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Physiological Performance and Skin Health Indicator of Elite East Java Kabaddi Athletes: A Pilot Study

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ABSTRACT

Objective: This study evaluates both physiological performance indicators and friction-induced skin lesions in elite kabaddi athletes from East Java, Indonesia.

Methods and Materials: This lab-controlled experimental pilot study involved 28 male elite Kabaddi athletes in East Java, assessed under standardized training conditions. Inclusion criteria were active competition status, age 18–30 years, and absence of acute injury. Physiological assessments included body composition, aerobic capacity (VO₂max), muscular strength, agility, and speed, all measured using validated protocols. Skin health evaluation consisted of post-activity physical examination for friction-induced lesions, scored on a standardized 0–4 scale, with anatomical site, pain, and itch recorded.

Findings: Athletes had an average body weight of 65.95 ± 2.75 kg, height of 169.29 ± 5.06 cm, and body fat percentage of 19.46 ± 4.20 %. Agility was moderate T-test (agility) 9.77 ± 0.52 s, sprint performance was good (20 m in 3.20 ± 0.13 s), and aerobic capacity was moderate (VO₂max: 40.50 ± 7.19 ml/kg/min). Friction-induced skin lesions were found in 57.10% of athletes, mostly mild (score 1–2), with the groin and axilla as the most common sites.

Conclusion: East Java's elite kabaddi athletes demonstrate a lean body composition and a sport-specific performance profile, although their aerobic capacity and lower-limb strength could be improved. The high prevalence of mild friction-induced lesions highlights the importance of integrating skin health monitoring into athlete conditioning and preventive programs, particularly in humid, high-contact sports.

Keywords: Physiological Performance, Skin Health Indicator, Athletes, Well-being.

Introduction

Kabaddi is a high-intensity contact sport that requires a unique combination of strength, speed, agility, and endurance (Pal et al., 2020). As the level of competition intensifies, so does the necessity for a comprehensive scientific evaluation of physiological characteristics to optimize athletic performance and inform targeted training strategies. Physiological parameters such as $VO_2\text{max}$, muscular strength, speed, agility, and body composition are critical determinants of success in kabaddi (Pramanick et al., 2022). Previous studies have primarily focused on athletes from traditional kabaddi-playing nations such as India, Iran, and Pakistan, leaving a research gap regarding athletes from emerging regions, including Indonesia (Roy & Sarkar, 2022).

The assessment of physical fitness in kabaddi athletes must encompass multiple components, including muscular strength, endurance, agility, flexibility, and sprinting ability (Nuzzo, 2020). A comprehensive battery of physical fitness tests enables accurate profiling of an athlete's readiness to meet the physical demands of the sport. Such tests are also instrumental in designing individualized training programs that focus on specific areas requiring improvement (Pol et al., 2020). The T-test and 20-meter sprint provide valuable information on an athlete's agility and speed—key attributes in kabaddi performance (Rasteiro et al., 2023). The Multistage Fitness Test (MSFT) is also an appropriate method for evaluating various dimensions of overall cardiorespiratory endurance (Susanto et al., 2024).

In addition to physiological and performance factors, skin health is a critical yet often overlooked component of athlete well-being, particularly in high-contact sports like kabaddi. Frequent physical contact, tight-fitting sportswear, and prolonged exposure to humid, sweat-prone environments increase the risk of friction-induced lesions and dermatological conditions, which can impair performance and cause training interruptions (Paradise & Hu, 2021; Pujalte et al., 2023; Szot et al., 2024). Integrating dermatological screening with physiological profiling may help identify risk factors early, guide targeted prevention strategies, and optimize both health and performance outcomes in kabaddi athletes (Ahomies et al., 2025; Utama et al., 2025).

This present study thus seeks not only to evaluate body composition and physical fitness through a

comprehensive test battery, but also to highlight the relevance of skin health in supporting optimal performance among elite kabaddi athletes. The outcomes are anticipated to inform coaches, trainers, and sports health practitioners in the design of more holistic training and health maintenance programs that address both performance and well-being (Simpson et al., 2023; Steins et al., 2024).

