



Relationship between bio-motor, physiological, and psychological variables and kabaddi performance in female players

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Abstract

The present study investigates the relationship between bio-motor, physiological, and psychological variables and their collective influence on the Kabaddi playing ability of district-level female players in Manipur, India. A total of 200 female Kabaddi players were assessed on a range of variables: bio-motor (speed, agility, explosive power, grip strength, and muscular endurance), physiological (anaerobic power, VO₂ max, vital capacity, forced expiratory volume, and breath-holding time), and psychological (stress, sports aggression, sports competition anxiety, sports achievement motivation, and self-esteem). Playing ability (PA) was evaluated by three certified Kabaddi coaches. Statistical analyses, including descriptive statistics and Pearson correlation, revealed significant of playing ability. The findings revealed significant correlations between playing ability and variables such as VO₂ max ($r = 0.966, p < 0.05$), grip strength ($r = 0.773, p < 0.05$), and self-esteem ($r = 0.771, p < 0.05$) were identified as the strongest contributors. Speed, agility, explosive power, muscular endurance and breath holding time also showed correlation ($r = -0.385, p < 0.05$), ($r = -0.936, p < 0.05$), ($r = 0.425, p < 0.05$), ($r = 0.362, p < 0.05$) and ($r = 0.501, p < 0.05$). Variables such as anaerobic power, vital capacity, forced expiratory volume, stress, sports aggression, sports competition anxiety and sports achievement motivation demonstrated weak or non-significant correlations, suggesting that these attributes may not be primary determinants of playing ability at the district level. These results highlight the importance of specific bio motor, physiological and psychological attributes in Kabaddi performance, providing valuable insights for talent identification and training programs.

Keywords: Kabaddi performance, playing ability, bio-motor variables, physiological variables, psychological variables, female athletes

Introduction

Kabaddi is a traditional contact sport that originated in ancient India and has gained immense popularity worldwide, especially in South Asia. It is a fast-paced, team-based game that combines elements of strength, agility, strategy, and endurance. Played between two teams, the objective is for a "raider" to infiltrate the opponent's court, tag as many defenders as possible, and return to their side-all while holding their breath and chanting "Kabaddi." The defenders aim to stop the raider by tackling them before they return. Kabaddi requires exceptional physical fitness, mental sharpness, and teamwork, making it a dynamic and thrilling sport. Over the years, Kabaddi has evolved from a rural pastime to an internationally recognized sport with professional leagues and global championships. This study aims to bridge this gap by analysing the collective influence

of these variables on the playing ability of female Kabaddi players. The findings are expected to provide a scientific basis for player selection, talent identification, and personalized training strategies.

Bio-motor variables are essential components of physical fitness that describe an athlete's ability to perform specific motor tasks. These include speed, agility, explosive power, grip strength, and muscular endurance. Each bio-motor skill contributes to the athlete's overall performance, with different sports emphasizing different combinations of these abilities. Kabaddi, being a high-intensity contact sport, demands a fine balance of all these variables. Speed and agility are critical for quick evasive actions, while explosive power and muscular endurance help players tackle or resist opponents effectively during prolonged bouts (Bompa, T. O., & Haff, G. G. 2009) [4]. Speed is the ability to move

quickly across the ground or perform rapid movements. In Kabaddi, speed is a crucial factor for successful raids and defensive maneuvers (Singh, H., & Brar, R. S. 2010) [22]. Agility is the ability to change direction quickly while maintaining control. Kabaddi requires high levels of agility for dodging opponents and making swift defensive moves (Gabbett, T. J., & Sheppard, J. M. 2012) [8]. Explosive power refers to the ability to exert maximum force in a short period. It is essential in Kabaddi for actions such as jumping, lunging, and tackling (Marković, G., & Mikulić, P. 2010) [13]. Grip strength is a measure of the force generated by the hands and forearms. In Kabaddi, a strong grip is vital for holding opponents during tackles and raids (Cronin, J., & Sleivert, G. 2005) [7]. Muscular endurance is the ability of a muscle group to sustain repeated contractions over time. In Kabaddi, endurance is critical for prolonged defensive or offensive efforts during a match (Mujika, I., & Padilla, S. 2001) [16].

