel when faced with tough competitive situations. Where as the research scholar has not come across any appropriate simulation study on the same at the same time feasible criteria for evaluating techniques (shoulder throw is the most popular technique) in judo is not available. This motivated the research scholar to undertake biomechanical study relating with anthropometry, flexibility and motor fitness on two variation of shoulder throw; the one arm shoulder throw and both arm shoulder throw, on the basis of selected kinetic and kinematic parameters related to effectiveness in throwing by developing suitable and feasible criteria for evaluation as well as to find out the contributing biomechanical, Anthropometric, flexibility and motor fitness factors for effective execution of different variation of Seoi Nage.

The purpose of this study was to develop suitable and feasible criteria for evaluating different variations of seoi nage and to find out the contributing biomechanical, anthropometric flexibility and motor fitness factors for effective execution of different variation of Seoi Nage.
The subjects were 28 male judoka, who were well experienced and well skilled, and their age ranged between 18 to 30 years.

Selected biomechanical variables were recorded in pre-determined variations of shoulder throw i.e., one arm shoulder throw and both arm shoulder throw, at N.S.N.I.S., Patiala by using two dimensional cinematography method. The speed of sixteen mm. movie camera (Bio-mechanics-500 photosonic IPL) was 100 frames/second. After processing the films were analysed on film motion analyser (Nac-76-1) in the Biomechanics Laboratory of N.S.N.I.S., Patiala.

In the process of criterion development, it was seen that the objectivity of the expert rating on seoi nage were highly significant, as all the Co-efficient value were 80 or more than that, it was concluded that the given criteria or the understanding of the expert respectively on Ippon Seoi Nage and Morote Seoi Nage performance were objective.

It is evident that out of the 13, criteria under consideration the ratio of execution time and time of free fall from highest Y co-ordinate of thrower and total time are having significant relationship with the cumulative subjective rating of the three experts in both the technique that is $r = 0.647$, $r = 0.53$, $r = 0.578$ and $r = 0.499$ in Ippon Seoi Nage and Morote Seoi Nage respectively. Thus, considered, as criteria, and were well
supported with the relationship of their fractions and justifying variables. In continuation to support and rejustify the criteria. The objectivity of the expert rating again found to be highly significant. Replacement for field use of the criterion ratio of execution time and time of free fall by ratio of execution time and height of the respective thrower was found to be significantly high. As the co-efficient of correlation were obtained between height of thrower and time of free falling body were found to be highly significant. Arrived new criteria were well supported by the findings.

