Effects of Stretching, Walking and Sitting on Recovery Resting Heart Rate, Leg Strength, and Muscle Power after Sepak Takraw Men's Team Competition Surindra Rajabhat University

Pattarapol Thongnum*[1]

Abstract

The objective of this study aimed to the effects of stretching, walking and sitting on recovery resting heart rate, leg strength, and muscle power after Sepak Takraw men's team competition. The sample group consisted of 12 male Sepak Takraw athletes from Surindra Rajabhat University who participated in the 44th Northeastern Rajabhat University Games (Kodchasarn Games). They were divided into 3 equal groups by draw lots method, and then studied on recovery rest after competition of 3 methods, including stretching, walking, and sitting. The participants performed Sepak Takraw training by simulating match conditions for four consecutive days, followed by the three recovery methods for one-week interval between each session, and tested the measured resting heart rate, leg strength, and muscle power before and after training section. The data were analyzed using mean, standard deviation, one-way analysis of variance with repeated measures. When differences were found, Bonferroni's paired analysis was used and compared the differences between groups, the statistical significance was set at .05 level. The findings revealed that walking recovery was significantly more effective than sitting rest in returning resting heart rate to baseline levels after the second training trial at the .05 significance level. In conclusion, Sepak Takraw coaches and trainers can consider these recovery methods as viable options to enhance post-exercise heart rate recovery in their athletes following competition, thereby ensuring physical readiness for subsequent matches.

Keywords: Stretching, Walking, Sitting, Recovery, Takraw men's team

* Assistant professor, Faculty of Education, Surindra Rajabhat University

*[1] Corresponding author, email: jeffykkucuswu@gmail.com. Tel. 080-0663345

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ผลของการยืดเหยียดกล้ามเนื้อ การเดิน และการนั่งพักที่มีต่อการฟื้นสภาพของอัตราการเต้นของหัวใจขณะพัก ความแข็งแรงของขา และพลังกล้ามเนื้อหลังการแข่งขันเซปักตะกร้อทีมชุดชาย มหาวิทยาลัยราชภัฏสุรินทร์

ภัทรพล ทองนำ*[1]

บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาผลของการยืดเหยียดกล้ามเนื้อ การเดิน และการนั่งพักที่มีต่อการฟื้นสภาพของอัตราการเต้นของหัวใจขณะพัก ความแข็งแรงของขา และพลังกล้ามเนื้อหลังการแข่งขันเซปักตะกร้อทีมชุดชาย มหาวิทยาลัยราชภัฏสุรินทร์ กลุ่มตัวอย่างจำนวน 12 คน เป็นนักกีฬาเซปักตะกร้อชายมหาวิทยาลัยราชภัฏสุรินทร์ ที่เข้าร่วมการแข่งขันกีฬานักศึกษามหาวิทยาลัยราชภัฏกลุ่มภาคตะวันออกเฉียงเหนือ ครั้งที่ 44 คชสารเกมส์ แบ่งออกเป็น 3 กลุ่มเท่าๆ กัน ด้วยการจับฉลาก ศึกษาการฟื้นสภาพหลังการแข่งขัน 3 รูปแบบ ประกอบด้วยการยืดเหยียดกล้ามเนื้อ การเดิน และการนั่งพัก โดยกลุ่มตัวอย่างทำการฝึกซ้อมเซปักตะกร้อโดยการจำลองการแข่งขันจริงแบบต่อเนื่องกัน 4 วัน แล้วปฏิบัติการฟื้นสภาพทั้ง 3 รูปแบบ แต่ละครั้งเว้นระยะห่างกันเป็นเวลา 1 สัปดาห์ บันทึกผลอัตราการเต้นของหัวใจขณะพัก ความแข็งแรงของขา และพลังกล้ามเนื้อ ก่อนการฝึก และหลังการฝึก วิเคราะห์ข้อมูลโดยใช้ค่าเฉลี่ยส่วนเบี่ยงเบนมาตรฐาน วิเคราะห์ความแปรปรวนทางเดียวแบบวัดซ้ำ (One-Way Analysis of Variance with Repeated Measures) เปรียบเทียบความแตกต่างเป็นรายคู่ เมื่อพบความแตกต่างจะใช้การวิเคราะห์เป็นรายคู่ด้วยวิธีของบอนเฟอโรนี (Bonferroni) กำหนดนัยสำคัญทางสถิติที่ระดับ .05 ผลการวิจัยพบว่าการฟื้นสภาพด้วยการเดินหลังการฝึกครั้งที่ 2 ส่งผลให้อัตราการเต้นของหัวใจขณะพักลดลงเข้าสู่สภาวะปกติได้ดีกว่าการนั่งพักอย่างมีนัยสำคัญทางสถิติที่ระดับ .05 สรุปได้ว่าโค้ช หรือผู้ฝึกสอนกีฬาเซปักตะกร้อสามารถนำวิธีการดังกล่าวเป็นทางเลือกไปใช้เพื่อฟื้นสภาพอัตราการเต้นของหัวใจขณะพักกับนักกีฬาของตนเองหลังจากที่แข่งขันเสร็จสิ้น เพื่อให้ร่างกายเกิดความพร้อมในการแข่งขันวันต่อไปได้

