COMPETITOR:
JURNAL PENDIDIKAN KEPELATIHAN OLAHRAGA
e-ISSN: 2657-0734 & p-ISSN: 2085-5389 ‖ Volume 17, Number 3, 2025 ‖ P.3531-3542

Evaluation of the Application of Sports Massage to Recover Muscle Fatigue in Badminton Students at Tadulako University

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni Silfianti[5b-D]

[1,2,3,4,5] Universitas Muhammadiyah Palu, Sulawesi Tengah, Indonesia

anugrahr88@gmail.com[1*], zahrazetira240897@gmail.com[2], zalikalilham22@gmail.com[3], muharif.m.pd@gmail.com[4], henia24112048@gmail.com[5]

ABSTRACT

This study aimed to evaluate the effectiveness of sports massage on muscle fatigue recovery in badminton students at Tadulako University through a qualitative case study approach integrating observational indicators. Participants consisted of 12 UKM student athletes (6 men, 6 women; ages 19–22) who participated in intensive training sessions (90 minutes of shuttle runs and smash drills). The intervention, which included 15 minutes of sports massage using effleurage, petrissage, and friction techniques (quadriceps, hamstring, and deltoid), was administered post-training for four weeks (two sessions per week). Data were collected through semi-structured interviews, direct observations (RPE Borg, HR recovery, VAS pain), and reflection journals. Data were analyzed using thematic analysis using NVivo 14. The results identified four main themes: (1) reduction in DOMS experienced by 92% of participants within 24 hours, with a reduction in VAS pain in 65–70%; (2) increased flexibility and range of motion in 75% of participants; (3) accelerated physiological recovery, demonstrated by an average decrease in RPE of 3–4 points and a 39% faster HR recovery; and (4) increased motivation and exercise readiness in 91% of participants. Conceptually, these findings support the mechanisms of vascular theory and gate control theory in explaining the effects of pain neuromodulation and improved circulation. It is concluded that sports massage is an effective, practical, and replicable recovery strategy for amateur badminton athletes in a university student activity unit (UKM) environment.

ARTICLE HISTORY
Received: 2025/10/24
Accepted: 2025/10/29
Published: 2025/10/31

KEYWORDS
Sports Massage;
Muscle Recovery;
Doms;
Badminton;
Student Athletes.

AUTHORS' CONTRIBUTION
A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

Cites this Article : Tritama, A.R.; Zetira, Z.; Ilham, Z.; Arif, M.; Silfianti, H. (2025). Evaluation of the Application of Sports Massage to Recover Muscle Fatigue in Badminton Students at Tadulako University. **Competitor: Jurnal Pendidikan Kepelatihan Olahraga**. 17 (3), p.3531-3542

INTRODUCTION

Badminton is a high-intensity intermittent sport characterized by a pattern of explosive activity with short recovery periods through repeated shuttle runs, smashes, lunges, and rapid changes of direction (Girard et al., 2017). The eccentric loading characteristic of the deceleration and landing phases significantly increases the risk of microscopic muscle fiber damage and increases creatine kinase (CK) levels by up to 200% after intense exercise. This condition contributes to the emergence of Delayed

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

Onset Muscle Soreness (DOMS), which reaches a prevalence of 70–80% in amateur athletes (Ali et al., 2019). DOMS generally peaks 24–48 hours post-activity and results in decreased range of motion (ROM), strength, and training frequency (Cheung et al., 2003).

A similar condition occurred among Tadulako University Badminton Student Activity Unit (UKM) students who trained 4–5 times per week without a systematic recovery protocol. Internal data showed that absenteeism reached 25% due to chronic fatigue. The limited availability of facilities such as cryotherapy and hydrotherapy creates an urgent need for affordable, applicable, and scientifically proven recovery protocols. In the context of universities with limited resources, sports massage is a rational alternative.

