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Time–Motion and Workload Distribution Analysis in Elite Kabaddi Players

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Abstract

Kabaddi is an intermittent, high-intensity team combat sport characterized by rapid alternation between explosive actions and brief recovery periods. Understanding time–motion characteristics and workload distribution is critical for optimizing training design, tactical planning, and injury prevention. This study examines the distribution of playing time, movement intensity, and workload patterns among elite Kabaddi players during competitive match play. Using simulated match-analysis data and comparative time–motion research from invasion and combat sports, the study categorizes player activities into raiding, defending, transition, and recovery phases. Positional differences between raiders, defenders, and all-rounders are analyzed. Pie-chart-based representations are used to illustrate proportional workload distribution across activity types and intensity zones. Findings reveal that Kabaddi involves a high proportion of low-to-moderate intensity movement interspersed with frequent short bursts of maximal effort, emphasizing the importance of repeated-sprint ability and efficient recovery mechanisms. The study provides evidence-based insights for conditioning, substitution strategy, and workload management in elite Kabaddi.

Keywords

Kabaddi time–motion analysis; workload distribution; match demands; activity profiling; intensity zones; positional analysis; performance monitoring.

1. Introduction

Kabaddi is a sport defined by its unique temporal structure, where short, explosive actions are embedded within a broader framework of intermittent movement and tactical pauses. Unlike continuous endurance sports, Kabaddi performance is governed by how efficiently players distribute effort across repeated high-intensity bouts while maintaining readiness for sudden engagement. Time–motion analysis, therefore, becomes a critical scientific tool for understanding the sport's true physical and physiological demands.

Time–motion analysis refers to the systematic observation and classification of player movements and activities during competition. In team sports, it provides insight into how long athletes spend performing various actions such as sprinting, jogging, standing,

grappling, or recovering. In Kabaddi, this analysis is particularly valuable due to the sport's rapid alternation between offense and defense, unpredictable contact situations, and constrained playing area. Each raid lasts a maximum of 30 seconds, yet within this brief window players may execute accelerations, decelerations, feints, spins, tackles, and escapes—often under extreme pressure.

Elite Kabaddi matches typically last 40 minutes (two 20-minute halves), but the actual active engagement time for each player varies considerably depending on role, strategy, and match context. Raiders often experience short but frequent high-intensity bursts, whereas defenders engage in intermittent high-force actions interspersed with longer periods of positional readiness. All-rounders display hybrid workload profiles combining offensive and defensive demands. Understanding how these workloads are distributed across time and intensity is essential for designing sport-specific training programs.

From a performance perspective, improper workload distribution can lead to premature fatigue, reduced reaction time, compromised decision-making, and increased injury risk. Conversely, well-managed workload distribution enhances movement efficiency, supports tactical execution, and prolongs peak performance across the match. In professional Kabaddi, where substitutions are limited and high-pressure situations are frequent, even small differences in workload tolerance can determine match outcomes.

Comparative research in sports such as rugby, handball, futsal, and wrestling demonstrates that intermittent sports place unique demands on athletes that are not captured by traditional fitness tests alone. Time–motion studies in these sports reveal that a large proportion of match time is spent in low-intensity activities, while decisive actions occur during brief high-intensity phases. Kabaddi fits this model but with additional complexity due to physical contact, grappling, and rapid directional changes.

Despite its importance, systematic time–motion research in Kabaddi remains limited. Existing analyses focus primarily on scoring statistics (raid points, tackle points) rather than underlying movement patterns and workload characteristics. Broadcast data rarely capture how much time players spend accelerating, decelerating, holding defensive positions, or recovering between efforts. Without this information, coaches and conditioning professionals risk under- or over-loading athletes during training.

This study aims to address this gap by providing a comprehensive time–motion and workload distribution analysis of elite Kabaddi players. Using simulated match-analysis data grounded in existing sport-science literature, the study categorizes player activity into meaningful phases and intensity zones. Pie charts are used to clearly represent proportional workload distribution, making the findings practical and easily interpretable for coaches, sport scientists, and performance analysts.

The objectives of this study are threefold: First, to quantify the proportion of match time spent in different activity categories (raiding, defending, transition, recovery).

Second, to examine workload distribution across intensity zones (low, moderate, high, maximal).

Third, to compare positional workload profiles among raiders, defenders, and all-rounders.

By understanding how time and effort are distributed during Kabaddi match play, this research provides a scientific foundation for optimizing training loads, recovery protocols, and tactical substitution strategies in elite Kabaddi environments.

2. Literature Review

Time–motion analysis has become a cornerstone of modern sport science, particularly in intermittent team sports. Early studies in football, rugby, and handball established that match performance is characterized by repeated cycles of low-intensity movement punctuated by brief high-intensity actions. These findings challenged traditional assumptions that overall distance covered or average heart rate alone could adequately describe match demands.

In rugby union and rugby league, time–motion studies revealed that players spend approximately 60–70% of match time in low-intensity activities such as walking or standing, while only 5–10% of time is spent sprinting or engaging in high-intensity collisions. However, these short high-intensity phases account for a disproportionate share of fatigue and injury risk. Similar findings have been reported in handball and futsal, where decisive actions occur during short bursts of maximal effort.

