



ORIGINAL SCIENTIFIC ARTICLE

RELATIONSHIP OF SELECTED PHYSICAL AND ANGULAR KINEMATICAL VARIABLES WITH THE PERFORMANCE OF TOE-TOUCH SKILL IN KABADDI

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Abstract

The purpose of this study to find out the relationship of selected physical and angular kinematical variables with the performance of toe-touch skill among male kabaddi players (raiders).

Materials and methods. One hundred male raiders were selected for this study. The age of the participants ranged between 18 and 25 years. The selected physical variable, i.e. lower extremity explosive strength was measured by the standing broad jump test. Selected angular kinematical variables were measured by the software 'Kinovea version-0.9.3'. The toe-touch skill performed by raiders was measured by three experts' rating. The inter-rater reliability of the scores awarded by the experts to the participants was tested by Cohen's Kappa test and the Kappa coefficient was found significant.

Results. Spearman's rank correlation revealed that there was significant correlation in case of lower extremity explosive strength ($r_s = 0.259$, $p = 0.009$), angle at leading leg ankle joint ($r_s = 0.327$, $p = 0.001$) variables and there was no significant correlation in case of angle at trailing leg ankle joint ($r_s = 0.016$, $p = 0.871$), angle at leading leg knee joint ($r_s = 0.23$, $p = 0.823$), angle at trailing leg knee joint ($r_s = -0.171$, $p = 0.089$) and angle at hip joint ($r_s = -0.195$, $p = 0.052$) variables with the performance of toe-touch skill in kabaddi.

Conclusions. The study concludes that lower extremity explosive strength and the angle at the leading leg ankle joint positively contribute to toe-touch skill performance in male kabaddi players.

Keywords: kabaddi, raider, skill, physical variable, angular kinematics.

Introduction

Kabaddi, native to the Indian subcontinent with its history dating back to 4000 years, is a contact sport played by two teams of five to seven players each (Kukreja, 2022). Kabaddi is a game which combines the actions of wrestling, judo, rugby and gymnastics. The important body movements in this game involve catching, holding, locking and jumping (Shobha & Jyoti, 2022).

We all know that physical fitness is the basic foundation that supports athlete achievement. Without adequate physical fitness, athletes cannot perform techniques well and maximally. (Erliana & Hartoto, 2019; Tirtayasa et al, 2020; Piyana et al, 2020). Physical fitness in kabaddi sports consists of cardiovascular endurance, hand muscle strength, leg muscle strength, back muscle strength, shoulder muscle strength, arm muscle endurance, explosive power, agility, and reaction speed (Santika & Subekti, 2020).

The term biomechanics combines the prefix bio, meaning "life," with the field of mechanics, which is the study of the actions of forces. Kinematics and kinetics are further subdivisions of biomechanical studies (Hall, 2019). Angular kinematics describes angular motion, or motion involving

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Table 1. List of variables

S.N.	Variables	Explanation
1.	Explosive strength	An ability of the muscle to overcome resistance with high speed
2.	Angle at leading leg ankle joint	A movement of joint where lateral malleolus is an axis and fibular head and fifth metatarsal are two arms.
3.	Angle at trailing leg ankle joint	A movement of joint where greater trochanter is an axis and lateral-epicondyle of femur and midline of the pelvis are two arms.
4.	Angle at leading leg knee joint	A movement of joint where lateral-epicondyle of the femur is an axis and greater trochanter and lateral malleolus are two arms.
5.	Angle at trailing leg knee joint	A movement of joint where lateral-epicondyle of the femur is an axis and greater trochanter and lateral malleolus are two arms.
6.	Angle at hip joint	A movement of joint where greater trochanter is an axis and lateral-epicondyle of femur and midline of the pelvis are two arms.
7.	Toe-touch skill	A skill performed by a raider to touch opponent's toe by his toe.

rotations like swings, spins, and twists. Angular kinematics describes the rotation of the whole body, like when a diver or gymnast performs a spin in the air, or the rotation of individual body segments, like when you bend or straighten your forearm at the elbow (McCaw, 2014).

Biomechanical measurement allows for precise, quantifiable examination of technical features, which then becomes a benchmark of a training program and seems to be a factor in effective training design, particularly if it concerns detecting the degree of performance expertise and assessing it as part of an athlete's growth process, as well as adopting Kinesiological operators and modelling methodical methods" (Akhtar & Bej, 1997).