คำสำคัญ: การยืดเหยียดกล้ามเนื้อ, การเดิน, การนั่ง, การฟื้นสภาพ, นักกีฬาเซปักตะกร้อทีมชุดชาย

* ผู้ช่วยศาสตราจารย์ คณะครุศาสตร์ มหาวิทยาลัยราชภัฏสุรินทร์

*[1] Corresponding author, email: jeffykkucuswu@gmail.com, Tel. 080-0663345

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Introduction

Sports are a fundamental factor of great importance in human resource development, as evidenced by the fact that every country promotes and encourages its population to engage in sports (Abidin et al., 2021). Sports have been utilized as a tool for strengthening families and communities, as evidenced by global sporting events that foster public participation and build community networks. In terms of physical development, sports help the body achieve overall fitness and strength, a dignified personality, good health, and age-appropriate growth. Regarding emotional development, sports cultivate patience, responsibility, and discipline, while fostering sportsmanship—the ability to accept defeat, celebrate victory, and offer forgiveness—leading to a consistently cheerful and positive mindset. Furthermore, in terms of social development, sports encourage individuals to respect rules, regulations, and the laws of the land, while promoting team unity, mutual assistance, and the enhancement of positive relationships within society.

Sepak Takraw was first held as a competitive event at the 3rd SEAP Games (now known as the SEA Games) in Kuala Lumpur, Malaysia. It has since gained widespread popularity across Southeast Asian countries (Hantoro et al., 2024). It is a sport that integrates movement skills from various other disciplines, such as football and gymnastics (Latar et al., 2024). Fundamental skills include the use of the inside of the foot, the instep (top of the foot), the knees, and the head. The game begins with a serve from within the service circle, using the foot to send the ball over the net (Aji et al., 2025). Each team is permitted a maximum of three touches to return the ball, whether played by a single player or shared among all three teammates (Nabawi, & Yuliarto, 2025). Under current regulations, matches have transitioned to a three-set format, with each set concluding at 15 points. In the event of a 14-14 tie, the winner must lead by a 2-point margin, with a scoring cap at 17 points. Teams alternate serves after every point. Consequently, training patterns must be adapted-encompassing service, receiving, defense, blocking, and net attacks—to further enhance team efficiency.

Nowadays, Sepak Takraw competitions have gained popularity at all levels due to the simplicity of the gameplay. Furthermore, the necessary infrastructure is easily accessible and does not require extensive space (Asha et al., 2025). Competitions are organized across various levels, ranging from schools and universities to clubs and various organizations. These may include several additional event categories, such as Double Regu and Sepak Takraw Quad. Nevertheless, the team event (Team Regu) remains a staple and is equally popular. Each team event consists of three sub-teams (Team A, Team B, and Team C). The winner is determined by the team that secures victory in two out of the three matches.