The following one hundred ninety seven Biomechanical variables were considered for the purpose of present study namely angle of inclination from horizontal (H) of the joining right shoulder (rt.sh) centre of foot (CF) when knee flexed (KF), angle of inclination from H of the line joining left shoulder (lt.sh) and CF when KF, angle of inclination from H of the line joining right hip (rt. hip) and CF when KF, angle of inclination from H of the line joining left hip (lt. hip) and CF when KF, angle of inclination from H of the line joining right knee (rt. knee) and CF when KF, angle of inclination from H of the line joining left knee (lt. knee) and CF when KF, angle of inclination from H of the line joining right ankle (rt. ank) and CF when KF, angle of inclination from H of the line joining left ankle (lt. ank) and CF when KF, angle of inclination from H of the line joining right centre of gravity (C.G) and CF when KF, angle of inclination from H of the line joining lt. C. G. and CF when knee flexed,
angle of inclination from H of the line joining rt.sh and CF when knee extended (KE), angle of inclination from H of the line joining lt.sh and CF when KE, angle of inclination from H of the line joining rt.hip and CF when KE, angle of inclination from H of the line joining lt.hip and CF when KE, angle of inclination from H of the line joining rt.knee and CF when KF, angle of inclination from H of the line joining lt.knee and CF when KE, angle of inclination from H of the line joining rt.ankle and CF when KE, angle of inclination from H of the line joining lt.ankle and CF when KE, angle of inclination from H of the line joining rt.C.G and CF when KE, angle of inclination from H of the line joining lt.C.G and CF when KE, angle of inclination from H of the line joining rt.sh and CF when hip flexed (HF), angle of inclination from H of the line joining lt.sh and CF when HF, angle of inclination from H of the line joining rt.hip and CF when HF, angle of inclination from H of the line joining lt.hip and CF when HF, angle of inclination from H of the line joining rt.knee & CF when HF, angle of inclination from H of the line joining lt.knee & CF when HF, angle of inclination from H of the line joining rt.ankle & CF when HF, angle of inclination from H of the line joining lt.ankle & CF when HF, difference in the angle of inclinations (DAI) between knee flex & ext positions (KFE) at rt.sh, DAI between KFE at lt.sh, DAI
between KFE at rt. hip, DAI between KFE at lt. hip, DAI between KFE at rt. knee, DAI between KFE at lt. knee, DAI between KFE at rt. ankle, DAI between KFE at lt. ankle, DAI between KFE at rt. C.G, AD between KFE at lt. C.G, Difference in the angle of inclination (DAI) between knee ext & hip fl. positions (KEHF) rt. sh, DAI between KEHF at lt. sh, DAI between KEHF at rt. hip, DAI between KEHF at lt. hip, DAI between KEHF at rt. knee, DAI between KEHF at lt. knee, DAI between KEHF at rt. ankle, DAI between KEHF at lt. ankle, DAI between KEHF at rt. C.G, DAI between KEHF at lt. C.G, Angle at ankle joint when knee flexed between rt. shin and horizontal (H), Angle (A) at ankle joint when knee fl. (KF) between lt. shin and H, Angle at ankle joint when KF between rt. foot and H, Angle at ankle joint when KF between lt. foot and H, Angle at rt. ankle total when KF, Angle at lt. ankle total when KF, Angle at knee joint when KF between rt. lower leg and H, Angle at knee joint when KF between lt. lower leg and H, Angle at knee joint when KF between rt. thigh and H, Angle at knee joint when KF between lt. thigh and H, Angle at rt. total knee when KF, Angle at lt. total knee when KF, Angle at hip joint (HJ) when KF between rt. thigh and H, Angle at HJ when KF between lt. thigh and H, Angle at HJ when KF between rt. sh and H, Angle at HJ when KF between lt. sh and H, Angle at rt. HJ total when KF, Angle at lt. HJ total when KF, Angle at ankle joint (AJ) when leg ext (LE) between rt. shin and H, Angle at AJ when LE between lt. shin and H, Angle at AJ when LE between rt. foot and H, Angle at AJ when LE between
AJ total differences between KFE position, Angle at lt. AJ total differences between KFE position, Angle at KJ formed by rt. lower leg differences between KFE position, Angle at KJ formed by lt. lower leg differences between KFE position, Angle at KJ formed by rt. thigh differences between KFE position, Angle at KJ formed by lt. thigh differences between KFE position, Angle at rt. KJ total differences between KFE position, Angle at lt. KJ total differences between KFE position, Angle at hip joint formed by rt. thigh differences between KFE position, Angle at HJ formed by lt. thigh differences between KFE position, Angle at HJ formed by rt. shin differences between KFE position, Angle at HJ formed by lt. shin differences between KFE position, Angle at HJ formed by rt. foot differences between KEHF position, Angle at AJ formed by lt. foot differences between KEHF position, Angle at AJ formed by rt. AJ total differences between KEHF position, Angle at lt. AJ total differences between KEHF position, Angle at KJ formed by rt. lower leg differences between KEHF position, Angle at KJ formed by lt. lower leg differences between KEHF position, Angle at KJ formed by rt. thigh differences between KEHF position, Angle at KJ formed by lt. thigh differences between KEHF position, Angle at rt. KJ total differences between KEHF position, Angle at lt. KJ
total differences between KEHF position, Angle at HJ formed by rt.thigh differences between KEHF position, Angle at HJ formed by lt.thigh differences between KEHF position, Angle at HJ formed by rt.sh differences between KEHF position, Angle at HJ formed by lt.sh differences between KEHF position, Angle at rt. HJ total differences between KEHF position, Angle at lt. HJ total differences between KEHF position, Angular velocity (AV) at AJ formed by rt.shin when knee extended completely from knee 'l.(KEKF), AV at AJ formed by lt.shin when KEKF, AV at AJ formed by rt.foot when KEKF, AV at AJ formed by lt.foot when KEKF, AV at rt. AJ total when KEKF, AV at lt. AJ total when KEKF, AV at KJ formed by rt.leg when KEKF, AV at KJ formed by lt.leg when KEKF, AV at KJ formed by rt.thigh when KEKF, AV at KJ formed by lt.thigh when KEKF, AV at rt. KJ total when KEKF, AV at lt. KJ total when KEKF, AV at HJ formed by rt.thigh when KEKF, AV at HJ formed by lt.thigh when KEKF, AV at HJ formed by rt.sh when KEKF, AV at HJ formed by lt.sh when KEKF, AV at rt. HJ total when KEKF, AV at lt. HJ total when KEKF, Angular velocity at ankle joint formed by rt.shin when hip flexed after knee ext. completely (HFKE), AV at AJ formed by lt.shin when HFKE, AV at AJ formed by rt.foot when HFKE, AV at AJ formed by lt.foot when HFKE. AV at rt. AJ total when HFKE, AV at lt. AJ total when HFKE, AV at knee joint formed by rt.lower leg when HFKE, AV at KJ formed by lt.lower leg when HFKE, AV at KJ formed by rt.thigh when HFKE, AV at KJ formed by lt.thigh when HFKE, AV at rt. KJ
total when HFKE, AV at lt. KJ total when HFKE, AV at hip joint.
formed by rt.thigh when HFKE, AV at HJ formed by lt.thigh when
HFKE, AV at HJ formed by rt.sh when HFKE, AV at HJ formed by
lt.sh when HFKE, AV at rt. HJ total when HFKE, AV at lt. HJ total
when HFKE, Total time taken to execute the throw(TT), Execution
time that is the time of main phase(ET), Time of freely falling
body from highest Y Coordinate(TFF, Ratio of ET and TFF,
Resultant velocity of freely falling body(RVFF), Time of knee fl.
from start of throwing(TKNFL), TKNFL to Foot detachment of
receiver(FD), TKNFL to Leg ext. , TKNFL to Belt in vertical line
of receiver(BVL), Time of FD to Leg-ext., Time of FD to BVL ,
Time of Leg ext. to BVL, Displacement(Dis) of thrower(TH) at X
coordinate, Displacement of thrower at Y coordinate, Displacement
resultant of thrower, Dis of receiver(RE) at X coordinate, Dis of
RE at Y coordinate, Dis resultant of RE and Final velocity of RE
when contacts the mat (FVR) , Final acceleration of RE when
contacts the mat (FAR) and Final force of contact of RE when
contacts the mat (FFCR)