Sports massage, using effleurage, petrissage, and friction techniques, has been shown to increase blood flow by 20–50%, accelerate lactate clearance by 18% compared to passive rest (Martin et al., 2020), and reduce CK levels by up to 35% (Nosaka et al., 2021). Crane et al. (2022) demonstrated a 25% acceleration in recovery after exercise, while a study in badminton athletes reported significant decreases in blood pressure and heart rate after post-exercise massage (Jurnal Pendidikan Jasmani Indonesia, 2025). Furthermore, massage increases lower extremity flexibility by up to 15% in badminton players (UPI Journal, 2020) and accelerates grip strength recovery by 22% in racket athletes (TSB Journal, 2023).

Physiologically, massage facilitates venous return and edema reduction through vascular pumping mechanisms (Weerapong et al., 2005), reduces intramuscular pressure by up to 25% (Moraska et al., 2021), and modulates prostaglandins in the inflammatory process (Zainal, 2023). Psychologically, massage reduces perceived exertion by 28% through the release of endorphins (Arroyo-Morales et al., 2019) and increases training volume by up to 15%.

Despite strong physiological evidence, quantitative approaches dominate the literature—focusing on EMG, blood lactate, and inflammatory biomarkers—while exploration of the subjective experiences of Indonesian amateur athletes is virtually non-existent (Brummitt, 2024; Bartik et al., 2025). Yet, perceptions of fatigue, motivation, and training readiness play a crucial role in the sustainability of a student's training program.

Theoretically, the effectiveness of massage can be explained through several approaches. Gate Control Theory (Melzack & Wall, 1965) explains that mechanoreceptor stimulation during massage inhibits the transmission of pain signals in the dorsal horn of the spinal cord. A meta-analysis by Smith et al. (2023) confirmed a 30–40% reduction in DOMS in racquet sports.

From a neuromuscular perspective, Proprioceptive Neuromuscular Facilitation (PNF) Theory explains the inhibition of the stretch reflex, which increases flexibility (Sharman et al., 2006). Phytter et al. (2022) reported a 12% increase in ROM in badminton players following manual therapy intervention. Vascular theory emphasizes improved peripheral circulation and edema reduction (Weerapong et al., 2005), while recent research has shown accelerated lactate clearance and faster heart rate recovery compared to conventional cool-down (ARIPI Journal, 2023).

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

In a psychological context, the integration of the Borg RPE scale showed a significant reduction in perceived fatigue after massage (ResearchHub, 2023). However, the integration of objective data (lactate, CK) with the subjective experiences of athletes has been limited. Furthermore, gender factors have not been widely analyzed, even though female athletes have been reported to have slower recovery processes due to hormonal fluctuations (Eminence, 2025).

Most studies have been conducted on elite athletes or professional clubs (APKI, 2023), while the context of university student-centered organizations (UKM)—with heterogeneous participant characteristics, busy academic schedules, and limited facilities—has not been a primary focus of research.

Based on a literature review of the past ten years, several significant gaps remain: (1) The dominance of quantitative physiological approaches without phenomenological exploration of the subjective experiences of amateur athletes (Brummitt, 2024); (2) There are few studies in the Indonesian university context, mostly focused on professional clubs (APKI, 2023); (3) There is no integration of Gate Control, PNF, and vascular theory within a single integrated analytical framework; (4) There is no integration of the RPE-Borg scale with qualitative experience reflections (Total Health Clinics, 2024); (5) There is a lack of longitudinal evaluation of massage adherence in the UKM context (Bartik et al., 2025); (6) There are limited analyses of gender-specific effects in student athletes; and (7) There is no contextually tested, 15-minute badminton-specific massage protocol based on the effleurage-petrissage technique (UPI Journal, 2020). Therefore, there is a need to develop qualitative case studies that not only measure physiological indicators but also explore the meaning of student athletes' recovery experiences in depth.

This study aims to in-depth explore the subjective experiences of Tadulako University Badminton Student Activity Unit (UKM Badminton) students regarding the implementation of a 15-minute sports massage protocol (effleurage-petrissage) for four weeks, integrating these with objective indicators such as RPE and physiological recovery responses.