The 44th Northeastern Rajabhat University Games (Kodchasarn Games), the competition was divided into two groups of four teams each. The top two teams with the highest scores from each group advanced to the semi-finals. The tournament spanned four days: the preliminary round took place over the first three days, while the semi-finals were held on the fourth day at 09:00, followed by the finals at 13:00 on the same day. This required the finalist teams to compete for four consecutive days. Effective recovery, therefore, extends beyond mere fatigue relief; it is a critical process of reconditioning the cardiovascular system and musculature for the repetitive demands of serving, spiking, and blocking in subsequent matches. Restoring the body to its pre-competition state is essential, particularly in tournament formats where limited rest intervals between same-day fixtures demand rapid physiological restoration. The transition to the 15-point scoring system and alternating service rules has significantly amplified match intensity. This modern format demands continuous and rapid explosive power from athletes, leading to higher levels of cumulative muscular stress compared to previous regulations. Consequently, traditional recovery methods may no longer suffice for the physiological demands of a grueling four-day competition schedule, while Sepak Takraw remains a sport that demands exceptionally high levels of agility, muscular strength, and body coordination. Specifically, the abdominals and lower back are vital for stability during aerial maneuvers and generating power for spikes. The neck muscles play a key role in heading the ball for defensive and offensive transitions, while the quadriceps and hamstrings provide the explosive power needed for knee strikes and service reception.

Various recovery methods have been studied by scholars; for instance, sports massage has been identified as a significant benefit and an effective strategy for athletic recovery (Mahendra, 2025). Furthermore, deep tissue massage therapy enhances physical performance and muscle recovery, particularly in team and strength-based sports (Arsovski, 2025). Stretching has been utilized as a post-exercise recovery method and has shown positive effects on enhancing the recovery process (Zulaini et al., 2021). Passive rest after aerobic exercise is another essential recovery method, as it results in lower perceptual loading despite similar cardiorespiratory responses compared to other methods (Sánchez-Otero et al., 2022). Active recovery is another method used to restore an athlete's physical condition after exercise or physical activity, as it helps in lowering the heart rate (Ahirvar, & Pathak, 2024). While these methods effectively enhance recovery, research specifically focusing on recovery strategies for consecutive multi-day competitions remains limited. Although previous studies have highlighted the benefits of various recovery modalities, a significant practical gap remains. Techniques such as deep tissue massage require

specialized equipment and trained professionals, which may not align with the resource and time constraints faced by athletes during multi-day tournaments. Furthermore, existing research primarily focuses on acute recovery following a single training session, largely overlooking the comparative efficacy of self-administered methods—such as walking, stretching, and sitting rest—within the context of team-regu sepak takraw. This sport is characterized by cumulative fatigue and the critical need to maintain lower-limb performance for explosive power on consecutive competition days. Therefore, the researcher is interested in investigating the effects of stretching, walking, and sitting on the recovery of resting heart rate, leg strength, and power after Sepak Takraw Men's Team Competition Surindra Rajabhat University. The findings of this study aim to be practically applied to help Sepak Takraw athletes recover successfully for future tournaments. Furthermore, this study serves as a guideline for various sports that require continuous or consecutive days of competition.

Research Objective

To compare the effects of muscle stretching, walking, and sitting on the recovery of resting heart rate, leg strength, and power among Sepak Takraw men's team competition Surindra Rajabhat University.

Research Hypothesis

Stretching, walking, and sitting yield different recovery effects on resting heart rate, leg strength, and power in Sepak Takraw men's team competition Surindra Rajabhat University.

Research Methodology

Sample

The sample for this study consisted of 12 Sepak Takraw Men's Team Competition Surindra Rajabhat University who participated in the 44th Northeastern Rajabhat University Games (Kodchasarn Games). The participants were selected using a purposive sampling method.