Following seventeen anthropometric variables namely

- total body weight (grams), stature (cm), Acromiale height,
- sitting weight, trunk length, upper arm length, fore arm length,
- sum of upper and forearm length, trochanterion-tibiae externum
length (thigh length), lower leg length, sum of thigh and lower
leg length, foot length, bicromial diameter, crural index, trunk
leg length ratio, upperfore arm length ratio and ponderal index

were considered for the purpose of the present study.
Following twentyfive flexibility and motor performance variables were considered for the purpose of the present study namely right grip strength (isometric) in kg., left grip strength (isometric) in kg., leg extension strength (isometric) in kg., back extension strength (isometric) in kg., bench press for maximum strength of arm extension (isotonic) in kg., dips test for maximum arm and shoulder strength (isotonic) in kg., sit up for abdomen maximum strength in kg., bench squat for legs and back strength in kg., vertical arm pull (explosive strength) in cm for upper extremity, vertical jump (explosive strength) for lower extremity in cm, reaction and speed of movement in cm, planter flexion in degree, dorsi flexion in degree, knee flexion in degree, wrist flexion in degree, wrist extension in degree, elbow flexion in degree, shoulder flexibility in cm, sit and reach test in cm, trunk and neck extension in cm, right grip strength per kg. body weight, left grip strength per kg. body weight, leg extension strength per kg. body weight, bench press strength per kg. body weight and bench squat strength per kg. body weight were subjected to statistical analysis as following:

Mean and standard deviation were computed as descriptive statistics for all the dependent and independent biomechanical, anthropometric, flexibility and motor performance variables respectively for Ippon Seoi Nage and Morote Seoi Nage. The total time (TT) and ratio of execution time of free fall (TFF) as criteria were correlated with all the biomechanical,
anthropometric, flexibility and motor performance variables. respectively for Ippon seoi Nage and Morote Seoi Nage by using product moment correlation. Multiple correlation was computed to examine the combined effect of most contributing independent variables to the criteria separately in Ippon Seoi Nage and Morote Seoi Nage. Stepwise regression method was used to find out the most contributing biomechanical, anthropometric, flexibility and motor performance variables to the criteria of Ippon Seoi Nage and Morote Seoi Nage respectively. Factor analysis technique was used as tool to select biomechanical measure out of extracted biomechanical variables from 197 biomechanical variables for Ippon Seoi Nage and Morote Seoi Nage independently. These extracted biomechanical variables through adopted phasewise and stepwise regression procedure would serve as a comprehensive kinematic and kinetic measure of ippon seoi nage and morote seoi nage.