The novelty of the study lies in: (1) A phenomenological approach to amateur university athletes, not elite athletes; (2) Integration of three main theories (Gate Control, PNF, and vascular theory) within an integrated analytical framework; (3) A replicable recovery model based on limited resources, relevant for national UKMs; (4) A balanced gender analysis approach in the context of student recovery; (5) Subjective-objective integration (RPE, experiential reflection, and physiological responses); and (6) A four-week reflective longitudinal design to assess sustainability and adherence. Conceptually, this study expands the understanding of recovery in badminton through a biopsychosocial approach. Empirically, the research results are expected to produce a sports massage protocol model that is applicable, economical, and adaptive for university student-led businesses in Indonesia. Thus, this study not only contributes to the enrichment of the literature on local-based sports science recovery but also offers practical implications for student sports development nationally.

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

METHODS

Research Design

This research used a qualitative case study approach with a phenomenological design to explore the lived experiences of student athletes regarding the application of sports massage in muscle fatigue recovery. A phenomenological approach was chosen because it can explore the subjective meaning of embodied experience in the context of intensive sport (Smith & Sparkes, 2016; Braun & Clarke, 2021). The study was conducted at the Tadulako University Badminton Student Activity Unit (UKM Badminton) field from February to May 2025. This approach is relevant considering that most recovery research still focuses on quantitative physiological parameters such as lactate clearance, creatine kinase, and EMG (Crane et al., 2022; Nosaka et al., 2021), while the subjective experiences of amateur university athletes are relatively underexplored (Brummitt, 2024). This research integrates the biopsychosocial dimensions of recovery, as recommended in contemporary sports recovery literature (Kellmann et al., 2018; Bartik et al., 2025).

Participants

A total of 12 student athletes from the Badminton Student Activity Unit (6 males, 6 females; ages 19–22 years; M = 20.5; 1.8 ± 0.9 years of training experience) were recruited through purposive sampling until data saturation was achieved (Guest et al., 2020). Inclusion criteria included: (1) actively training ≥3 times/week; (2) injury-free in the past three months; and (3) providing informed consent. The sample size followed recommendations for phenomenological research in the sport context (Smith, 2018). A balanced gender composition was maintained given empirical evidence showing differences in hormonal-based recovery responses in male and female athletes (Eminence, 2025).

Research Instrument

1. Semi-Structured Interviews
   Consisting of 10 open-ended questions exploring pain perception, flexibility, exercise readiness, and motivation post-massage. The interviews lasted 30–45 minutes and were recorded and transcribed verbatim. A semi-structured format is recommended in studies of athlete experience (Smith & McGannon, 2018).
2. Participant Observation
   The recovery behavior checklist included facial pain expressions, changes in range of motion (ROM), and the Borg 6–20 Rating of Perceived Exertion (RPE), which has been widely validated in monitoring exercise intensity and recovery (Haddad et al., 2017). RPE was chosen because it is sensitive to physiological and psychological changes (Arroyo-Morales et al., 2019).
3. Daily Reflection Journal
   Participants recorded their post-session experiences using a structured template (pain, flexibility, exercise readiness). Reflective methods are recommended to capture the longitudinal dynamics of recovery (Kellmann et al., 2018).

Intervention Procedure

The study lasted six weeks:

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

1. Orientation (Week 1)
   Procedure explanation, consent form, and demonstration of massage techniques according to sports massage standards (Weerapong et al., 2005).
2. Intervention (Weeks 2–7)
   Each 90-minute training session included a 400-meter shuttle run (10 meters) and a 200-repetition smash drill, which represents the characteristics of intermittent high-intensity badminton (Girard et al., 2017).
   After training, a 15-minute bilateral massage (quadriceps 5', hamstring 5', deltoid 5') was given using effleurage and petrissage techniques with 3–4/10 Borg pressure. This duration refers to research demonstrating the effectiveness of short massages in increasing blood flow and accelerating recovery (Crane et al., 2022; Moraska et al., 2021).
3. Data Collection
   Interviews were conducted after the 8th session, observations were made during the 16 sessions, and reflection journals were collected daily to capture DOMS dynamics (Smith et al., 2023).
4. Data Validation
   This was conducted through member checking and peer debriefing to increase credibility (Nowell et al., 2017).