Physiological variables are measures of the body's functional capabilities and processes, particularly those influencing physical performance and fitness. In sports science, these variables are used to assess an athlete's physical condition, endurance, and ability to perform during training or competition. These physiological variables are interrelated and directly influence an athlete's ability to sustain performance, recover, and excel during competition. The inclusion of such variables in the study highlights their importance in identifying and developing optimal performance in Kabaddi players. The ability to exert high-intensity efforts in short bursts without relying on oxygen intake. It reflects the capacity of the anaerobic energy systems (ATP-PC and glycolytic systems). In Kabaddi, explosive bursts during raiding or defending depend heavily on anaerobic power McArdle, W.D., Katch, F.I., & Katch, V.L. (2010) [15]. The maximum amount of oxygen an individual can utilize during intense exercise. It is a key indicator of aerobic endurance. A higher VO_2 max enables players to maintain activity over longer periods without fatigue, crucial for Kabaddi's high-intensity intervals Bassett, D.R., & Howley, E.T. (2000) [2]. The maximum amount of air a person can exhale after a maximum inhalation. It reflects the efficiency of the respiratory system. Better lung function supports sustained effort during extended play periods in Kabaddi Wilmore, J.H., & Costill, D.L. (2004) [25]. The volume of air a person can forcefully exhale in one second. It indicates respiratory system efficiency and airway health. Kabaddi players with high FEV_1 can quickly recover from short bursts of intense activity, aiding performance American Thoracic Society (1995) [1]. The duration an individual can hold their breath after a full inhalation. It reflects respiratory control and lung function. In Kabaddi, players often rely on controlled breath-holding during "raids," making this variable critical for success Park, K. (2021) [17].

Psychological variables are factors that reflect an athlete's mental and emotional state, which significantly impact their performance in sports. These variables help in understanding how athletes cope with stress, handle competition, stay motivated, and maintain focus during training or matches. These variables are critical because Kabaddi is an intense, high-pressure game requiring not only physical skills but also mental toughness.

Psychological preparation enhances a player's ability to stay calm under pressure, maintain focus, and make strategic decisions during crucial moments of the match. In the study on Kabaddi players, psychological variables such as stress, sports aggression, sports competition anxiety, sports achievement motivation, and self-esteem were assessed. Stress is the body's response to challenges or demands, which can be physical, emotional, or mental. In sports, stress can arise from pressure to perform, expectations, or competitive situations. Kabaddi players experiencing high levels of stress may face reduced focus, poor decision-making, or fatigue, affecting their performance Selye, H. (1956) [19]. Sports aggression refers to assertive, forceful, or dominating behavior aimed at achieving a goal within the rules of the game. It can be both positive (instrumental aggression) or negative (hostile aggression). Kabaddi players need controlled aggression to tackle opponents or succeed in raiding while avoiding penalties for hostile actions Silva, J.M. (1983) [21]. A state of nervousness, tension, or worry experienced before or during competitive situations. It includes both cognitive anxiety (worry about performance) and somatic anxiety (physical symptoms like sweating or increased heart rate). High competition anxiety can impair Kabaddi players' focus and performance, whereas moderate levels may enhance motivation Martens, R., Vealey, R.S., & Burton, D. (1990) [14]. The drive or desire to achieve excellence, overcome obstacles, and demonstrate competence in sports. This variable combines intrinsic (internal satisfaction) and extrinsic (rewards, recognition) motivation. Highly motivated Kabaddi players are more likely to train consistently, push their limits, and succeed in matches Roberts, G.C., & Treasure, D.C. (2012) [18]. Self-esteem refers to an individual's confidence in their abilities and self-worth. In sports, high self-esteem helps athletes stay positive and recover from setbacks. Kabaddi players with strong self-esteem can better handle criticism, stay confident in challenging situations, and improve performance Harter, S. (1990) [9].

