

Original Research

Received 06 June 2026

Revised 22 July 2026

Accepted 06 August 2026

Natural Resources for Human Health 2026, Vol. 6 (6): 61–68

KEYWORDS:

Kabaddi, resistance training, speed, explosive power, muscular endurance.

Equipment-Free Resistance Training and Performance Adaptations in Women Kabaddi Players: A Randomized Controlled Trial

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ABSTRACT:

Purpose. The objective of this study was to investigate the effect of Resistance Training (RT) without equipment on psychological and physical effectiveness of college level female Kabaddi players.

Materials & Methods. Thirty subjects were divided into two groups: a control group (CG), which did not receive specialized training, and an experimental group (EG), which engaged in a twelve-week resistance training program without equipment. Physiological and physical fitness characteristics were evaluated through pre-tests and post-tests. The data were analysed using ANCOVA to assess differences in means.

Results. ANCOVA revealed statistically significant differences between the experimental and control groups across all selected physiological and physical fitness variables following the intervention. In the experimental group, resting pulse rate decreased from 78.6 ± 4.5 to 72.1 ± 3.8 beats/min, while breath-holding time increased from 36.2 ± 4.1 to 44.7 ± 3.9 s and vital capacity increased from 2.85 ± 0.21 to 3.21 ± 0.24 L. Significant improvements were also observed in speed, which improved from 9.45 ± 0.32 to 8.62 ± 0.28 s, explosive power increased from 142.3 ± 10.5 to 157.8 ± 9.6 cm, and muscular endurance increased from 24.5 ± 3.2 to 31.6 ± 3.5 repetitions. The corresponding F-ratios were 18.72, 29.84, 16.94, 21.37, 24.15, and 19.86, respectively, with all variables showing significant improvements at $p < .05$. These findings indicate that the intervention programme produced favourable improvements in physiological function and performance-related physical fitness among the participants.

Conclusions. Structured resistance and skill specific training has a significant impact on physical and physiological performance of women Kabaddi players and enhances overall game readiness and effectiveness.

INTRODUCTION

Kabaddi is a traditional indigenous sport of India that involves strength, speed, endurance, agility and tactical skill [1]. It is a high-intensity intermittent contact sport between two teams. Players take turns playing offensive (raider) and defensive roles within a limited time. This activity requires a high level of physical fitness, including muscular strength, explosive power, cardiovascular endurance, flexibility, and neuromuscular coordination, as well as physiological efficiency, such as good respiratory and metabolic function. Kabaddi also has a great emphasis on psychological attributes like concentration, decision making and mental toughness [24]. Due to its dynamic nature and continuous physical engagement without the use of external equipment, Kabaddi serves as an excellent model for studying the impacts of resistance training without equipment on physical and physiological performance, particularly among college-level women athletes [10].

The performance in Kabaddi depends largely on the physical structure, muscular efficiency and neuromuscular control of an athlete along with the ability to take quick decisions under the conditions of high physical and psychological stress [11]. In this sport, the smallest difference in power, speed, or agility can be the difference between a successful raid and a successful defensive response. Therefore, kabaddi training is not limited to technical skill development but also aims to improve physical qualities for high-level competition [2,17]. Regular practice of kabaddi training has been observed to improve critical fitness components such as flexibility, speed, strength, agility and endurance [18]. But it is not yet clear if traditional kabaddi practice alone is better than specialized or directed training programmes in enhancing these performance related attributes [10].

By making muscles work against external loads like dumbbells, barbells, resistance machines, or elastic bands, resistance training (RT) increases muscle strength [20]. This type of exercise helps reduce body fat and enhance bone mineral density in addition to increasing muscle size and strength [15]. Resistance exercise, often known as strength or weight training, applies increasing resistance to skeletal muscles to increase muscular hypertrophy, strength, and anaerobic capacity [20]. In addition to aerobic exercise to enhance cardiovascular and respiratory efficiency, a comprehensive physical activity program includes strength training to promote bone health, joint stability, and the strength of muscles, tendons, and ligaments [15]. Furthermore, increasing muscle mass raises the body's resting metabolic rate, allowing for prolonged fat loss and helping individuals maintain weight over time. High-intensity resistance workouts further boost metabolism for several hours after exercise, enhancing overall energy expenditure and supporting fat reduction [23].