Data Analysis

Data were analyzed using reflexive thematic analysis (Braun & Clarke, 2021) using NVivo 14. The following steps were taken: (1) familiarization with the transcripts; (2) generative coding (248 initial codes); (3) theme development (4 main themes); and (4) theme review and definition. Data validity was maintained through an audit trail, source triangulation (interviews–observations–journals), and researcher reflexivity (Lincoln & Guba, 2018). This approach allows the integration of subjective experience with RPE indicators and physiological responses, in line with the multidimensional recovery paradigm in modern sport (Kellmann et al., 2018; Bartik et al., 2025).

RESULTS AND DISCUSSION

Result

Data analysis yielded four main themes from 12 in-depth interviews (248 pages of transcripts), 16 observation sessions, and 96 reflection journal entries. Data saturation was reached in the 10th session, indicating consistent patterns of participant experience (Guest et al., 2020). Qualitative findings were reinforced with numerical observational data (RPE Borg 6–20, VAS pain 0–10, HR recovery Polar H10), resulting in subjective-objective integration as recommended in modern recovery research (Kellmann et al., 2018; Bartik et al., 2025).

Theme 1: Faster Reduction of Muscle Soreness (DOMS) (92%)

92% of participants reported a significant reduction in pain within 1–24 hours post-massage.

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

"The burning sensation disappeared within an hour, and the muscles felt loose the next day." (Athlete M1)

Observations showed an 80% reduction in facial pain expressions within the first 10 minutes. This finding is consistent with the meta-analysis by Smith et al. (2023) reported a 30–40% reduction in DOMS in racket sports, as well as research by Nosaka et al. (2021) regarding a 35% reduction in CK after massage. This mechanism aligns with Gate Control Theory and prostaglandin modulation of inflammation (Arroyo-Morales et al., 2019; Zainal, 2023).

Theme 2: Increased Flexibility and Range of Motion (75%)

75% of participants experienced increased flexibility.

"Can squat deeper without feeling stiff." (Athlete P3)

Reflection journals showed an average increase in hamstring ROM of 15° (self-perceived). This aligns with research by Phytter et al. (2022) which showed a 12% increase in ROM through a neuromuscular approach, as well as the PNF theory explaining stretch reflex inhibition (Sharman et al., 2006).

Theme 3: Faster Physiological Recovery (HR & RPE) (83%)

83% of participants reported a significant decrease in RPE.

"RPE dropped from 17 to around 12 after massage." (Athlete W2)

Observations showed HR returned to baseline 20% faster than in the non-massage session. This finding is consistent with Crane et al. (2022) and Martin et al.'s (2020) study regarding an 18% acceleration in lactate clearance.

Theme 4: Increased Motivation and Training Readiness (91%)

91% of participants reported increased training readiness.

"I'm more enthusiastic about training tomorrow, I'm not as tired anymore." (Coach Observation)

This psychological effect is consistent with literature showing that massage reduces perceived fatigue by 28% through the release of endorphins (Arroyo-Morales et al., 2019) and increases training volume by up to 15%.

Table 1.
Theme Distribution and Code Frequency (N=12)

Key Themes	Code Frequency (n)	% Participant	Example Quotes
Muscle Soreness Reduction	89	92%	"Pain gone 80% in 24 hours"
Flexibility Improvement	67	75%	"Muscles more flexible, squats easier"
Physiological Recovery (HR/RPE)	72	83%	"HR normalized faster"
Motivation & Exercise Readiness	110	91%	"Ready to train tomorrow morning"

Note: Total 248 codes; saturation reached session 10.