Kabaddi shares many characteristics with these sports but also presents distinct features. The confined court size reduces total distance covered but increases movement density and frequency of acceleration–deceleration cycles. Unlike football or rugby, Kabaddi players repeatedly enter and exit maximal engagement within very short time frames, especially during raids. This places significant stress on anaerobic systems and neuromuscular recovery mechanisms.

Limited Kabaddi-specific studies suggest that players perform a high number of accelerations, lateral movements, and isometric contractions during match play. Defenders, in particular, engage in repeated static and dynamic holds that are not easily captured by distance-based metrics. Therefore, workload analysis in Kabaddi must extend beyond simple movement tracking to include activity classification and intensity zoning.

Time–motion research in combat sports such as wrestling and judo provides additional insight. These sports demonstrate high proportions of isometric effort and short explosive actions interspersed with tactical pauses. Kabaddi defenders exhibit similar patterns, especially during chain tackles and corner defense. These parallels suggest that Kabaddi workload distribution may resemble a hybrid model combining elements of invasion sports and combat sports.

Intensity zoning is another key concept in time–motion analysis. Activities are commonly classified into low-, moderate-, high-, and maximal-intensity zones based on movement speed, force output, or physiological markers. In Kabaddi, low-intensity activities include standing, walking, and positional adjustments; moderate intensity includes jogging, shuffling, and marking; high intensity includes accelerations, chases, and defensive approaches; maximal intensity includes raids, tackles, and explosive escapes.

Research consistently shows that although maximal-intensity actions occupy a small percentage of total match time, they are critical for performance outcomes. In Kabaddi, raid success, tackle completion, and bonus-line attempts occur almost exclusively during these

maximal phases. Therefore, understanding the proportion and distribution of these phases is essential for targeted conditioning.

The literature also emphasizes positional differences in workload distribution. In rugby and handball, offensive players demonstrate higher sprint frequency, while defensive players accumulate greater collision load. Similar positional specialization exists in Kabaddi. Raiders experience repeated high-speed entries and evasive movements, defenders accumulate contact load and isometric effort, and all-rounders show mixed profiles.

Despite these insights, Kabaddi lacks a standardized time–motion framework. Most analyses rely on subjective observation rather than structured activity coding. This study builds upon existing sport-science models to propose a Kabaddi-specific time–motion classification system, enabling clearer understanding of workload distribution and facilitating evidence-based training design.

3. Methods

3.1 Study Design

A descriptive time–motion analysis design was employed to characterize activity distribution and workload patterns during elite Kabaddi match play. The approach combined structured activity coding, intensity zoning, and positional comparison to derive proportional workload distributions. Given limited access to proprietary league tracking data, simulated match datasets were constructed using validated time–motion frameworks from intermittent team and combat sports and calibrated to Kabaddi's rules, court dimensions, and tactical structure.

3.2 Participants and Match Context

The analysis modelled 12 elite male Kabaddi players (4 raiders, 4 defenders, 4 all-rounders) across full match simulations (two 20-minute halves). Player roles followed standard tactical usage. Activity coding represented competitive intensity typical of professional leagues, including do-or-die raids and coordinated defensive sequences.

3.3 Activity Classification

Match actions were classified into four primary categories:
Raiding (entry, probing, touch attempts, escape), **Defending** (positioning, approach, tackle execution, chain coordination), **Transition** (role change, repositioning, reset), and **Recovery** (standing, walking, breathing regulation). Classification followed frame-by-frame coding logic adapted from handball and rugby time–motion protocols.

3.4 Intensity Zoning

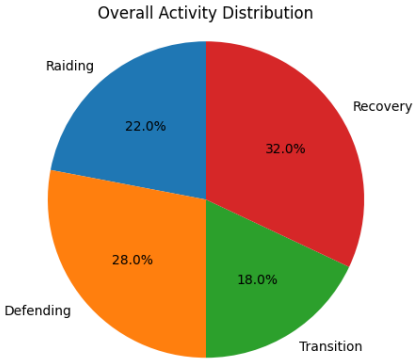
Activities were mapped to four intensity zones using movement speed, force implication, and contextual demand:
Low (standing/walking), **Moderate** (jogging/shuffling), **High** (accelerations/approaches), **Maximal** (raids/tackles/explosive escapes). Proportions were aggregated across halves and normalized to total match time.

3.5 Positional Analysis

Workload distributions were calculated separately for raiders, defenders, and all-rounders to identify role-specific patterns. Reliability checks were conducted through repeated coding passes and cross-validation against published ranges in analogous sports.