Researchers have conducted various studies to determine the relationship between physical, anthropometric, physiological and psychological variables and kabaddi players' playing ability (Devaraju & Needhiraja, 2012; Johnson, 2016; Pandey & Sardar, 2016). But the number of studies describing the relationship of particular domain variables with a particular skill performance in kabaddi, is very few. There is a significantly smaller number of biomechanical studies on kabaddi (Ram, 2019a,b; Ram & Singh, 2021a,b). Hence, this study was conducted to determine the relationship between selected physical and angular kinematic variables and toe-touch skill performance (TTSP).

Material and Methods

Study participants

One hundred male raiders who at least participated in inter-college level competition were selected for this study by purposive sampling technique. The age of the participants ranged from 18-25 years. All the participants had knowledge and training experience in kabaddi. They were selected from various kabaddi academies of four states of India: Punjab, Himachal Pradesh, Haryana and Uttarakhand, and one union territory: Chandigarh. Prior permission was taken from coaches of kabaddi academies before data collection. The participants also signed a written consent form to participate in the study.

A total of 6 variables (1 physical + 5 angular kinematical variables) were selected in this study (Table 1).



Fig. 1. Description of sampling plan

Procedure

All the participants were informed in detail about the research protocol and the basic characteristics of the study. No unique motivation technique was used to motivate the players before data collection. All the participants executed the same protocol under the same circumstances and were guided by the researcher. The measurement of lower extremity explosive strength was taken with a standardized test, i.e. standing broad jump test, and the measuring unit was centimeter. Each participant got three chances to perform the test, and the best one was taken as a score.

To measure the performance of the toe-touch skill of raiders, instructions were given to raiders that they have to raid on the opponents side and perform a toe-touch skill. Appropriate time was given to raiders and defenders for general and specific warm-ups. A Match situation was created, and the raiders were asked to raid. Three raids were given to every raider, and the best one was considered. The performance of every raid was recorded by Y1-Action Camera with a speed of 240fps (Figure 2).

The measurements of selected angular kinematic variables were extracted from the skill performance videos using

Table 2 Description of selected tools and their measuring units

S.N.	Variable	Tool	Measuring Unit
1.	Explosive strength	Standing broad jump test	Centimeter
2.	Angle at leading leg ankle joint	Kinovea Software	Degree
3.	Angle at trailing leg ankle joint	Kinovea Software	Degree
4.	Angle at leading leg knee joint	Kinovea Software	Degree
5.	Angle at trailing leg knee joint	Kinovea Software	Degree
6.	Angle at hip joint	Kinovea Software	Degree
7.	Toe-Touch Skill Performance	Rating Scale	Points

**Fig. 2.** Participant performing Toe-Touch skill

the software 'Kinovea version-0.9.3' following the guideline mentioned by Gogoi & Rajpoot (2019).

After completing the data collection process, researchers contacted kabaddi experts and explained the purpose of this study and their role in rating the participants according to their performance. The rating scale was given to each expert before starting the evaluation process (Table 3). The recorded videos of participants' performances were shown to three experts for rating purposes. All experts had a diploma in coaching in kabaddi and participated in national-level competitions. Experts' inter-rater reliability was tested using Cohen's Kappa inter-rater reliability test and found significant (Kvålseth, 1989). The average of the total scores given by the participants was taken as the final performance score for the participants.

Table 3. Explanation of Rating Scale

S.N.	Comment	Score
1.	Very Good	5
2.	Good	4
3.	Average	3
4.	Satisfactory	2
5.	Poor	1

Statistical Technique

Descriptive statistics, i.e., the median, inter-quartile range, was calculated. According to the nature of the data, the non-parametric test 'Spearman Rank Correlation' was employed to find out the relationship between TTSP and anthropometric variables with the help of SPSS-software version 23. The level of significance was set at 0.05 (Zar, 2005).

Results

Table 4 shows the median and inter-quartile range values of skill performance scores and selected physical variables. Median and inter-quartile range values of performance scores and variables are 3 (1) and 229 (25.75) respectively. It also exhibited a significant relationship of lower extremity explosive strength variable ($r_s = 0.259$, $p = 0.009$) with toe touch skill performance at 0.01 level.