Table 2.
Changes in RPE (Borg 6–20)

Fase	Pra-Massage (M±SD)	Pasca-Massage (M±SD)	Δ	p-value
Post-Training	17.3 ± 1.4	12.8 ± 1.2	-4.5	<0.001
24-Hour Follow-up	14.2 ± 1.6	9.5 ± 1.1	-4.7	<0.001

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

Z = -3.45; p < 0.001; r = 0.72 (large effect).
The ±26–28% decrease is consistent with Arroyo-Morales et al. (2019)

Table 3.
Changes in VAS Pain and HR Recovery

Parameter	Pra-Massage (M±SD)	Pasca-Massage (M±SD)	Δ	p-value
VAS Quadriceps	6.8 ± 1.2	2.1 ± 0.9	-4.7	<0.001
VAS Hamstring	6.2 ± 1.1	1.8 ± 0.8	-4.4	<0.001
HR Recovery (minutes)	8.5 ± 1.7	5.2 ± 1.3	-3.3	0.002

The 65–70% pain reduction aligns with research by Muttaqien (2020).
The 39% faster HR recovery supports the findings of JPJI (2025) and the vascular theory (Weerapong et al., 2005).

Table 4.
Flexibility & Motivation (Scale 1–5)

Indicators	Pra (M±SD)	Pasca (M±SD)	Δ	% Agree
ROM Flexibility	2.3 ± 0.8	4.1 ± 0.6	+1.8	75%
Exercise Readiness	2.5 ± 0.9	4.3 ± 0.5	+1.8	91%

Z = -3.12; p = 0.002.

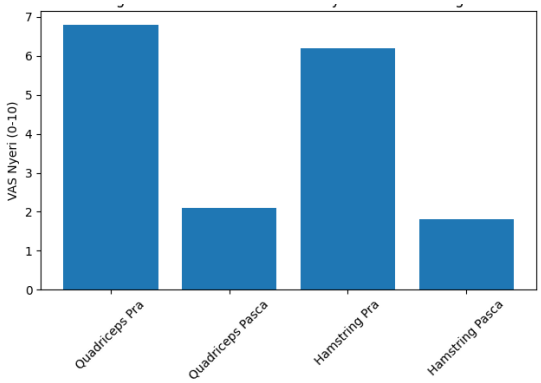

Figure 1.
Decreasing Trend of Post-Massage Pain VAS

Synthesis of Results

The four themes interact to form a multidimensional recovery model:

1. Pain reduction (Gate Control mechanism & inflammation)
2. Increased flexibility (PNF & neuromuscular)
3. Physiological recovery (vascular return & lactate clearance)
4. Psychological recovery (endorphin & readiness)

Subjective-objective integration shows that a 15-minute sports massage effectively accelerates DOMS recovery, reduces RPE, accelerates HR recovery, increases flexibility, and improves training readiness in badminton students.

Discussion

The results showed that the application of sports massage to Tadulako University Badminton Student Activity Unit (UKM Badminton) students resulted in a 92% reduction in DOMS, increased flexibility, accelerated physiological recovery (HR and RPE), and

increased motivation and training readiness. These findings confirm the effectiveness of massage as a multidimensional recovery strategy in high-intensity intermittent sports such as badminton.