Therefore, this study aims to assess the physiological performance along with skin health indicators of elite kabaddi athletes in East Java, Indonesia, to provide foundational data for coaches, sports scientists, and fitness professionals. The findings are expected to contribute to the development of sport-specific conditioning protocols and talent identification frameworks tailored to Indonesian athletes. Furthermore, the study may offer comparative insights into how physiological adaptations vary across different training environments.

Methods and Materials

Study Design

This pilot study employed a lab-controlled experimental design to evaluate the physiological performance indicators of male elite kabaddi athletes from East Java, Indonesia. All assessments were conducted once in a standardized training environment to ensure uniform testing conditions. A total of 28 elite kabaddi athletes participated in this study. Physiological performance assessments included body composition (body weight, height, body fat percentage), aerobic capacity ($VO_2\text{max}$), muscular strength, agility, and sprint speed, using validated field test protocols.

In addition, a brief skin health screening was conducted as a supporting observation. Following the physiological assessments, athletes underwent a standardized inspection for friction-induced skin lesions using a Modified SASI (Skin Abrasion Severity Index), which is a clinical scoring system to assess skin irritation/abrasion based on clinical irritation scoring models (Charmeau-Genevois et al., 2021). Lesions were scored using a 0–4 severity scale (0 = normal, 1 = mild erythema, 2 = erythema + small abrasion, 3 = moderate abrasion, 4 = extensive abrasion/infection). This approach aligns with previous methodological frameworks for assessing sports-related abrasion

injuries, such as those applied in systematic reviews of skin trauma on artificial turf (Twomey et al., 2019). It also documented anatomical location, pain intensity, and itch symptoms. The skin health data were not intended as a primary outcome but served to provide contextual information regarding potential associations between body composition, physical exertion, and dermatological risk in high-contact sports. Therefore, lesion findings were analyzed and reported qualitatively. This approach was chosen because lesion prevalence was relatively low, the data were exploratory in nature, and the limited sample size restricted statistical generalization. Instead, the information is presented descriptively to highlight potential directions for future research on skin health in kabaddi athletes.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Health Research Ethics Committee of Universitas Negeri Surabaya, Indonesia (Approval No. 001/UN38.10/EC.KEPK/HK.01.02/2025). All participants provided informed consent prior to participation.

Procedure

The measurements were conducted during the off-season, following the National Sports Week (PON Aceh). All assessments were performed in the morning under standardized conditions. Participants first underwent anthropometric measurements. Body mass (kg) and body fat percentage (%) were assessed using a body composition analyser (Omron HBF-375), while height (cm) was measured using a GEA Stature Meter in accordance with standardized protocols. All measurements were performed with the subject standing in a standard upright position.

Physiological performance indicators were assessed. Aerobic capacity ($\text{VO}_{2\text{max}}$) was measured using the Multi-Stage Fitness Test (also known as the Bleep Test), which involved continuous 20-meter shuttle runs with

progressively increasing speeds. Subsequent tests for anaerobic power and muscular strength were measured using side jump test chin up (number in 30 seconds), sit up (number in 60 seconds) superman back test (back extensor endurance), single leg Squat Right and Left Foot and Russian twist, speed was measured using sprint 20m, agility was measured using agility T-Test and flexibility of the lower back and hamstring measured using sit and reach test with specialized box with a scale.

All measurements were conducted after the $\text{VO}_{2\text{max}}$ test, following standardized field protocols to minimize measurement bias. Following the performance tests, participants underwent a post-activity physical examination to assess friction-induced skin lesions using a standardized 0–4 severity scale, with documentation of anatomical location, pain intensity, and itch symptoms.