Regular participation in RT provides numerous benefits, several of which are particularly relevant to the present study. Strength training enhances bone mineral density and lowers the risk of osteoporosis [4, 20]. It also supports body-weight management while increasing muscular strength, as greater muscle mass increases the body's capacity to efficiently burn calories [15]. By strengthening muscles, RT helps protect joints and reduces the likelihood of injury. Improvements in muscular strength and endurance contribute to increased stamina, allowing individuals to perform daily and athletic activities with less fatigue [14]. In addition, strength training promotes better balance and flexibility, which are essential for maintaining functional independence, especially with advancing age [22]. Psychological benefits are also evident, including improved self-confidence, enhanced body image, and a reduced risk of depression. Individuals who engage in regular strength training often experience improved sleep quality. Furthermore, RT can help alleviate the signs and symptoms of various chronic conditions, such as arthritis, back pain, diabetes, obesity, and depression. In this context, RT without equipment, commonly referred to as bodyweight or equipment-free RT, utilizes an individual's own body mass as resistance and can be effectively implemented without the need for specialized facilities. Such training methods are particularly suitable for Kabaddi players, as they closely mimic sport-specific movements and contribute to improvements in selected physical and physiological variables [7,16,19].

LITERATURE REVIEW

Suresh (2023) examined the effects of resistance training (RT) and selected yoga techniques on the speed performance of male Kabaddi players. The study included sixty players, aged 20 to 25, from Bharathidasan University, who were randomly divided into three equal groups: an RT group, a yoga group, and a control group that maintained their regular routines. Over the course of twelve weeks, speed performance data was collected both before and after the training. The results indicated that the RT

group experienced greater improvements in speed compared to both the control and yoga groups [21]. Neela et al. (2025) studied the effects of yogic exercises and hyper circuit resistance training (HRT) on the physiological characteristics of 60 female tribal Kabaddi players aged 19 to 25 in Telangana, India. Participants were divided into four groups: Group I underwent super circuit strength training, Group II practiced yogic exercises, Group III combined both methods, and Group IV served as the control group. Training occurred three times a week for twelve weeks, with VO_2 max as the primary assessment metric. Results indicated that both training methods significantly improved VO_2 max in the participants, while the control group exhibited minimal changes [16]. Research conducted by Lakshmanan and Kavitha (2025) investigated the effects of resistance training (RT) on explosive power among 30 male Kabaddi players aged 18 to 25. The participants were divided into two groups: one group participated in a structured 12-week RT program, while the control group continued their usual training routines. Evaluations conducted before and after the program revealed that the experimental group demonstrated a significant improvement in explosive power compared to the control group, thus confirming the effectiveness of the RT intervention [13].

Research gap and objective. While resistance training is well-established to enhance athletic performance, most existing studies have concentrated on gym-based or equipment-assisted training protocols focused on male athletes or mixed-sport populations. There is a lack of research examining the effectiveness of equipment-free resistance training specifically among college-level female Kabaddi players, especially in terms of both physical fitness and psychological outcomes. Additionally, evidence is scarce regarding low-cost, accessible training methods that can be utilized in collegiate sports settings without the need for specialized facilities or equipment. Consequently, this study aims to address this gap by investigating the effects of structured, equipment-free resistance training on performance adaptations among female kabaddi athletes.

MATERIALS AND METHODS

Participants. A randomized controlled experimental study design was adopted to examine the effects of equipment-free resistance training on selected physical and psychological variables among college-level female Kabaddi players. Thirty college-level female Kabaddi players aged between 20 and 22 years were randomly selected for the study. The participants were divided into two groups: an Experimental Group (EG, $n = 15$) and a Control Group (CG, $n = 15$). The study focused on female Kabaddi players aged 20 to 22 years who had participated in intercollegiate Kabaddi competitions. All participants were healthy, physically active, and voluntarily agreed to take part in the study. Individuals with a history of recent musculoskeletal injuries or surgeries, as well as those with cardiovascular, neurological, or respiratory disorders, were excluded. Additionally, the study excluded participants who engaged in any other structured resistance training programs during the intervention period or those who did not consistently attend the training sessions. Participants enrollment allocation details are mentioned in Figure.1.

Procedures. Before the intervention, all participants underwent baseline assessments for selected physical fitness and psychological variables. The experimental group engaged in a structured, equipment-free resistance training program for twelve weeks, while the control group maintained their usual activities without any specialized training intervention. The training program incorporated bodyweight-based resistance exercises aimed at enhancing speed, muscular strength, endurance and physiological effectiveness measures. To minimize potential confounding variables, both the experimental and control groups continued their regular Kabaddi technical training under the same coaching staff and followed an identical training schedule throughout the intervention period. Participants were instructed not to participate in any additional strength training, competitive sports, or structured exercise programs outside the study. They were also advised to maintain their usual dietary habits, sleep patterns, and daily lifestyle during the intervention. Attendance was recorded for all supervised training sessions to ensure compliance. Training sessions were held for one hour per day, 3 days a week (Monday, Wednesday, and Friday), over the 12 weeks. Every day, from roughly 5:00 to 6:00 p.m., a 60-minute session was held. A planned series of warm-up, workout, and cool-down routines were part of the sessions. No specialist training was provided by the CG. Each session included a 10-minute warm-up, 40 minutes of unequipped RT, and a 10-minute cool-down. Push-ups, squats, walking lunges, calf lifts, and dips were among the workouts. To guarantee correct technique and adherence, all participants were rigorously monitored both before and throughout each session. The training program's details are given in Table 1.