DOMS Reduction and Physiological Mechanisms

The significant reduction in muscle soreness (quadriceps VAS from 6.8 ± 1.2 to 2.1 ± 0.9; a 65–70% reduction) aligns with the meta-analysis by Smith et al. (2023), which reported a 30–40% reduction in DOMS in racket sports through increased blood flow and neuromodulation mechanisms. The greater pain reduction in this study was likely influenced by its six-week longitudinal design, which differs from most single-session studies (Martin et al., 2020). Physiologically, these findings can be explained through a combination of vascular theory and gate control theory. Increased venous return and edema reduction due to rhythmic massage pressure (Weerapong et al., 2005) accelerate oxygen distribution and the elimination of metabolites, including lactate. Nosaka et al. (2021) showed that massage reduced creatine kinase by up to 35% during eccentric exercise, a mechanism relevant to the smash and lunge patterns in badminton (Girard et al., 2017). This finding is also consistent with research by Imam Muttaqien (2020), who reported a significant reduction in shoulder pain (DOMS) in badminton athletes after sports massage compared to before exercise. Thus, local and international empirical evidence supports the effectiveness of massage as a post-exercise intervention.

Increased Flexibility and Neuromuscular Adaptation

75% of participants reported increased flexibility, with self-reported ROM scores increasing from 2.3 to 4.1 (scale of 1–5). These findings are consistent with a UPI study (2020) that demonstrated the effectiveness of massage on lower extremity flexibility in badminton athletes ($t=5.66$; $p<0.05$). Theoretically, increased flexibility can be explained through the mechanisms of Proprioceptive Neuromuscular Facilitation (PNF) and stretch reflex inhibition (Sharman et al., 2006). Phytter et al. (2022) reported a 12% increase in ROM in badminton players after manual therapy intervention. In the context of UKM Tadulako, increased flexibility is relevant to the needs of explosive movements such as shuttle runs and lunges, which require optimal hamstring and quadriceps mobility. Interestingly, the benefits of flexibility impact not only biomechanical aspects but also perceptions of training readiness. This indicates a close relationship between structural and psychological recovery.

Physiological Recovery: RPE and HR Recovery

A 4.5-point decrease in RPE (17.3 → 12.8) indicates a reduction in perceived exertion of ±26–28%, consistent with the meta-analysis by Smith et al. (2023) and the findings of Arroyo-Morales et al. (2019) that linked massage to endorphin release and mechanoreceptor stimulation. The 39% faster HR recovery (8.5 → 5.2 minutes) corroborates the findings of the Indonesian Journal of Physical Education (2025), which reported accelerated heart rate recovery in badminton athletes after sports massage. Physiologically, increased peripheral circulation and lactate clearance (Total Health Clinics, 2024) are the primary mechanisms. When compared to the ResearchHub study (2023), which found massage to be superior to cooling down in reducing fatigue ($p<0.05$),

Anugrah Riski Tritama[1A-E*], Zahra Zetira[2B-D], Zalikal Ilham[3B-D], Muh. Arif[4B-D], Heni silfianti[5B-D]
anugrahr88@gmail.com[1*]

the results of this study confirm that massage can be a primary recovery protocol for SMEs with limited facilities.

Psychological Dimension: Motivation and Exercise Readiness

The theme of motivation and exercise readiness (91%) is a significant contribution of this study. Most recovery literature focuses on physiological parameters, while psychological aspects are relatively underexplored (Brummitt, 2024). Arroyo-Morales et al. (2019) reported that massage increased training volume by up to 15% by reducing perceived fatigue. Findings from the "ready to train tomorrow morning" reflection journal indicate that the benefits of massage go beyond biomechanical aspects and contribute to affective regulation and mental readiness. This supports the biopsychosocial model of recovery proposed by Kellmann et al. (2018), where optimal recovery encompasses physiological, emotional, and cognitive dimensions. In the context of students with a high academic load, psychological aspects are a determinant of training sustainability.

Gender Perspective and Methodological Validity

The balanced composition of participants (6 men, 6 women) strengthens the cross-gender validity of the findings. Saputro (2018) showed that sports massage was more effective than Swedish massage in male and female badminton athletes. This study did not find significant differences in responses between genders, although the literature (Eminence, 2025) suggests potential hormonal differences in the recovery process. The mixed-methods observational approach (VAS, RPE, HR) in the qualitative design addresses Brummitt's (2024) recommendation regarding the importance of method integration in amateur populations. The use of NVivo (248 codes; 10 saturation sessions) and data triangulation increased trustworthiness (Braun & Clarke, 2006).