Analysis

All raw data collected from the physiological performance test and skin health assessment of elite East Java Kabaddi athletes were first checked for completeness and accuracy. Descriptive statistics (mean, standard deviation, minimum, and maximum values) were used to summarize the data. Statistical analysis was conducted using IBM SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Findings and Results

The study on elite Kabaddi athletes from East Java ($N = 28$) revealed the following average body composition values: body weight, 65.95 ± 2.75 kg; height, 169.29 ± 5.06 cm; and body fat percentage, 19.46 ± 4.20 %. The biomotor test results showed: side jump 53.50 ± 6.19 , T-test (agility) 9.77 ± 0.52 s, sit-up 29.82 ± 9.25 repetitions, single squat right and left 3.00 ± 0.00 repetitions, superman back 53.11 ± 7.08 s, Russian twist 12.29 ± 1.33 repetitions, sprint 20 m 3.20 ± 0.13 s, chin up 9.29 ± 3.05 repetitions, sit and reach 19.93 ± 4.96 cm, and $\text{VO}_{2\text{max}}$ 40.50 ± 7.19 ml/kg/min.

Table 1

Body Composition of Elite Athlete Kabaddi East Java

No	Test	N	Min	Max	Mean $\pm$ Sd
1	Weight (kg)	28	62	70	65.95 $\pm$ 2.75
2	Height (cm)	28	161	180	169.29 $\pm$ 5.06
3	Body Fat (%)	28	10.59	26.85	19.46 $\pm$ 4.20

Table 2*Physiological Performance Indicators of elite athlete kabaddi East Java*

No	Test	N	Min	Max	Mean $\pm$ Sd
1	Side Jump	28	41	64	53.50 $\pm$ 6.19
2	T Test	28	8.77	10.39	9.77 $\pm$ 0.52
3	Sit up	28	20	54	29.82 $\pm$ 9.25
4	Single Squat R	28	3	3	3.00 $\pm$ 0.00
5	Single Squat L	28	3	3	3.00 $\pm$ 0.00
6	Superman Back	28	40	60	53.11 $\pm$ 7.08
7	Russian Twist	28	9.90	14.49	12.29 $\pm$ 1.33
8	Sprint 20m	28	2.9	3.47	3.20 $\pm$ 0.13
9	Chin up	28	3	12	9.29 $\pm$ 3.05
10	Sit and reach	28	10	28	19.93 $\pm$ 4.96
11	VO ₂ Max	28	31	56.20	40.50 $\pm$ 7.19

Table 1 shows that the mean body weight (65.95 kg), height (169.29 cm), and body fat percentage (19.46 %) of East Java elite Kabaddi athletes are lower than values reported in studies on Indian Kabaddi players, where mean weights and heights often exceed 80 kg and 175 cm, respectively, and body fat percentages are typically in the range of 16–23%. For example, research on Punjabi male Kabaddi players reported mean heights of 178.67 cm and mean weights of 84.53 kg, with a mean body fat percentage of 22.62%. The East Java athletes' body fat percentage falls within the lower end of the range found in Indian studies, suggesting a relatively lean profile, which is beneficial for speed and agility in Kabaddi. Compared to other Indonesian athletes, these values are consistent with adolescent athlete profiles, where heights and weights are generally lower than in South Asian or international samples. This may reflect differences in genetics, nutrition, and training environments.

Friction-induced skin lesions were observed in 16 out of 28 athletes (57.10%). The majority of lesions were mild (score 1–2), with a median lesion score of 1 (range 0–4). The distribution of lesion severity was as follows: score 0 (n = 12), score 1 (n = 6), score 2 (n = 5), score 3 (n = 4), and score 4 (n = 1). The most commonly affected anatomical sites were the groin (43.70%), axilla (25%), knee (18.70%), and flank (12.60%). No statistically significant correlation was observed between agility or sprint performance and lesion severity in this pilot analysis. However, athletes with higher lesion scores tended to report longer durations of high-intensity training and a greater frequency of body contact during matches (Table 2).

Discussion and Conclusion

The current research presents descriptive statistics on the physiological performance metrics of elite kabaddi players from East Java, Indonesia, evaluated under standardized field-testing conditions. The results indicate that these athletes possess a lean physique, moderate aerobic capacity, and commendable sprinting abilities, in line with the essential physical requirements of kabaddi as a high-intensity contact sport. These findings generally correspond with earlier research on kabaddi players from various regions, although significant differences in body measurements and fitness levels were noted when compared to athletes from nations where kabaddi is more popular, such as India, Iran, and Pakistan (Ahomies et al., 2025; Rasteiro et al., 2023).