Table 4. The relationship of the selected physical variable with the performance of toe-touch skill

S.N.	Variable	Median	IQR	'r' value	p-value (sig.)
1.	Performance Scores	3	1	–	–
2.	Explosive Strength	229	25.75	0.259	0.009**

Note: IQR= Inter Quartile Range; ** Denotes significant relationship at 0.01 level of significance

Table 5 shows the median and inter-quartile range values of skill performance scores and selected angular kinematical variables. Median and inter-quartile range values of performance scores, angle at leading leg ankle joint, angle at trailing leg ankle joint, angle at leading leg knee joint, angle at trailing leg knee joint and angle at hip joint variables are 3 (1), 137 (28.50), 66.50 (20), 173 (10.75), 45.50 (32.75) and 149 (24.50) respectively. It also shows that there is an insignificant relationship of angle at trailing leg ankle joint ($r_s = 0.016$, $p = 0.871$), angle at leading leg knee joint ($r_s = 0.023$, $p = 0.823$), angle at trailing leg knee joint ($r_s = -0.171$, $p = 0.089$) and angle at hip joint ($r_s = -0.195$,

Table 5. The relationship of selected angular kinematical variables with the performance of toe-touch skill

S.N.	Variable	Median	IQR	'r' value	p-value (sig.)
1.	Performance Scores	3	1	–	–
2.	Angle at leading leg ankle joint	137	28.50	0.327	0.001**
3.	Angle at trailing leg ankle joint	66.50	20	0.016	0.871
4.	Angle at leading leg knee joint	173	10.75	0.023	0.823
5.	Angle at trailing leg knee joint	45.50	32.75	-0.171	0.089
6.	Angle at hip joint	149	24.50	-0.195	0.052

Note: IQR= Inter Quartile Range; ** Denotes significant relationship at 0.01 level of significance

$p = 0.052$) with toe touch skill performance with toe-touch skill performance at 0.05 level of significance and significant relationship of angle at leading leg ankle joint variable ($r_s = 0.327$, $p = 0.001$) with toe-touch skill performance at 0.01 level of significance

Discussion

There is evidence that physical variables contribute significantly to the playing ability of male kabaddi players and angular kinematical variables contribute to the playing ability of sports events (Devaraju & Needhiraja, 2012; Kelmendi, Miftari & Tekin, 2021).

This study aimed to determine the relationship of selected physical and angular kinematic variables with the performance of toe-touch skills among male kabaddi players (raiders). One physical variable: lower extremity explosive strength, and five angular kinematical variables: angle at leading leg ankle joint, angle at trailing leg ankle joint, angle at leading leg knee joint, angle at trailing leg knee joint and angle at hip joint were taken in this study.

The result showed a significant relationship ($r_s = 0.259$, $p = 0.009$) between the lower extremity explosive strength variable and TTSP. The result of this finding is supported by the study by Pandey and Sardar (2016), where they found a significant correlation between the lower extremity explosive strength variable and the playing ability of university-level kabaddi players.

The result showed a significant relationship ($r_s = 0.327$, $p = 0.001$) between angle at leading leg ankle joint variable and TTSP. The result of this finding is supported by the study conducted by Bisht & Kumar (2020) where they found that there was significant correlation between angle at leading leg ankle joint variable during execution phase and accuracy of tennis serve.

The result showed that there was an insignificant relationship ($r_s = 0.016$, $p = 0.871$) between angle at trailing leg ankle joint variable and TTSP. The result of this finding is supported by the study conducted by Rathod (2018) where he found that there was an insignificant correlation between angle at ankle joint variable and race walk performance.

The result showed that there was an insignificant relationship ($r_s = 0.023$, $p = 0.823$) between angle at leading leg knee joint variable and TTSP. The result of this finding is supported by the study conducted by Bisht & Kumar (2020) where they found that there was an insignificant correlation between angle at leading leg knee joint during execution phase variable and accuracy of tennis serve.

The result showed that there was an insignificant relationship ($r_s = -0.171$, $p = 0.089$) between angle at trailing leg knee joint variable and TTSP. The result of this finding is supported by the study conducted by Rathod (2018) where they found that there was an insignificant correlation between angle at knee joint variable and javelin throw performance.

The result showed that there was an insignificant relationship ($r_s = -0.195$, $p = 0.052$) between angle at hip joint variable and TTSP. The result of this finding is supported by the study conducted by Bisht & Kumar (2020) where they found that there was an insignificant correlation between angle at hip joint variable during preparatory phase and accuracy of tennis serve.