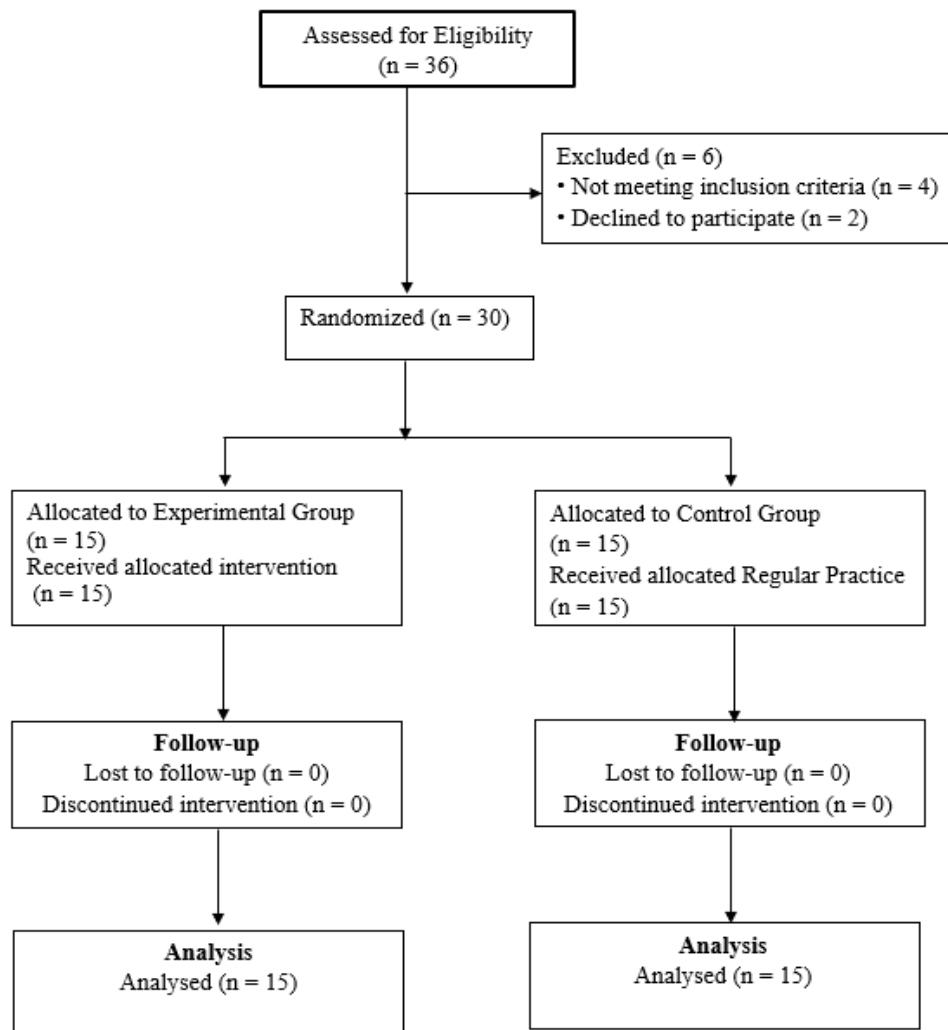


Figure 1. CONSORT Flow Diagram of Participant Enrollment and Allocation

Table 1. Equipment-Free Resistance Training Schedule

Weeks	Exercises	No of sets	No of repetition
1st - 4th weeks	Push-up, squats, walking lunges, calf raise, dips	3	10 – 12
5th – 8th weeks	Push-up, squats, walking lunges, calf raise, dips	3	10 – 12
9th – 12th weeks	Push-up, squats, walking lunges, calf raise, dips	3	10 – 12

Outcome measures. The study focused on outcome measurements that included both physiological and physical fitness variables. Physiological variables, such as breath-holding time, were measured in seconds using a standardized breath-holding procedure. The resting pulse rate was recorded in beats per minute after allowing for adequate rest, and vital capacity was assessed using a spirometer, expressed in liters. Physical fitness variables evaluated included explosive power (EP), assessed via

the standing broad jump; speed, measured through a 50-meter sprint; and muscular endurance, evaluated using sit-up and push-up tests. All measurements were conducted under controlled conditions both before and after the intervention to assess the effectiveness of the training program [1,6,8].