Variations in body composition and physiological capabilities between Indonesian and international kabaddi athletes may be influenced by factors such as genetic predisposition, training intensity, dietary practices, and levels of competitive exposure. For instance, the shorter average height and body mass noted in the participants of this study may enhance agility and speed. Still, they could also hinder certain aspects of tackling and defensive capabilities. Additionally, the moderate VO₂max values found in this group indicate potential areas for focused endurance training to improve match performance, considering the ongoing high-intensity efforts required in kabaddi.

The mean body weight, height, and body fat percentage of East Java elite Kabaddi athletes are lower than those reported in Indian Kabaddi studies, where mean heights and weights are often above 175 cm and 80

kg, and body fat percentages range between 16% and 23%. For example, Indian male Kabaddi players had a mean height of 169.9 cm, a mean weight of 63.7 kg, and a mean body fat percentage of 13.4% (Aggarwala et al., 2019). The East Java athletes' body fat percentage (19.46%) is within the optimal range for Kabaddi, supporting agility and speed.

The T-test result (9.77 sec) reflects moderate agility. Agility is a key determinant of Kabaddi performance, as supported by recent research highlighting its importance for rapid changes in direction and evasive maneuvers in the game (Utama et al., 2025). The 20m sprint (3.20 sec) demonstrates the athletes' acceleration ability, which is crucial for both offensive and defensive actions in Kabaddi. Speed is consistently identified as a core biomotor quality in Kabaddi athletes (Raspal & Hoshiyar, 2013).

For muscular endurance, performance athletes emphasize the importance of good core endurance, which is vital for sustaining repeated high-intensity efforts during matches. Muscular endurance is linked to better tackling and raiding performance in Kabaddi. Chin-up (9.29 reps) and single squat (3.00 reps) values suggest moderate upper and lower body strength. Strength is fundamental for resisting tackles and executing powerful movements (Suryaraj & Rajkumar, 2024). The sit-and-reach score (19.93 cm) reflects average flexibility, which is vital for injury prevention and dynamic movement. Flexibility has been shown to improve performance and reduce injury risk in Kabaddi athletes (Prianto et al., 2024; Solikah et al., 2024; Suryaraj & Rajkumar, 2024). The VO₂max value (40.50 ml/kg/min) falls within the moderate range for team sports. Higher aerobic capacity is associated with enhanced recovery and sustained performance throughout the game (Suryaraj & Rajkumar, 2024).

The physical characteristics of East Java Kabaddi athletes, particularly in terms of height and weight, are lower than those reported in Indian studies, where Kabaddi players tend to be taller and heavier (Shelke et al., 2024). This aligns with broader trends observed in international research, where South Asian athletes often have higher anthropometric values, possibly due to differences in selection, training intensity, and nutritional intake (Titis Penggalih et al., 2024). The body fat percentage of East Java athletes, if within the range of 16–24%, would be consistent with findings from both

Indian male and female Kabaddi athletes (Shelke et al., 2024). However, if the percentage is significantly lower or higher, it may reflect differences in training regimens or dietary practices.

When compared to other East Java athletes from different sports, the body composition of Kabaddi athletes may be similar, particularly in terms of BMI and body fat percentage, as Indonesian adolescent athletes also show a wide range of heights and a notable proportion with higher BMI (Titis Penggalih et al., 2024). This suggests that while Kabaddi athletes may not differ drastically from their regional peers, international comparisons highlight a gap that could be addressed through targeted nutrition and training programs.

This pilot study investigated the prevalence and severity of friction-induced skin lesions in elite kabaddi athletes with moderate agility and speed performance. The findings revealed that 57.10% of athletes experienced friction lesions, predominantly mild (score 1–2), with the groin and axilla being the most commonly affected areas. These results suggest that even in athletes with moderate agility and speed, repetitive contact and high-intensity directional changes inherent to kabaddi may predispose them to friction-related dermatoses.