Materials and Methods

The study included 200 district-level female Kabaddi players from Manipur, India. Participants were selected through purposive sampling based on their active participation in district-level tournaments. Informed consent was obtained from all participants prior to data collection. Weight, height, arm length, leg length, and calf girth were measured using standardized anthropometric tools. Speed was assessed using a 50-meter sprint test, agility through the shuttle run test, explosive power using the standing broad jump, grip strength via a handgrip dynamometer, and muscular endurance through a sit-up test. Anaerobic power was measured using the RAST, VO_2 max via the copper's run and walk test, vital capacity and forced expiratory volume using a spirometer, and breath-holding time through a nose clip, stopwatch method. Stress was evaluated using the Perceived Stress Scale (PSS), sports aggression through the Sports Aggression Inventory, sports competition anxiety using the SCAT (Sports Competition Anxiety Test), sports achievement motivation via the SAMT (Sports Achievement Motivation Test), and self-esteem using the Rosenberg Self-Esteem Scale. Playing ability was rated by three certified Kabaddi coaches. They used a 100-point

scale based on ten different factors to assess the players. The investigator provided guidelines for the ratings, which can be found in a table-I. Descriptive statistics (mean and standard deviation) were calculated for all variables. Pearson correlation analysis was conducted to examine the relationship between playing ability and the independent variables with the help of SPSS software to find out the significance difference. Significance levels were set at $p < 0.05$.

Table 1: Rating Scale for Evaluation of Kabaddi Playing Ability

Sl. No.	Factors	Points									
1.	Touching Skill	1	2	3	4	5	6	7	8	9	10
2.	Kicking Skill	1	2	3	4	5	6	7	8	9	10
3.	Other Offensive Skills	1	2	3	4	5	6	7	8	9	10
4.	Foot Work	1	2	3	4	5	6	7	8	9	10
5.	Catching Skill	1	2	3	4	5	6	7	8	9	10
6.	Movement in Chain	1	2	3	4	5	6	7	8	9	10
7.	Other Defensive Skills	1	2	3	4	5	6	7	8	9	10
8.	Team co-ordination	1	2	3	4	5	6	7	8	9	10
9.	Tactics	1	2	3	4	5	6	7	8	9	10
10.	Improvisation	1	2	3	4	5	6	7	8	9	10

Analysis

Table 2: Descriptive Statistic of Anthropometric variables and Bio Motor skills of Women Kabaddi Players

Sl. No.	Variable	Mean	Std. Deviation
1.	Playing Ability (PA)	61.37	8.19
2.	Speed (S)	9.02	0.78
3.	Agility (A)	11.66	1.16
4.	Explosive Power (EP)	181.89	7.78
5.	Grip Strength (GS)	36.64	3.34
6.	Muscular Endurance (ME)	39.57	9.68
7.	Anaerobic Power (AP)	4.36	1.83
8.	VO2 Max	34.67	0.94
9.	Vital Capacity (VC)	3258.63	47.93
10.	Forced Expiratory Volume (FEV)	3.33	0.52
11.	Breath-Holding Time (BHT)	56.30	12.52
12.	Stress (PSS)	17.29	4.26
13.	Sports Aggression (SA)	10.37	2.48
14.	Sports Competition Anxiety (SCAT)	18.79	3.61
15.	Sports Achievement Motivation (SAMT)	27.71	4.25
16.	Self-Esteem (RSE)	19.45	3.24

Table- 2 shows the mean value for kabaddi playing ability and bio motor skills such as speed, agility, explosive power, grip strength and muscular endurance are 61.37, 9.02, 11.66, 181.89, 36.64 and 39.57 respectively. The mean value for physiological variables such as anaerobic power, vo2 max, vital capacity, forced expiratory volume and breath-holding time are 4.36, 34.67, 3258.63, 3.33 and 56.30 respectively. And the mean value for psychological variables such as stress, sports aggression, sports competition anxiety, sports achievement motivation and self-esteem are 17.29, 10.37, 18.79, 27.71 and 19.45 respectively.