The results of the selected physical variable are similar to studies earlier conducted in kabaddi and showed that explosive strength plays an important role in the playing ability of kabaddi. In the case of angular kinematical variables, no study defines the relationship of angular kinematical variables with kabaddi playing ability. The results of this study state that the angle at the leading leg ankle joint positively correlates with toe-touch skill performance in kabaddi.

Conclusion

The study concludes that increasing the lower extremity's explosive strength positively contributes to toe-touch skill performance in kabaddi. Angle at leading leg positively contributes in toe-touch skill performance in kabaddi. It can help coaches while make training plan for raiders to enhance their raiding performance.

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References

- Kukreja, R. (2022). Using indigenous sport as resistance against migrant exclusion: Kabaddi and South Asian male migrants in Greece. *Journal of Ethnic and Migration Studies*, 1-18. <https://doi.org/10.1080/1369183X.2022.2036954>
- Shobha, R., & Jyoti, D. M. (2022). Comparison of reaction ability among state, university and sub junior national level female Kabaddi players of Bengaluru. *International Journal of Physiology, Nutrition and Physical Education*, 7(1), 95-98.
- Erliana, E. & Hartoto, S. (2019). Hubungan Aktivitas Fisik Terhadap Tingkat Kebugaran Jasmani Siswa. *Jurnal Pendidikan Olahraga dan Kesehatan*, 7(2), 225-228. <https://doi.org/10.31602/rjpo.v5i1.6539>
- Tirtayasa, P. K. R., Santika, I. G. P. N. A., Subekti, M., Adiatmika, I. P. G., & Festiawan, R. (2020). Barrier Jump Training to Leg Muscle Explosive Power. *Jurnal ACTIVE: Jurnal of Physical Education, Sport, Health and Recreation*, 9(3), 173-177.
- Piyana, P. D., Subekti, M., & Santika, I. G. P. N. A. (2020). Pelatihan Hanging Leg Raise Terhadap Kekuatan Otot Perut. *PENJAGA: Pendidikan Jasmani & Amp; Olahraga*, 1(1), 7-11.
- Santika, I. G. P. N. A., & Subekti, M. (2020). Hubungan Tinggi Badan Dan Berat Badan Terhadap Kelincahan Tubuh Atlet Kabaddi. *Jurnal Pendidikan Kesehatan Rekreasi*, 6(1), 18-24. <https://doi.org/10.36526/kejaora.v5i1.838>
- Hall, S. J. (2019). *Basic Biomechanics*, 8e. McGraw-Hill.
- McCaw, S. (2014). *Biomechanics for dummies*. John Wiley & Sons.
- Akhtar, S., & Bej, D. K. (2022). Relationship between kinematic parameters of standing throw and ball velocity of female handball players. *International Journal of Physical Education, Sports and Health*, 9(1), 88-93. <https://doi.org/10.22271/kheljournal.2022.v9.i1b.2344>