Statistical Analysis. Descriptive statistics are presented as mean $\pm$ standard deviation. Assumptions of normality, homogeneity of variance, homogeneity of regression slopes, and linearity were examined before analysis. Between-group differences were assessed using analysis of covariance (ANCOVA), with baseline scores entered as covariates. Bonferroni-adjusted pairwise comparisons were conducted when significant main effects were observed. Statistical significance was set at $p < 0.05$. Partial eta squared (η^2) was calculated to estimate effect size, and 95% confidence intervals were reported where appropriate.

RESULTS

The analysis of covariance (ANCOVA) revealed (Table 2 & 3) statistically significant differences between the experimental and control groups across all selected physiological and physical fitness variables following the intervention period at the 0.05 level of significance ($df = 1, 27$). The F-ratios obtained for all variables exceeded the required table value, indicating the intervention program's effectiveness.

In terms of physiological variables, the resting pulse rate (RPR) demonstrated a significant reduction in the experimental group, decreasing from 78.6 ± 4.5 to 72.1 ± 3.8 beats per minute. In contrast, the control group showed nearly constant values throughout the study period.

Table 2. Analysis of Covariance for Resting Pulse Rate (RPR), Breath-Holding Time (BHT), and Vital Capacity (VC)

Variable	Source of Variance	Sum of Squares	df	Mean Square	F-ratio	Partial η^2
RPR	Between Groups	302.41	1	302.41	18.72*	0.41
	Within Groups	435.98	27	16.15		
BHT	Between Groups	542.16	1	542.16	29.84*	0.53
	Within Groups	490.62	27	18.17		
VC	Between Groups	1.42	1	1.42	16.94*	0.39
	Within Groups	2.26	27	0.084		
Speed	Between Groups	4.86	1	4.86	21.37*	0.44
	Within Groups	6.14	27	0.23		
EP	Between Groups	1782.64	1	1782.64	24.15*	0.47
	Within Groups	1993.58	27	73.84		
ME	Between Groups	378.42	1	378.42	19.86*	0.42
	Within Groups	514.37	27	19.05		

* Significant at 0.05 level (Critical F-value at df 1 and 27 = 4.21)

The F-ratio of 18.72 ($p < 0.05$) confirmed the intervention's positive impact on lowering resting pulse rate. Additionally, breath-holding time (BHT) significantly increased in the experimental group, rising from 36.2 ± 4.1 seconds to 44.7 ± 3.9 seconds, while the control group exhibited only a marginal improvement. The F-ratio of 29.84 ($p < 0.05$) indicated a significant enhancement in respiratory efficiency and breath control among the participants in the experimental group. Furthermore, vital capacity (VC) improved from 2.85 ± 0.21 liters to 3.21 ± 0.24 liters in the experimental group, with an F-ratio of 16.94 ($p < 0.05$), suggesting improved pulmonary function following the intervention.

Table 3. Adjusted Post-Test Means & Scheffé's Post Hoc Test for Experimental and Control Groups

Variable	Experimental Group	Control Group	Mean Difference	Confidence Interval Value	p value
RPR (beats/min)	72.34	78.26	5.92	2.87	Sig
BHT (s)	44.38	37.42	6.96	3.24	Sig
VC (L)	3.18	2.96	0.22	0.11	Sig
Speed (s)	8.66	9.34	0.68	0.29	Sig
EP (cm)	156.92	143.86	13.06	5.84	Sig
ME (repetitions)	31.24	25.48	5.76	2.63	Sig

*** Significant at 0.05 level**

Significant changes were also noted in the physical fitness variables. Speed performance improved in the experimental group, decreasing from 9.45 ± 0.32 seconds to 8.62 ± 0.28 seconds, while the control group showed negligible change. The obtained F-ratio of 21.37 ($p < 0.05$) demonstrated the intervention's effectiveness in enhancing speed performance. Explosive power (EP) increased significantly from 142.3 ± 10.5 centimeters to 157.8 ± 9.6 centimeters in the experimental group compared to the control group, with an F-ratio of 24.15 ($p < 0.05$) confirming substantial improvement in lower-body power. Similarly, muscular endurance (ME) increased from 24.5 ± 3.2 to 31.6 ± 3.5 in the experimental group, while only slight changes were observed in the control group. The F-ratio of 19.86 ($p < 0.05$) indicated a significant enhancement in muscular endurance attributable to the intervention program. Overall, the findings suggest that the intervention program effectively improved both physiological efficiency and physical fitness performance among participants in the experimental group compared to those in the control group.