Table 3: Correlation coefficient between kabaddi playing ability and selected variables

Sl. No.	Variable	Mean	Correlation with PA (r)
1.	Speed (S)	9.02	-0.385**
2.	Agility (A)	11.66	-0.936**
3.	Explosive Power (EP)	181.89	0.425**
4.	Grip Strength (GS)	36.64	0.773**
5.	Muscular Endurance (ME)	39.57	0.362**
6.	Anaerobic Power (AP)	4.36	-0.004
7.	VO2 Max	34.67	0.966**
8.	Vital Capacity (VC)	3258.63	0.042
9.	Forced Expiratory Volume (FEV)	3.33	-0.080
10.	Breath-Holding Time (BHT)	56.30	0.501**
11.	Stress (PSS)	17.29	0.034
12.	Sports Aggression (SA)	10.37	0.038
13.	Sports Competition Anxiety (SCAT)	18.79	-0.089
14.	Sports Achievement Motivation (SAMT)	27.71	-0.015
15.	Self-Esteem (RSE)	19.45	0.771**

*Significance levels were set at $p < 0.05$ (Required table value 'r'= 138).

Table 3 presents the Pearson correlation coefficients between the criterion variable (kabaddi playing ability) and the predictor variables. The predictor variables are listed in the following order: speed, agility, explosive power, grip strength, muscular endurance, anaerobic power, vo2 max, vital capacity, forced expiratory volume, breath-holding time, stress, sports aggression, sports competition anxiety, sports achievement motivation and self-esteem. The results indicated that kabaddi playing ability was significantly correlated with speed, agility, explosive power, grip strength, muscular endurance, vo2 max, breath-holding time and self-esteem with obtained 'r' value of -0.385, -0.936, 0.425, 0.773, 0.362, 0.966, 0.501 and 0.771 respectively, all exceeding the required table 'r' value of 0.138 at the 0.05 level of confidence. In contrast, no significant relationships were found between kabaddi playing ability and other variables such as anaerobic power, vital capacity, forced expiratory volume, stress, sports aggression, sports competition anxiety and sports achievement motivation, as their obtained 'r' values ranged from -0.004 to -0.089, all falling below the threshold of 0.138.

Findings

The results demonstrate that bio-motor, physiological and psychological variables significantly correlate with Kabaddi playing ability, while psychological variables showed limited direct influence. Among the significant predictors, VO2 max ($r = 0.966, p < 0.05$), grip strength ($r = 0.773, p < 0.05$), and self-esteem ($r = 0.771, p < 0.05$) were identified as the strongest contributors. Speed, agility, explosive power, muscular endurance and breath holding time also showed correlation ($r = -0.385, p < 0.05$), ($r = -0.936, p < 0.05$), ($r = 0.425, p < 0.05$), ($r = 0.362, p < 0.05$) and ($r = 0.501,$