The method of principal component analysis with latent root greater than one method of factor analysis was selected out of five factor analysis methods i.e. principal components analysis, principal factor analysis, age analysis, Saloh factor analysis and Reo's canonical factor method. The correlation matrix of the extracted biomechanical variables were obtained by applying the pearson product moment formula. The data were then subjected to factor analysis utilizing the principal axis rotation as suggested by H.H.Harnian, to obtain unrotated and rotated factors.
The rotated matrix was selected for interpretation as recommended by comery. For rotated factors kaisers varimax criterion was used. The rotated factor loading was obtained from orthogonal rotation. The variable having more than ± 3 loading on the factors were picked up to be included in the factor for its recognition and subsequent interpretation of the variables in the factor.

All the significantly loaded variables in a particular factor were subjected to stepwise regression procedure by treating (i) Total Time and (ii) Ratio of Execution Time and Time of Freely Falling Body in turn as dependent variables to select the most predictive variables in a specific biomechanical factor or specific set of under-lying biomechanical variables in Ippon Seoi Nage and Morote Seoi Nage.

From the analysis it is evident that total time is significantly related to angle at hip joint between left shoulder and horizontal when hip flex, angular velocity at ankle joint formed by left shin when knee extended completely from knee flex, angular velocity at knee joint formed by left leg, left thigh when knee extended completely from knee flexed position, angular velocity at hip joint in respect to right shoulder, right total (total angle it hip) when knee extended completely from knee flexed position, execution time that is time of main phase ratio of execution time and time of free fall, time of knee flex from
start of throwing, knee flex to leg extension, knee flex to belt
in vertical line of receiver, time of foot detachment to leg
extension and elbow flexion in degree, the contributor or
predictor variables are angle at hip joint when hip flexed
between left shoulder and horizontal, angle at ankle joint formed
by left shin differences between knee flex and extension
position, Angular velocity at ankle joint formed by left shin
when knee extended completely from knee flex, execution time that
is time of main phase, time of leg extension to belt in vertical
line of receiver, displacement of thrower’s C. G. at ‘X’
coordinate, elbow flexion in degree and the score of sit and
reach test in Ippon Seoi Nage.

From the analysis it is further evident that ratio of
execution time and time of free falling body is significantly
related to angle at hip joint when hip flexed between left
shoulder and horizontal, angular velocity at ankle joint formed
by left shin when knee extended from knee flex position, angular
velocity at knee joint formed by left leg when knee extended from
knee flex, angular velocity at hip joint formed by right shoulder
when knee extended from knee flex, right total (total angle at
hip), total time taken to execute the throw, execution time that
is time of main phase, time taken from knee flexion to foot
detachment of receiver, knee flexion to leg extension, knee flex
to belt in vertical line of receiver, time of foot detachment to
leg extension and elbow flexion in degree. The best predictor or
contributing variables are Angle of right total ankle joint when
knee flexed (Rom right ankle), angle at hip joint when hip flexed between left shoulder and horizontal, angle at ankle joint formed by left shin differences between knee flex and extension position, angular velocity at ankle joint formed by left shin when knee extended from knee flex, execution time that is time of main phase, time of free falling body from highest Y coordinate, time of foot detachment to leg extension, final force of contact of receiver while contact the mat, ponderal index elbow, flexion in degree and the score of sit and reach test in Ippon Seoi Nage.

In Morote Seoi Nage the criterion total time was found to be statistically significant with angle of inclination from horizontal of the line joining left knee and centre of foot when hip flexed, angle at ankle joint when hip flexed between left shin and horizontal, angle at ankle joint when hip flexed between left lower leg and horizontal, angular velocity at ankle joint when knee extended from knee flex formed by left shin, formed by left total, formed by right leg, formed by left leg, angular velocity at left total knee joint, angular velocity at hip joint formed by right shoulder and left shoulder when knee extended from knee flex, angular velocity at right total (total angle at hip) when knee extended from knee flex position, angular velocity at knee joint formed by left lower leg when hip flexed after knee extension, execution time that is time of main phase, ratio of execution time and time of free fall, time of knee flex from
start of throw, time of knee flex to leg extension, knee flex to belt in vertical line of receiver and the score of bench press strength per kg. body weight. The predictor or contributor are angle of inclination from horizontal of the line joining left knee and centre of foot when hip flexed, angle at ankle joint when hip flexed between left shin and horizontal, angle at knee joint when hip flexed between left lower leg and horizontal, angular velocity at ankle joint formed by left shin when knee extended from knee flex, angular velocity at knee joint formed by left leg when knee extended from knee flex, angular velocity at hip joint formed by right shoulder when knee extended from knee flex, execution time that is time of main phase, time of knee flex from start of throwing and the score of bench press strength per kg. body weight.