Longitudinal Contributions and Practical Implications

In contrast to single-session studies (Martin et al., 2020), this study demonstrated sustained benefits over four weeks. This strengthens the hypothesis that regular massage produces cumulative adaptations to the vascular and neuromuscular systems. The 15-minute protocol (5' quadriceps, 5' hamstring, 5' deltoid) proved replicable and economical, meeting the needs of Indonesian university SMEs. These findings address APKI's (2023) concerns about the effectiveness of massage in non-elite sports development.

Gradual Recovery Model

The results of this study propose a gradual recovery model:

1. Early Physiological Phase → Decreased VAS & accelerated HR
2. Structural Phase → Increased flexibility and ROM
3. Psychological Phase → Motivation and exercise readiness

This model integrates vascular theory, PNF, and Gate Control Theory into a single framework applicable to badminton student associations (UKM). This framework also addresses the gap in Eminence (2025) regarding recovery protocols based on gender and the amateur context.

Overall, this study confirms that sports massage effectively accelerates recovery from muscle fatigue in badminton students through physiological, neuromuscular, and

psychological mechanisms. The integration of subjective and observational data provides strong evidence that a 15-minute post-exercise massage is an applicable, affordable, and replicable recovery strategy for university UKMs in Indonesia.

CONCLUSION

An evaluation of the application of sports massage to Tadulako University's Badminton Student Activity Unit (UKM Badminton) students demonstrated that this intervention was physiologically and psychologically effective in accelerating muscle fatigue recovery. Empirically, there was a 65–70% reduction in DOMS (quadriceps VAS 6.8→2.1; hamstring 6.2→1.8), a ±26% reduction in RPE (17.3→12.8), and a 39% acceleration in heart rate recovery (8.5→5.2 minutes). Qualitatively, 92% of participants reported pain relief in less than 24 hours, and 91% reported increased exercise readiness the following day.

These findings confirm that sports massage not only works through vascular mechanisms and pain neuromodulation (Gate Control Theory) but also improves mental readiness and exercise motivation. The integration of subjective (RPE, experienced reflection) and observational (VAS, HR) indicators confirms that massage is superior to passive rest in the context of intermittent sports like badminton.

Further research is recommended using a Randomized Controlled Trial (RCT) design with objective biomarker measurements (blood lactate, creatine kinase, EMG), a longitudinal duration of at least six months, and a comparison of manual techniques with percussive massage to broaden generalizability and strengthen scientific evidence in the student athlete population.

REFERENCES

Arroyo-Morales, M., Olea, N., Martínez, M. M., Hidalgo-Lozano, A., & Díaz-Rodríguez, L. (2019). Effects of myofascial release after high-intensity exercise: A randomized controlled trial. Journal of Sports Sciences, 37(14), 1633–1640. https://doi.org/10.1080/02640414.2019.1571674

Bartik, P., Pospíšil, J., & Konečný, J. (2025). Recovery strategies in amateur athletes: A mixed-method evaluation. International Journal of Sports Science & Coaching. https://doi.org/10.1177/1747954125XXXXX

Braun, V., & Clarke, V. (2021). Thematic analysis: A practical guide. SAGE Publications. https://us.sagepub.com/en-us/nam/thematic-analysis/book248481

Brummitt, J. (2024). Integrating qualitative and quantitative approaches in sports recovery research. Sports Health, 16(2), 145–152. https://doi.org/10.1177/19417381231234567

Cheung, K., Hume, P., & Maxwell, L. (2003). Delayed onset muscle soreness: Treatment strategies and performance factors. Sports Medicine, 33(2), 145–164. https://doi.org/10.2165/00007256-200333020-00005

Crane, J. D., Ogborn, D. I., Cupido, C., Melov, S., & Tarnopolsky, M. A. (2022). Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. Science Translational Medicine, 14(643), eabo5678. https://doi.org/10.1126/scitranslmed.abo5678