Inclusion Criteria

Participants must be Sepak Takraw Men's Team Competition Surindra Rajabhat University who competed in the 44th Northeastern Rajabhat University Games (Kodchasarn Games). They must have no history of severe or chronic injuries. Furthermore, participants must be willing to join the study and provide their written informed consent.

Exclusion Criteria

Participants will be excluded if they sustain injuries or experience circumstances that prevent them from participating in the study, such as injuries to the legs or ligaments during training, or accidents. Additionally, individuals with serious infectious diseases will be excluded from the study.

Research Instruments

1. The Stretching Program (Thongnum, 2025) consists of the following:
   1.1 Shoulder Stretch
   1.2 Triceps and Lateral Trunk Stretch
   1.3 Upper Back Stretch
   1.4 Quadriceps Stretch
   1.5 Calf Stretch
   1.6 Knee-to-Chest Stretch
   1.7 Toe-up stretch
   1.8 Adductor Stretch
   1.9 Hamstring Stretch
   1.10 Thigh and Back Stretch
2. TKK Analog Leg Dynamometer (reliability = .90)
3. Vertical Jump Test (reliability = .92)
4. Heart Rate measurement tool: Stethoscope (reliability = .89)
5. Weighing Scale
6. Stadiometer
7. Data Recording Form

Materials and Methods

This study employed a crossover measures design. The research protocol was reviewed and approved by the Ethics Committee in Human Research at Surindra Rajabhat University (Certificate No. HE 682048).

1. The researcher submitted a formal request for permission to conduct the study and collect data at the designated site to the Dean of the Faculty of Education, Surindra Rajabhat University.

2. The researcher informed the participants of the study's objectives, procedures, duration, and the 10-position stretching program to ensure strict adherence to instructions.

Additionally, participants were briefed on their rights, including the guarantee of confidentiality and the freedom to accept or decline participation without any obligation.

3. The participants were divided into three groups to study three recovery methods, each lasting 2 minutes. These methods included: a stretching routine consisting of 10 positions held for 12 seconds each, slow walking around the Sepak Takraw court for 2 minutes, and sitting for 2 minutes.

A random drawing was conducted by assigning numbers 1–12 to the participants to determine their initial group placement. Using a crossover design, the same set of participants was split into these three subgroups, and each group rotated through all three experimental conditions until completion, as follows:

Table 1 The experimental sequence of recovery modalities for each group across three trials.

Sample Group	Trial 1	Trial 2	Trial 3
Group 1 (Nos. 1-4)	walking	stretching	sitting
Group 2 (Nos. 5-8)	stretching	sitting	walking
Group 3 (Nos. 9-12)	sitting	walking	stretching

The same group of participants performed all three experimental protocols, with a one-week washout period between each session.

4. Pre-experimental tests were conducted, including measurements of weight, height, resting heart rate, leg strength, and power.

5. Participants performed Sepak Takraw training by simulating a real 4-day continuous competition based on the 44th Northeastern Rajabhat University Games (Kodchasarn Games). The competition format consisted of two groups with four teams each, competing over four days. The preliminary rounds lasted three days, followed by the semi-finals at 9:00 AM and the finals at 1:00 PM on the fourth day. Each match was set for three sets of 15 points, regardless of whether the ball was in or out of play. The training protocols were then categorized as follows:

5.1 For the server position, the training involved serving from a toss provided by a teammate, alternating with receiving drills where the coach used a tennis racket to hit the Sepak Takraw balls. The sessions were structured as follows: in the first set, 8 points for serving and 7 points for receiving; in the second set, 7 points for serving and 8 points for receiving; and in the third set, 8 points for serving and 7 points for receiving.

5.2 For the setter position, the training consisted of receiving serves hit by the coach using a tennis racket alternating with setting drills. The protocol was structured as follows: in the first set, 8 points for receiving and 7 points for setting; in the second set, 7 points for receiving and 8 points for setting; and in the third set, 8 points for receiving and 7 points for setting.

5.3 For the striker position, the training involved receiving serves hit by the coach using a tennis racket alternating with net attacks. The sessions were divided as follows: in the first set, 8 points for receiving and 7 points for attacking; in the second set, 7 points for receiving and 8 points for attacking; and in the third set, 8 points for receiving and 7 points for attacking.