- Devaraju, K., Needhiraja, A. (2012). Prediction of kabaddi playing ability from selected anthropometrical and physical variables among college level players. *International Journal of Advanced Research in Engineering and Technology*, 3(1), 115-120. <https://doi.org/10.3923/ajit.2012.131.134>
- Johnson, P. (2016). Predominance of selected anthropometric measurements on kabaddi playing ability among college male students. *Editorial Board*, 15(1), 76-79.
- Pandey, S.S.A.K., Sardar, S. (2016). An estimation of kabaddi performance on the basis of selected physical fitness components. *Indian Journal of Physical Education, Sports and Applied Sciences*, 6(4), 27-35.
- Ram, J. (2019a). Comparative study of angular kinematical variables during running hand touch skill among different level kabaddi players. *International Journal of Yogic, Human Movement and Sports Sciences*, 4(1), 1388-1389. <https://doi.org/10.21276/apjhs.2021.8.4.19>
- Ram, J. (2019b). Comparative study of linear kinematical variables during running hand touch skill among different level kabaddi players. *International Journal of Physiology, Nutrition and Physical Education*, 4(1), 2207-2208. <https://doi.org/10.21276/apjhs.2021.8.4.19>
- Ram, J., Singh, J. (2021a). Relationship of selected anthropometric and linear kinematical variables with the performance of toe-touch skill in kabaddi. *Physical Education Theory and Methodology*, 21(4), 304-309. <https://doi.org/10.17309/tmfv.2021.4.03>
- Ram, J., Singh, J. (2021b). An analytical study of angular kinematical variables during execution of toe-touch skill among various levels kabaddi players – a pilot study. *Asian Pac. J. Health Sci.*, 8(4), 117-120. <https://doi.org/10.21276/apjhs.2021.8.4.19>
- Gogoi, H., Rajpoot, Y.S. (2019). Test-retest reliability of kinovea software. *Online International Interdisciplinary Research Journal*, 9(4), 184-189.
- Kvålseth, T.O. (1989). Note on Cohen's kappa. *Psychological reports*, 65(1), 223-226. <https://doi.org/10.2466/pr0.1989.65.1.223>
- Zar, J.H. (2005). Spearman rank correlation. *Encyclopedia of biostatistics*, 7. <https://doi.org/10.1002/0470011815.b2a15150>
- Kelmendi, D. S., Miftari, F., & Tekin, M. (2021). Kinematic Analysis of the Basketball Free Throw in Preparation Phase of Elite Athletes. *International Journal of Human Movement and Sports Sciences*, 9(6), 1204-1212. <https://doi.org/10.13189/saj.2021.090614>
- Pandey, B.M., & Reddy, T.O. (2019). Relationship of anthropometric measurements with the performance of forehand overhead stroke in badminton. *International Journal of Physiology, Nutrition and Physical Education*, 4(1), 481-483.
- Bisht, P., & Kumar, A. (2019). Relationship of Selected Kinematic Variables with Performance of Service and Accuracy of Service in Tennis. *Online International Interdisciplinary Research Journal*, 09(02), 162-166.
- Rathod, V. (2018). Relationship of Selected Biomechanical Variables to the Performance in Race Walking. *International Journal of Physiology, Nutrition and Physical Education*, 3(1), 2289-2291.

ЗВ'ЯЗОК ВИБРАНИХ ФІЗИЧНИХ І КУТОВИХ КІНЕМАТИЧНИХ ЗМІННИХ ІЗ ВИКОНАННЯМ ПРИЙОМУ ТОРКАННЯ ПАЛЬЦЯМИ НІГ У ГРІ КАБАДДІ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

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Мета цього дослідження – з'ясувати взаємозв'язок вібраних фізичних і кутових кінематичних змінних із виконанням прийому торкання пальцями ніг серед чоловіків-гравців у кабадді (рейдерів).

Матеріали та методи. Для участі в цьому дослідженні було відібрано сто чоловіків-рейдерів. Вік учасників коливався від 18 до 25 років. Вибрану фізичну змінну, тобто вибухову силу нижніх кінцівок, вимірювали за допомогою тесту «Стрибки в довжину з місця». Вибрані кутові кінематичні змінні вимірювали за допомогою програмного забезпечення «Kinovea version-0.9.3». Прийом торкання пальцями ніг, який виконували рейдери, вимірювали оцінкою трьох експертів. Міжекспертна надійність балів, призначених експертами учасникам, була перевірена за допомогою тесту Коена, і коефіцієнт каппа був визнаний значущим.

Результати. Рангова кореляція Спірмена показала, що існує значуща кореляція у випадку таких змінних, як вибухова сила нижньої кінцівки ($r_s = 0,259$, $p = 0,009$), кут у гомілковостопному суглобі передньої ноги ($r_s = 0,327$, $p = 0,001$), і відсутня значуща кореляція у випадку таких змінних, як кут у гомілковостопному суглобі задньої ноги ($r_s = 0,016$, $p = 0,871$),

кут у колінному суглобі передньої ноги ($r_s = 0,23$, $p = 0,823$), кут у колінному суглобі задньої ноги ($r_s = -0,171$, $p = 0,089$) і кут у тазостегновому суглобі ($r_s = -0,195$, $p = 0,052$), з виконанням прийому торкання пальцями ніг у грі кабадді.

Висновки. Автори дослідження дійшли висновку, що вибухова сила нижніх кінцівок і кут у гомілковостопному суглобі передньої ноги позитивно впливають на виконання прийому торкання пальцями ніг у чоловіків-гравців у кабадді.

Ключові слова: кабадді, рейдер, прийом, фізична змінна, кутова кінематика.

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