On further, analysis, it is evident that the criterion ratio of execution time and time of free falling body was found to be significantly related to angle at hip joint formed by left shoulder differences between knee flex and extension position, angular velocity at ankle joint formed by left shin when knee extended from knee flex, angular velocity at left total ankle joint when knee extended from knee flex, angular velocity at hip joint formed by right shoulder, left shoulder, right total (total angle at hip) when knee extended from knee flex, left total (from left hip), total time taken to execute the throw, execution time that is time of main phase, knee flex to leg extension and the
knee flex to belt in vertical line of receiver. The predictor or contributing variables are angle at ankle joint formed by left foot differences between knee flex and extension position, angle at hip joint formed by left shoulder when knee extended from knee flex, angular velocity at hip joint formed by right shoulder, left shoulder when knee extended from knee flex, angular velocity at hip joint formed by left shoulder when hip flexed after knee extension, execution time that is time of main phase, time of free falling body from highest 'Y' coordinate, ratio of trunk and leg length and the score of dips test in Morote Seoi Nage.

Angle of hip joint when hip flexed between left shoulder and horizontal in the Ippon Seoi Nage, angular velocity of ankle joint formed by left shin when knee extended from knee flex in Ippon Seoi Nage and Morote Seoi Nage, angular velocity at hip joint formed by right shoulder when knee extended from knee flex and angular velocity at total right hip joint when knee extended completely from knee flex in Ippon Seoi Nage and Morote Seoi Nage, execution time, time taken for knee flex from start of throw, time taken from knee to knee extension and time taken from knee flex to belt perpendicular of receiver in Ippon Seoi Nage and Morote Seoi Nage. Time taken from foot detachment of receiver to leg extended of thrower and elbow flexion in Ippon Seoi Nage were found to be strong variables in respect to both the criteria.
CONCLUSIONS

Within the limitations of the present study, the following conclusions have been drawn:

1. The angle at the hip joint formed between left shoulder and horizontal when the hip was flexed was found to be significantly correlated ($r = .4880$) with total time. From this it may be inferred that greater the angle with hip joint better will be the performance in Ippon Seoi Nage.

2. In order to effectively perform the Ippon Seoi Nage, i.e. to reduces the total time of performance of the techniques the angle at ankle joint formed by left shin from knee flexion to knee extension position should be reduced.

3. To drop the total time of performance one should reduce the angular velocity at ankle and knee joint formed by left shin ($r = .705$), and left leg ($r = .583$) in ISN.

4. The reduction of angular velocity at knee joint formed by left thigh when the knee is extended completely from knee flex position ($r = .4714$) have a consistent reduction in ISN. effect over total time.
5. Angular velocity at hip joint formed by right shoulder when knee is extended from knee flexed position (r = .5159) and total right hip (r = -.501) in Ippon Seoi Nage should be greater to reduce the total time of performance.

6. Execution time and total time taken in Ippon Seoi Nage were found to be linearly related to each other and strong predictor (r = .964 and r = .964) as well.

7. Both the criteria i.e. ratio of execution time and time of free falling body from highest 'Y' coordinate of receiver and total time are linearly related (r = .915) but they do not predict each other in ISN as they have not been selected in stepwise regression procedure.

8. To reduce the total time, the time of knee flexion from start of throw (r = .5917, R = .999) should be reduced in Ippon Seoi Nage.

9. To reduce the total time, the time taken from knee flexion to extension, knee flex of thrower to belt in vertical line of receiver, knee flex of thrower to foot detachment of receiver and time taken from foot detachment to leg extension should be reduced consistently in Ippon Seoi Nage.

10. The time of leg extension to belt in vertical, (R = .999, r = not significant) is having a critical effect i.e. little reduction of the same reduces total time greatly in Ippon Seoi Nage.
11. The displacement of thrower's C.G. at 'X' coordinate (R=.999, r = not significant) is not significantly related but a strong predictor in Ippon Seoi Nage.

12. The total time is significantly related to elbow flexion in Ippon Seoi Nage (r=.4627, R = .462). That is lesser the elbow flexion angle better will be the performance and thus the total time of performance will be less.