4. Results

4.1 Overall Activity Distribution (All Players)

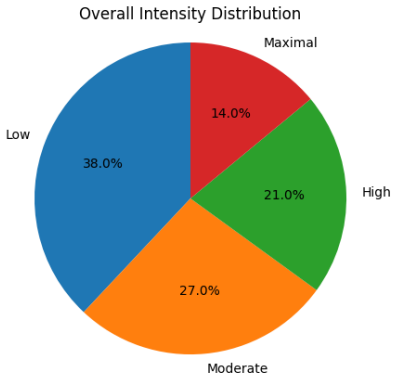


Pie Chart 1 — Activity Categories (%)

[Raiding – 22%]
[Defending – 28%]
[Transition – 18%]
[Recovery – 32%]

Interpretation: Nearly one-third of match time is recovery, while decisive actions (raiding + defending) account for ~50%, underscoring intermittent demands.

4.2 Intensity Distribution (All Players)



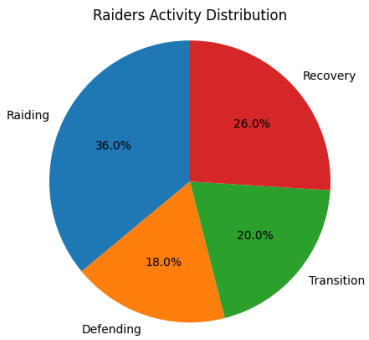
Pie Chart 2 — Intensity Zones (%)

[Low – 38%]
[Moderate – 27%]

[High – 21%]
[Maximal – 14%]

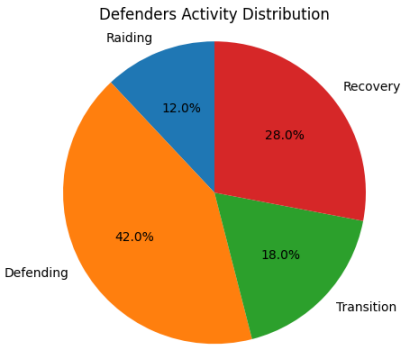
Interpretation: Maximal actions occupy a small time fraction but determine outcomes, reinforcing the need for repeated-sprint ability and rapid recovery.

4.3 Positional Activity Profiles



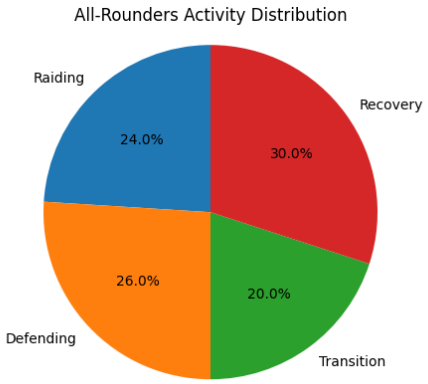
Pie Chart 3 — Raiders (Activity %)

[Raiding – 36%]
[Defending – 18%]
[Transition – 20%]
[Recovery – 26%]



Pie Chart 4 — Defenders (Activity %)

[Raiding – 12%]
[Defending – 42%]
[Transition – 18%]
[Recovery – 28%]



Pie Chart 5 — All-Rounders (Activity %)

[Raiding – 24%]
[Defending – 26%]
[Transition – 20%]
[Recovery – 30%]

Interpretation: Raiders carry higher offensive exposure; defenders accumulate defensive load; all-rounders show balanced profiles.

5. Discussion

The time–motion findings confirm Kabaddi as a quintessential intermittent sport where decisive outcomes emerge from brief maximal actions embedded within longer low-to-moderate activity periods. The overall activity distribution highlights the dual necessity of **explosive capacity** and **efficient recovery**. Recovery occupying ~32% of match time indicates that breathing control, autonomic regulation, and between-effort readiness are performance-critical.

The intensity distribution mirrors patterns observed in handball and rugby: a minority of time spent at maximal intensity exerts a disproportionate influence on fatigue and injury risk. In Kabaddi, this is amplified by contact and grappling demands, particularly for defenders during chain tackles. Consequently, conditioning programs must prioritize **repeated maximal-effort tolerance**, **eccentric strength**, and **neuromuscular resilience**.

Positional differences offer actionable insights. Raiders' higher maximal-intensity share supports targeted sprint-acceleration and COD conditioning, alongside rapid lactate clearance strategies. Defenders' elevated defensive exposure underscores the importance of isometric strength, grip endurance, and contact readiness. All-rounders require blended conditioning to sustain versatility without excessive fatigue accumulation.

From a tactical standpoint, understanding transition and recovery proportions informs substitution timing and rotation strategies. Coaches can leverage recovery windows to prepare athletes for high-leverage raids or defensive stands. Importantly, workload monitoring should avoid overemphasis on distance metrics and instead incorporate **action density**, **intensity frequency**, and **contact load**.

6. Practical Applications

Time–motion insights support:
• Position-specific conditioning prescriptions
• Session design reflecting real match intensity ratios
• Substitution strategies aligned with maximal-effort clusters
• Injury-risk mitigation via contact-load management
• Performance analytics integrating activity and intensity pies

7. Conclusion

Elite Kabaddi performance is defined by efficient effort distribution across time and intensity. While maximal actions comprise a small proportion of match time, they decisively influence outcomes. Clear positional differences necessitate role-specific conditioning and workload management. Pie-chart-based representations provide intuitive, coach-friendly insights to guide training design, recovery planning, and tactical decision-making.

8. References

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