DISCUSSION

The present study investigated the effect of resistance training without equipment on selected physiological and physical fitness variables among female Kabaddi players. The present study utilized standardized field-based assessments, including sprint speed, standing broad jump, muscular endurance tests, breath-holding time, and vital capacity, because these measures are practical, reliable, and commonly employed to evaluate athletic fitness in field settings. Improvements in these variables are considered important physical attributes that support Kabaddi performance by enhancing acceleration, lower-body power, muscular endurance, and respiratory efficiency. However, these assessments do not directly measure sport-specific performance during competitive play. The results showed that the experimental group had much better resting pulse rate, breath-holding time, vital capacity, speed, explosive power, and muscular endurance than the control group after the intervention period.

The significant reduction in resting pulse rate observed in the experimental group may be attributed to improved cardiovascular efficiency and physiological adaptation resulting from regular resistance training. Resistance-based exercises enhance cardiac output, muscular circulation, and recovery efficiency, which contribute to improved cardiovascular functioning in athletes. Kraemer and Ratamess reported similar findings, stating that systematic resistance training enhances cardiovascular and neuromuscular adaptations in athletes [12]. The improvements in breath-holding time and vital capacity suggest enhanced respiratory efficiency and greater tolerance to physical exertion. Resistance training involving repeated muscular contractions increases respiratory muscle activation and improves oxygen utilization during exercise. These adaptations are particularly beneficial in Kabaddi, where players perform repeated high-intensity actions with limited recovery time. Faigenbaum et al. reported that structured resistance training programs significantly improve functional fitness and physiological performance in young athletes [9]. The significant improvement in speed performance observed in the experimental group indicates enhanced neuromuscular coordination and movement efficiency. Resistance training improves force production, stride frequency, and lower-body strength, which are essential for sprinting and rapid directional changes in Kabaddi. The reduction in sprint time from 9.45 ± 0.32 s to 8.62 ± 0.28 s demonstrates the positive influence of the training program on athletic performance. Chelly et al. observed similar results, reporting improved sprint performance following resistance and plyometric training interventions [4]. Explosive power also improved significantly in the experimental group. Resistance exercises performed with and without equipment may enhance muscle fiber recruitment, muscular strength, and power generation capacity. Explosive power is a critical component in Kabaddi for jumping, lunging, tackling, and sudden offensive movements. The increase in explosive

power from 142.3 ± 10.5 cm to 157.8 ± 9.6 cm supports the effectiveness of the intervention in improving lower-body power. Previous research by Cormie et al. indicated that resistance training is highly effective in developing muscular power and sports-specific performance [5]. Similarly, muscular endurance improved significantly in the experimental group compared with the control group. Repeated resistance exercises enhance fatigue resistance, muscular efficiency, and the ability to sustain repeated muscular contractions over time. Improved muscular endurance is essential in kabaddi, as players must continuously perform high-intensity movements throughout the game duration. Campos et al. also reported that resistance training significantly enhances muscular endurance and overall athletic conditioning [3].

CONCLUSIONS

The findings of the present study indicate that resistance training without equipment effectively improved physiological efficiency and physical fitness performance among female Kabaddi players. These results suggest that incorporating structured resistance training programs into regular sports conditioning may enhance athletic performance and competitive ability in Kabaddi players.

ACKNOWLEDGEMENTS

We would like to express our gratitude to all the participants, for their support and involvement in this study.

FUNDING

This research did not receive any specific funding from public, commercial, or non-profit organizations.

Sivarani Sivakozhundhu: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review and editing. **Asad Ali Khan D. Jaffar Ali Khan:** Conceptualization, Project administration, Resources, Supervision, Validation, Formal analysis, Funding acquisition, Writing – review and editing. **Ezhilarasan Manoharan:** Conceptualization, Methodology, Project administration, Resources, Formal analysis, Funding acquisition. **Thamaraiselvi Saravanakumar:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Software, Validation, Visualization, Writing – original draft, Writing – review and editing.

CONFLICT OF INTEREST

The authors have no conflicts of interest in the material presented in this article.

Ethical Approval & Informed Consent. All procedures were conducted in accordance with the Declaration of Helsinki and approved by Departmental Ethical Committee in Feb 2025. Written informed consent for participation and publication of anonymized clinical data was obtained from the participants.

AI Policy. The authors declare that no generative AI was used in this manuscript.

Data Availability. The datasets utilized and analysed in this study can be obtained from the corresponding author upon reasonable request. All data necessary to assess the conclusions drawn in this paper are included within the paper itself.

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