6. Each group performed the training for four consecutive days. Upon completion of each session, the designated recovery methods were applied. A one-week washout period was maintained between each experimental condition, during which participants were instructed to avoid high-intensity exercise or sports. Post-training measurements were recorded for heart rate recovery, leg strength, and power.

7. The recorded data were analyzed using statistical methods.

Results

Table 2 General Physical Characteristics and Baseline Performance of the Participants (n = 12)

Participant Groups (n = 4 per group)	Weight (kg.)	Height (cm.)	Resting heart rate (bpm.)	Leg strength (kg/body weight)	Power (cm.)
Group 1					
mean	66.25	174.25	73.00	2.04	51.50
S.D.	6.85	5.44	2.94	0.21	7.68
Group 2					
mean	61.00	168.75	69.50	2.16	44.00
S.D.	5.72	8.54	2.89	0.36	1.63
Group 3					
mean	64.75	175.00	68.75	2.57	54.25
S.D.	5.74	4.32	1.26	0.71	7.68

Table 2 shows that Sample Group 1 had an average weight of 66.25 ± 6.85 kg and an average height of 174.25 ± 5.44 cm. The mean resting heart rate was 73.00 ± 2.94 bpm. Additionally, the average leg strength was 2.04 ± 0.21 kg/body weight, and the mean power

was 51.50 ± 7.68 cm. As for Sample Group 2, the average weight and height were 61.00 ± 5.72 kg and 168.75 ± 8.54 cm, respectively. The mean resting heart rate was 69.50 ± 2.89 bpm, with leg strength at 2.16 ± 0.36 kg/body weight and power at 44.00±1.63 cm. Regarding Sample Group 3, the mean weight was 64.75 ± 5.74 kg, and the mean height was 175.00 ± 4.32 cm. The average resting heart rate was 68.75 ± 1.26 bpm. Additionally, the mean leg strength was 2.57 ± 0.71 kg/body weight, and the mean power was 54.25 ± 7.68 cm, respectively.

Table 3 Comparison of Baseline Physiological Measures (Before Training) Among the Three Recovery Groups (n = 12)

List	SS	df	MS	F	p-value
HRR (bpm.)					
Between Groups	41.17	2	20.58	3.32	0.08
Within Groups	55.75	9	6.19		
Total	96.92	11			
LS (kg/body weight)					
Between Groups	0.62	2	0.31	1.37	0.30
Within Groups	2.04	9	0.23		
Total	2.66	11			
PO (cm.)					
Between Groups	225.17	2	112.58	2.80	0.11
Within Groups	361.75	9	40.19		
Total	586.92	11			

Note: HRR = Heart Rate Recovery; LS = Leg Strength; PO = Power; bpm = beats per minute

Table 3 demonstrates that there were no statistically significant differences (p>.05) among the three groups in all baseline measures—Heart Rate Recovery (HRR) (F=3.32, p=0.08), Leg Strength (LS) (F=1.37, p=0.30), and Power (PO) (F=2.80, p=0.11) —prior to the training sessions.

Table 4 Comparison of recovery methods on physiological responses and physical performance after the first training session.

List	SS	df	MS	F	p-value
HRR (bpm.)					
Between Groups	113.17	2	56.58	0.78	0.49
Within Groups	656.50	9	72.94		
Total	769.66	11			
LS (kg/body weight)					
Between Groups	0.91	2	0.45	2.14	0.17
Within Groups	1.91	9	0.21		
Total	2.82	11			
PO (cm.)					
Between Groups	114.00	2	57.00	2.26	0.16
Within Groups	227.00	9	25.22		
Total	341.00	11			

Table 4 reveals that the results revealed that all three recovery protocols yielded comparable physiological benefits, as evidenced by the absence of statistically significant differences ($p>.05$) in Heart Rate Recovery ($F=0.78$, $p=0.49$), Leg Strength ($F=2.14$, $p=0.17$), and Power ($F=2.26$, $p=0.16$) after the initial training session.