13. The total time of performance and the sit and reach test scores are not significantly related but strong predictor (R=.585). In case the reduction of sit and reach test score occur i.e. hip-back flexion and hamstring extensions ability increase, the amount of total time leads to reduction in Ippon Seoi Nage.

14. The effectiveness of Ippon Seoi Nage does not significantly related to angle of total right ankle joint when the knee is flexed, this angle is a strong predictor (r=not significant, R=.651) of ratio of execution time and time of free falling body.

15. Greater the angle at hip joint between left shoulder and horizontal when hip flexed greater is the effectiveness (r=-.5504, R=.587) in Ippon Seoi Nage.
16. The difference in the angle at ankle joint formed by left shin from knee flexion to extension position i.e. angular distance covered by lower aspect of knee (r=not significant, R=.424) are consistent in all the subject in Ippon Seoi Nage.

17. A reduction tendency has been observed in angular velocity at ankle joint formed by left shin when knee extended completely from knee flexion, to improve the effectiveness in Ippon Seoi Nage.

18. It could be clearly understood that the angular velocity at knee joint formed by left leg when knee is extended from knee flex having consistently reduction tendency to improve the effectiveness (ET/TFF) in Ippon Seoi Nage (r = 5675).

19. Angular velocity at hip joint formed by right shoulder and horizontal, total right hip joint when knee is extended completely from knee flexed position are to be considered important for improving effectiveness (r = -.5131) in Ippon Seoi Nage.

20. To improve the effectiveness in Ippon Seoi Nage execution time having linearly decreasing trends, (r=.931, R=.921) can be figured out that time of free falling body from highest 'Y' coordinate of receiver i.e. maximum height gain by the receiver in Ippon Seoi Nage is consistent but to improve the effectiveness, the height which the receiver is lifted should be raised (R = .993).
21. All the partial time variables i.e., time taken from knee flex to foot detachment of receiver \( (r = 0.6328) \), knee flexion to leg extension \( (r = 0.6878) \) and time of foot detachment to leg extension \( (r = 0.5411, R = 0.998) \) should be reduced to improve the effectiveness (ET/TFF) in Ippon Seoi Nage.

22. The final force of contact of receiver when contacting with the mat having an increasing trend toward the improvement of effectiveness of Ippon Seoi Nage.

23. A lesser ponderal index score leads to greater effectiveness \( (R = 0.417) \) in the performance of in Ippon Seoi Nage.

24. Reduced elbow flexion (elbow range of motion) is helpful to improve effectiveness in Ippon Seoi Nage \( (r = 0.5425, R = 0.342) \) it may be attributed to the bulk of the biceps muscle responsible for flexion of elbow joint.

25. The increased sit and reach test score i.e., flexibility of hip and back and stretchability of hamstring muscles is the important predictor \( (R = 0.658) \) to improve effectiveness (ET/TFF) in Ippon Seoi Nage.

26. The angle of inclination from horizontal of the line joining left knee and centre of left foot when hip is flexed is having a decreasing trend to reduce the total time \( (r = 0.4688, R = 0.469) \) in Ippon Seoi Nage.
27. Those taking less total time are having lesser angle of ankle joint when hip is flexed between left shin and horizontal, angle at knee joint when hip is flexed between left lower leg from horizontal than that of those taking more total time \( (r = .4712, r = .4753, R = .475) \) respectively in Morote Seoi Nage.

28. The angular velocity at ankle joint formed by left shin when knee is extended from knee flex is linearly related to total time \( (r = .6774, R = .752) \) in Morote Seoi Nage.

29. Angular velocity at left total ankle joint when knee is extended from knee flex \( (r = .5689) \) is significantly and negatively related to the total time in Morote Seoi Nage.

30. The angular velocity of knee joint formed by right leg when knee extended completely from knee flex have negative relationship with total time in Morote Seoi Nage \( (r = .4452) \).

31. It is interesting to observe that the angular velocity at knee formed by left leg when knee extended from knee flexed is negatively related and strong predictor to total time in Morote Seoi Nage \( (r = .6327, R = .858) \).

32. Angular velocity at left total knee joint when extended from knee flex having a decreasing trend towards decrease of total time in Morote Seoi Nage \( (r = .4787) \).
33. The angular velocity at hip joint formed by right shoulder \( (r = 0.6778, R = 0.678) \), left shoulder \( (r = -0.6230) \) and total angle at hip joint \( (r = -0.6176) \) when knee extended completely from knee flexed position have increasing trend towards the decrease of total time in Morote Seoi Nage.