Our results are comparable to those reported in contact sports, such as wrestling and rugby, where the prevalence of friction dermatitis ranges from 40–60% during competitive seasons (Paradise & Hu, 2021; Szot et al., 2024). However, the majority of lesions in our cohort were mild, aligning with the findings of (Pujalte et al., 2023) who observed that mild friction lesions typically resolve within a few days with conservative management (Ahomies et al., 2025). Notably, the higher occurrence in the groin area mirrors patterns in judo and wrestling athletes, where occlusion, sweat accumulation, and mechanical friction converge to impair skin barrier integrity (Pujalte et al., 2023).

A recent systematic review indicates that the incidence of friction injuries ranges from 20 to 60% depending on the type of sport and environmental conditions (Islam & Islam, 2025). Similarly, Arora et al. (2023) emphasised that moisture, occlusion, and the type of textile fabric act as essential mediators in the development of frictional dermatoses, particularly in athletes exposed to humid environments. This reinforces the notion that sport-specific demands, equipment, and

environmental factors critically influence friction lesion risk.

Although agility and speed did not show direct causal links in this pilot analysis, it is plausible that higher movement frequency, rapid changes of direction, and repetitive tackling increase localized mechanical load on skin, particularly in moisture-prone areas. This hypothesis is supported by Utama et al., who emphasized agility as a predictor of high-frequency directional shifts that could exacerbate friction at skin-skin or skin-fabric interfaces (Utama et al., 2025).

The integration of skin health assessment into routine performance evaluation could be particularly beneficial in sports like kabaddi and similar activities. Preventive measures such as moisture-wicking uniforms, improved hygiene protocols, and targeted skin barrier protection may reduce lesion incidence without compromising agility or speed performance.

Practical Implications and Future Directions

The findings of this study have practical implications for the training, health monitoring, and performance optimization of kabaddi athletes in Indonesia and similar settings. The moderate VO₂max values, limited lower-limb strength (as reflected by uniformly low scores in single-leg squats), and moderate agility levels suggest the need for multifactorial training programs that enhance cardiovascular endurance, dynamic stability, and explosive strength attributes essential to competitive kabaddi.

Body composition should be routinely monitored not only as a performance determinant but also as a predictor of dermatological risk. Athletes with elevated body fat levels may benefit from targeted interventions, such as nutritional counseling and weight management, to reduce the risk of skin-fold-associated dermatoses. Coaches and sports health professionals should consider using bioimpedance analysis or skinfold measurements not only for fitness tracking but also to identify anatomical regions at risk for infection.

From a broader perspective, this study supports a holistic approach to athlete development, emphasizing the integration of physical training, dermatological health, and psychosocial well-being. Implementing interdisciplinary sports medicine teams involving dermatologists, physiologists, and dietitians can provide more comprehensive care, particularly in high-contact sports with environmental risk factors.

Future studies should adopt a longitudinal design to assess the effectiveness of skin health interventions and their relationship with athletic performance. It is also recommended to include female athletes, who may experience different dermatological challenges, and to investigate the impact of climate, clothing, hygiene behavior, and cultural stigma on skin health in athletes. Moreover, the development of standardized dermatological screening tools for use in sports teams would enhance early detection and prevention strategies.

This research presents foundational data on the physiological performance metrics of elite kabaddi athletes from East Java, indicating a slender body composition, moderate aerobic capacity, and strong sprint performance, in line with the requirements of the sport. While these athletes possess physical traits that support agility and speed, there is a necessity to enhance both aerobic endurance and lower-limb strength.

This pilot study found that elite kabaddi athletes from East Java exhibited moderate agility and sprint performance, with 57.10% mainly experiencing mild friction-induced skin lesions in high-friction areas, such as the groin and axillae. These results highlight the potential impact of repetitive high-intensity movements and contact on skin health in humid, high-contact sports. Future studies should integrate skin health assessments with physiological profiling to develop targeted prevention and performance strategies that optimize overall well-being.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Health Research Ethics Committee of Universitas Negeri Surabaya, Indonesia (Approval No. 001/UN38.10/EC.KEPK/HK.01.02/2025).

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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