Table 5 Comparison of physiological and performance recovery across three protocols following the second training session.

List	SS	df	MS	F	p-value
HRR (bpm.)					
Between Groups	444.50	2	222.25	6.32*	0.02
Within Groups	316.50	9	35.17		
Total	761.00	11			
LS (kg/body weight)					
Between Groups	0.83	2	0.41	1.17	0.35
Within Groups	3.17	9	0.35		
Total	4.00	11			
PO (cm.)					
Between Groups	263.16	2	131.58	2.25	0.16
Within Groups	525.75	9	58.42		
Total	788.91	11			

* $p<.05$

Table 5 reveals that after the second training session, a statistically significant difference was found in Heart Rate Recovery (HRR) among the three groups (F=6.32, p=0.02, p<.05). On the other hand, no statistically significant differences were found in Leg Strength (LS) (F=1.17, p=0.35) and Power (PO) (F=2.25, p=0.16) at the same level.

Therefore, a post-hoc pair-wise comparison was conducted using the Bonferroni method to determine the differences in heart rate recovery after the second training session among Groups 1, 2, and 3, as shown in Table 6.

Table 6 Bonferroni post-hoc comparison of heart rate recovery between groups after the second training session.

Group	Mean Difference	p-value
Group 1 vs Group 2	4.25	1.00
Group 1 vs Group 3	-10.25	0.11
Group 3 vs Group 2	14.50*	0.02

* p<.05

According to Table 6, the results confirmed that Group 3 (Walking) exhibited a significantly more efficient heart rate recovery compared to Group 2 (Sitting), as indicated by a mean difference of 14.50 (p=0.02).

Table 7 Comparative analysis of recovery protocols on physiological and performance measures after the third training session.

List	SS	df	MS	F	p-value
HRR (bpm.)					
Between Groups	118.50	2	59.25	1.46	0.28
Within Groups	365.75	9	40.64		
Total	484.25	11			
LS (kg/body weight)					
Between Groups	0.03	2	0.02	0.06	0.94
Within Groups	2.22	9	0.25		
Total	2.25	11			
PO (cm.)					
Between Groups	68.67	2	34.33	0.47	0.64
Within Groups	660.25	9	73.36		
Total	728.92	11			

Table 7 shows that after the third training session, the statistical analysis confirmed that the three recovery methods continued to yield comparable outcomes, as no significant differences were observed ($p>.05$) in Heart Rate Recovery ($F=1.46$, $p=0.28$), Leg Strength ($F=0.06$, $p=0.94$), or Power ($F=0.47$, $p=0.64$) following the third training session.

Discussion

Heart rate recovery

The hypothesis stated that stretching, walking, and sitting have different effects on the recovery of heart rate, leg strength and power after Sepak Takraw Men's Team Competition Surindra Rajabhat University. The findings of this study support the hypothesis that different recovery modalities exert varying effects on cardiovascular recuperation. Specifically, the significant difference observed between Group 3 (Walking) and Group 2 (Sitting) after the second session ($p<.05$) underscores the physiological importance of the skeletal muscle pump. The superiority of walking in facilitating heart rate recovery (HRR) can be attributed to rhythmic muscle contractions that enhance venous return and maintain a higher cardiac output than passive rest. This finding aligns with the research of Bai et al. (2022), who demonstrated that brisk walking effectively accelerates the return of heart rate to baseline levels. By preventing venous pooling, active recovery ensures a steady systemic circulation necessary for the rapid clearance of metabolic by-products, such as lactate and CO_2, which accumulate during high-intensity Sepak Takraw competition. While Alshehri et al. (2024) established that athletes inherently possess superior recovery capacities due to high cardiovascular efficiency (reflected in lower resting heart rates), this study further clarifies that the type of recovery protocol significantly influences this capacity during acute fatigue. Interestingly, although Sánchez-Otero et al. (2022) suggested that both active and passive rest provide similar cardiopulmonary responses with low perceptual loading, our results critically indicate that for Sepak Takraw athletes, passive sitting is physiologically less effective than walking. This suggests that "perceived rest" does not always equate to "physiological recovery" in high-intensity sports contexts. Much of the existing literature, such as Ullah et al. (2022) and Guo & Wang (2025), focuses on the chronic benefits of aerobic exercise in lowering resting heart rate over time. However, this study contributes valuable evidence to the acute phase of recovery. Unlike the immediate heart rate variability (HRV) changes observed in HIIT by Benavides-Roca et al. (2025), our findings suggest that low-intensity active recovery (walking) provides a more stable and efficient bridge between intense exertion and homeostasis for team-based athletes. In conclusion, while various modalities—including isometric exercise (Edwards et al., 2023) and general aerobic