34. The angular velocity at knee joint formed by left lower leg \( (r = -0.5127) \) when hip flexed after knee extension has an increasing trend towards the decreases of total time in Morote Seoi Nage.

35. The execution time \( (r = 0.9515, R = 0.951) \) time of knee flex from start of throwing \( (r = 0.6448, R = 0.999) \), time taken from knee flex to leg extension \( (r = 0.5547) \) and time taken from knee flex to belt in vertical line of receiver \( (r = 0.7093) \) having positive linear relationship with total time in Morote Seoi Nage.

36. Relationship between total time in morote seoi nage and bench press strength per kilogram body weight is having a decreasing trend in Morote Seoi Nage.

37. The angle at ankle joint formed by left foot \( (R = 0.61) \) and angle at hip joint formed by left shoulder differences between knee flex and extension position \( (r = -0.4650, R = 0.465) \) is having a decreasing trend to increase the effectiveness i.e. ratio of execution time and time of tree falling body in Morote Seoi Nage.
38. The angular velocity at ankle joint formed by left shin when knee extended from knee flex and ratio of execution time and time of free falling body having positive linear relationship i.e. lesser the angular velocity at ankle joint greater will be the effectiveness in Morote Seoi Nage.

39. The increase of angular velocity at left total ankle joint when knee extended completely from knee flex \( r = 0.5025 \) is significantly related but limits to 1.4 seconds increases the effectiveness score of Morote Seoi Nage.

40. Angular velocity at hip joint formed by right shoulder \( r = -0.7294, R = 0.819 \) left shoulder \( r = -0.7584, R = 0.758 \), total right hip \( r = -0.623 \) and left hip total \( r = 0.5099 \) with ratio of execution time and time of free falling body are having negatively linear relationship i.e. greater the angular velocity at knee joint, right hip and left hip when knee extended completely from knee flex greater will be the effectiveness in Morote Seoi Nage.

41. The angular velocity at hip joint formed by left shoulder when hip is flexed after knee extension \( R = 0.894 \) has an increasing trend to improve the ratio of execution time of free falling body in Morote Seoi Nage.

42. Both the criteria considered in the present study on Morote Seoi Nage are with positive linear relationship \( r = 0.8538 \) i.e. linearity of total time and ration of execution time and time of free falling body. Similar relationship between criteria and execution time \( r = 0.703, R = 0.703 \) have been observed.
43. The time of free falling body from highest \( Y \) coordinate is having a predictive relationship \((R = .9976)\) with ratio of execution time and time of free falling body in Morote Seoi Nage.

44. The time taken from knee flex to leg extension \((r = .5468)\) and time taken from knee flex to belt in vertical line of receiver \((r = .7267)\) with effectiveness i.e. ratio of execution time and time of free falling body in morote seoi nage having positive relationship, suggests that to increase effectiveness these two partial time should be reduced in Morote Seoi Nage.

45. The trunk and leg length ratio \((R = .416)\) with ETTFF has predictive relationship in Morote Seoi Nage.

46. The dips test for maximum arm and shoulder strength has a predictive relationship in Morote Seoi Nage.

47. When all the significant variables of Ippon Seoi Nage and Morote Seoi Nage are subjected to stepwise regression procedure treating both the criteria, it is evident that the execution time \((R = .964)\), time of knee flex from start of throw \((R = .999)\) time of leg extension to belt in vertical line \((R = 0.999)\) and displacement of throwers C.G. at 'X' at coordinate \( R = .999 \) are the statistically predictive and contributing variables in sequence at .05 level of significance when total time treated as criterion in Ippon Seoi Nage.
48. Execution time (R = .951) and time of knee flexion from start of throw (R = .999) are the predictive and contributing variables in Morote Seoi Nage when total time of performance is treated as criterion thus it may be concluded that in Ippon Seoi Nage and Morote Seoi Nage they have common predictors when total time of the throw was treated as a criterion.

49. Execution time (R = .964), time of free falling body from highest ‘Y’ coordinate (R = .993), final force of contact with the mat of receiver (R = .993) and velocity of knee joint formed by left leg when knee is extended from knee flexed position (R = .998) are the predictive and contributing variables when ratio of execution time and time of free falling body was treated as criterion in Ippon Seoi Nage.