$p < 0.05$). These findings highlight the necessity of incorporating a multidisciplinary approach for player selection and training. The need for a multidisciplinary approach in Kabaddi training has been well-supported. Kumar *et al.* (2020)^[11] recommended integrating bio-motor, physiological, and psychological variables into talent identification and training programs to address the multifaceted demands of the sport. By focusing on these factors, coaches can optimize player performance and enhance their overall game strategies. VO2 max has long been recognized as a critical indicator of endurance and overall fitness in sports, including Kabaddi. Singh *et al.* (2018)^[24] reported that VO2 max significantly influences performance by enhancing aerobic capacity, enabling players to sustain high-intensity efforts during prolonged matches. Further, Kumar & Sharma (2016)^[12] highlighted that players with higher VO2 max recover faster during matches, which is crucial for maintaining peak performance during repetitive raids and defensive actions. As mentioned earlier, grip strength is indispensable in Kabaddi. Research by Chaubey *et al.* (2017)^[5] affirmed its strong correlation with playing ability, emphasizing its role in holding opponents and maintaining defensive stances. While speed and agility demonstrated weaker correlations in this study, several previous works have highlighted their sport-specific role. However, Sharma *et al.* (2019)^[6] noted that these attributes are secondary to strength and power in Kabaddi due to its close-contact and tactical nature. Explosive power, which facilitates dynamic movements such as jumping and lunging, has been emphasized by Chandrasekaran *et al.* (2019)^[6] as essential for offensive strategies, including raiding. Similarly, muscular endurance has been highlighted by Joseph *et al.* (2016)^[10] as crucial for maintaining performance over the duration of the match. Breath-holding time is uniquely important in Kabaddi, as players must often raid while holding their breath. In a study by Singh *et al.* (2015)^[23], a significant correlation was found between breath-holding time and raiding efficiency, underscoring its importance in sustaining longer and more effective raids. Self-esteem is a critical psychological variable that influences player confidence and performance under pressure. Yadav *et al.* (2017)^[26] observed a significant positive correlation between self-esteem and performance among district-level athletes, including Kabaddi players, suggesting that players with high self-esteem are more likely to take calculated risks during matches. Interestingly, variables such as anaerobic power, vital capacity, forced expiratory volume, stress, sports aggression, sports competition anxiety and sports achievement motivation demonstrated weak or non-significant correlations, suggesting that these attributes may not be primary determinants of playing ability at the district level. Studies such as Kumar *et al.* (2019) found that while anaerobic power and vital capacity are essential for explosive efforts, their limited correlation at the district level may be attributed to the players' general fitness levels. Kabaddi demands a balance of anaerobic and aerobic energy systems, with aerobic capacity (VO2 max) often playing a more dominant role. Limited significance of forced expiratory volume has been similarly reported in prior studies. Sharma *et al.* (2018)^[24] observed that FEV may be more critical for endurance sports like running or swimming

than for Kabaddi, which involves intermittent bursts of activity. While your study found limited influence of stress, sports aggression, and sports competition anxiety, previous research (e.g., Bhardwaj & Singh, 2018)^[3] suggests these factors might play a larger role at elite levels, where the intensity of competition and pressure is higher. At the district level, physical and physiological attributes appear to take precedence. Similar findings were reported by Sharma & Kaur (2020)^[20], who noted that motivation is a latent variable that indirectly influences performance but may not show a direct correlation with measurable outcomes in district-level competitions.

Conclusion

The study highlights that bio-motor, physiological, and psychological variables significantly influence Kabaddi playing ability, though psychological factors showed limited direct impact. Among the variables, VO2 max, grip strength and self-esteem emerged as the strongest contributors to performance, emphasizing the importance of endurance, strength, and confidence in the game. Additionally, variables like speed, agility, explosive power, muscular endurance, and breath-holding time also demonstrated moderate correlations, underscoring their role in specific game situations. Interestingly, attributes such as anaerobic power, vital capacity, forced expiratory volume, stress, sports aggression, sports competition anxiety, and sports achievement motivation showed weak or no significant correlations at the district level. This suggests that the physical and physiological demands of Kabaddi may outweigh psychological factors at this level of play. These findings underline the importance of adopting a multidisciplinary approach in training and player selection, focusing on enhancing key to bio motor, physiological, and psychological attributes to align with the sport's specific demands. The study provides actionable insights for coaches and trainers. By prioritizing the development of VO2 max, grip strength, self-esteem, speed, agility, explosive power, muscular endurance, and breath-holding time, training programs can be better aligned with the demands of Kabaddi. Additionally, these variables can serve as reliable criteria for talent identification and player selection.

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