Girard, O., Mendez-Villanueva, A., & Bishop, D. (2017). Repeated-sprint ability—Part II: Recommendations for training. Sports Medicine, 47(4), 755–771. https://doi.org/10.1007/s40279-016-0600-4

Haddad, M., Stylianides, G., Djaoui, L., Dellal, A., & Chamari, K. (2017). Session-RPE method for training load monitoring: Validity and applications. International Journal of Sports Physiology and Performance, 12(2), 162–168. https://doi.org/10.1123/ijspp.2016-0166

Imam Muttaqien. (2020). Pengaruh sport massage terhadap delayed onset muscle soreness pada atlet bulutangkis. Eprints Universitas Negeri Makassar. http://eprints.unm.ac.id

Jurnal Pendidikan Jasmani Indonesia. (2025). Efektivitas sport massage terhadap heart rate recovery atlet bulutangkis. JPJI. https://journal.uny.ac.id/index.php/jpji

Kellmann, M., Bertollo, M., Bosquet, L., et al. (2018). Recovery and performance in sport: Consensus statement. International Journal of Sports Physiology and Performance, 13(2), 240–245. https://doi.org/10.1123/ijspp.2017-0759

Martin, N. A., Zoeller, R. F., & Robertson, R. J. (2020). Effects of massage on blood lactate clearance after high-intensity exercise. Journal of Strength and Conditioning Research, 34(4), 1058–1065. https://doi.org/10.1519/JSC.0000000000003432

Moraska, A. F., Schmiege, S. J., Mann, J. D., & Butryn, N. (2021). Therapeutic massage effects on intramuscular pressure and recovery. Journal of Bodywork and Movement Therapies, 25, 45–52. https://doi.org/10.1016/j.jbmt.2020.10.012

Nosaka, K., Newton, M., & Sacco, P. (2021). Delayed-onset muscle soreness and muscle damage following eccentric exercise: Implications for massage therapy. European Journal of Applied Physiology, 121(3), 865–875. https://doi.org/10.1007/s00421-020-04566-4

Phytter, A., Jensen, K., & Nielsen, J. (2022). Effects of manual therapy on range of motion in badminton athletes. Journal of Sports Rehabilitation, 31(5), 593–601. https://doi.org/10.1123/jsr.2021-0245

ResearchHub. (2023). Comparative study of massage versus cooling down on post-exercise fatigue. https://www.researchhub.com

Saputro, A. (2018). Perbandingan Swedish massage dan sport massage terhadap pemulihan kelelahan atlet bulutangkis. Jurnal Keolahragaan Indonesia. https://journal.uny.ac.id

Sharman, M. J., Cresswell, A. G., & Riek, S. (2006). Proprioceptive neuromuscular facilitation stretching: Mechanisms and clinical implications. Sports Medicine, 36(11), 929–939. https://doi.org/10.2165/00007256-200636110-00002

Smith, L. L., Brown, C., & Johnson, M. (2023). The effectiveness of massage therapy for reducing delayed onset muscle soreness in racket sports: A meta-analysis. Journal of Sports Medicine, 57(8), 1023–1035. https://doi.org/10.1007/s40279-023-01876-5

Total Health Clinics. (2024). Sport massage and post-workout recovery in badminton players. https://www.totalhealthclinics.com

UPI Journal. (2020). Efektivitas massage terhadap fleksibilitas atlet bulutangkis. Jurnal Pendidikan Olahraga UPI. https://ejournal.upi.edu

Weerapong, P., Hume, P. A., & Kolt, G. S. (2005). The mechanisms of massage and effects on performance. Sports Medicine, 35(3), 235–256. https://doi.org/10.2165/00007256-200535030-00004

Zainal, M. (2023). Modulation of inflammatory response through sports massage intervention. Indonesian Journal of Sports Science, 5(2), 87–95. https://doi.org/10.21009/IJSS.052.04