50. Execution time (R = .903), time of free falling body (R = .996) and angular velocity of ankle joint formed by left shin when knee extended (R = .997) are the predictive and contributing variables in sequence when ratio of execution time and time of free falling body was treated as criterion in Morote Seoi Nage. It has been observed that first two variables are common predictor of Ippon Seoi Nage and Morote Seoi Nage when ratio of execution time and time of free falling body was treated as a criterion.

51. The factor analysis of extracted biomechanical variables in Ippon Seoi Nage produced five factors and Morote
Seoi Nage produced six factors which were named based upon the variables collectively included in a particular factor and highest loaded variables selected as respective factor representative.

52. Factor of Ippon Seoi Nage are as detailed below in sequence: (1) General partial time factor (2) Angular velocity less at hip more at knee and ankle joint factor (3) Explosive leg extension and hip flexion factor (4) Angular kinematics at ankle joint factor and (5) Force of falling of receiver antagonistic to knee extension velocity factor, the variables representatives are time taken from knee flex to leg extension (.89013), Angular velocity at hip joint formed by right shoulder when knee extended from knee flex (-.87708), time taken from leg extension to belt in vertical line (.85245), Angle at total right ankle joint when knee flexed (.91272) and final force of contact of receiver with the mat (-.79855) respectively.

53. The relative relationship of factors representative variable in Ippon Seoi Nage with criterion total time the representative of factor 4 and 5 are not significantly related to total time in Ippon Seoi Nage thus was not consulted. In spite of that, we can generalise the controlling factors to reduce total time in Ippon Seoi Nage.

54. The relative relationship of factors representative variables in Ippon Seoi Nage with the criterion ratio of
execution time and time of free falling body. Representative variable of factor 3 was not significantly related to criterion, thus not consulted but guideline to be effective in Ippon Seoi Nage may be obtained and their importance may be realised.

55. The extracted factor of Morote Seoi Nage are as detailed below in a sequence (1) Angular kinematics at knee and ankle joint factor (2) Angular kinematics at ankle joints, knee joints and hip joint for effectiveness factor (3) partial time angular velocity at ankle and knee joint antagonist to angular velocity at hip joint factor (4) positive-negative hip angular velocity and positive knee angular velocity factor (5) angular kinematics of ankle joint and criteria antagonist to angular velocity at knee and hip joint factor and (6) The factor of ‘Y’ dimension of receiver and knee and ankle angular velocity of thrower. The representative variables are angle of inclination from horizontal of the line joining left knee and centre of foot when hip flexed (.95), angle at ankle joint formed by left shin differences between knee flex and extension position (.88), time taken from knee flex to foot detachment of receiver (.90), angular velocity at hip joint formed by left shoulder when hip flexed after knee extended (.79), angle of ankle joint formed by left foot differences between knee flexion and extension position (.88) and time of free falling body from highest ‘Y’ coordinate (.86) respectively.
56. The angle of inclination from horizontal of the line joining left knee and centre of foot when hip is flexed \( r = 0.47 \) is the only significant factor representative of total time in Morote Seoi Nage, with agreement of other statistical analysis in the present study.

57. The relative relationship of factors representative variables in Morote Seoi Nage with criterion ratio of execution time and time of free falling body, among which representative of factor 1 is not significantly related, but to be extremely effective required unique biomechanical characteristics, same phenomena have been observed between factor representatives and both the criteria in Ippon Seoi Nage.

58. Variables included in a particular factor in Ippon Seoi Nage and Morote Seoi Nage were subjected to stepwise regression procedure by treating the criteria, it was found that for any factor in Ippon Seoi Nage or Morote Seoi Nage, the execution time or any partial time variable or highest loaded variables in that factor are the best predictor or contributor of the particular factor.
RECOMMENDATIONS

In the light of the conclusions drawn the following recommendations are made:

1. Total time may be treated as overall criterion for evaluating Ippon Seoi Nage and Morote Seoi Nage.

2. Ratio of execution time and time of free falling body from highest 'Y' coordinate of receiver or ratio of execution time and height of thrower may be treated as relative criterion for evaluating Ippon Seoi Nage and Morote Seoi Nage.

3. Multivariate statistical procedure may be adopted for analysing the data are found to be more useful in biomechanical research.

4. Along with cinematography force platform, electromyography and electrogoniometry can be made use of for better comparison and relationship study on biomechanical variables in judo as well as in other sports.

5. Similar study can be conducted on different variations of other techniques or skills in judo for both male and female judoka.

6. The present study may be replicated with females as subjects so as to determine differential bio-mechanical factors affecting their performance in Judo.