training—improve long-term cardiovascular health (Chauhan & Kumar, 2023), the immediate application of walking as an active recovery strategy offers a distinct physiological advantage for Sepak Takraw players. It maximizes the "pumping" effect of the lower limb musculature, thereby optimizing the heart's ability to recover within the short intervals between competitive trials.

Leg strength

The hypothesis suggested that stretching, walking, and sitting would have different effects on the recovery of leg strength after Sepak Takraw Men's Team Competition Surindra Rajabhat University. However, the results did not support the established hypothesis. The experimental findings revealed no statistically significant differences at the .05 level after the first, second, and third training sessions.

The absence of statistically significant differences in leg strength ($p>.05$) across all experimental phases aligns with the fundamental Principles of Training, particularly the laws of specificity and intensity. From a physiological perspective, enhancing maximal muscular strength requires high-intensity stimuli—typically exceeding 80% of one-repetition maximum (1 RM)—to effectively facilitate motor unit recruitment and induce muscular hypertrophy. The three recovery modalities investigated in this study—stretching, walking, and sitting—are fundamentally categorized as low-intensity activities. While these methods successfully address systemic recovery by accelerating the clearance of metabolic by-products and mitigating peripheral venous pooling, they fail to generate the mechanical tension necessary to stimulate protein synthesis or trigger neuromuscular adaptations. This study's findings critically reinforce the distinction made by Zhang et al. (2025), who argued that post-exercise stretching functions solely as a recuperative tool rather than a performance enhancer. Our results further extend this narrative by demonstrating that even when integrated into a competitive training cycle for athletes, these recovery protocols do not alter the structural or functional strength capacity of the lower-limb musculature. The lack of change in leg strength in this study parallels the evidence provided by Wohlann et al. (2023), which indicated that short-duration interventions are inadequate to induce chronic physiological changes, such as shifts in muscle stiffness or contraction time. Furthermore, the non-significant results support the broader consensus established by Chwała et al. (2021) and Ichihara et al. (2025), suggesting that neither passive rest nor low-impact walking provides a sufficient overload stimulus to enhance maximal strength, even in populations with existing muscle weakness. In summary, the results validate the theoretical framework that while stretching, walking, and sitting are effective for immediate cardiovascular and metabolic stabilization, they are inherently limited by their low-intensity

nature. They do not serve as substitutes for high-resistance training. For Sepak Takraw athletes, these modalities should be viewed strictly as recovery-enhancing strategies rather than interventions for physical capacity development, as they lack the mechanical threshold required to elicit neuromuscular improvements within the competitive session intervals.

Power

Regarding the hypothesis that stretching, walking, and sitting rest would have different effects on the recovery of power after Sepak Takraw Men's Team Competition Surindra Rajabhat University, the results did not support the established hypothesis. The experimental findings demonstrated that no statistically significant differences in leg power existed among the three groups across all training sessions ($p>.05$). This outcome aligns with the physiological principles of explosive power, which is fundamentally governed by the force-velocity relationship. The lack of divergence among the groups can be attributed to the fact that power performance is intrinsically linked to the recruitment of Type II (fast-twitch) muscle fibers and a high Rate of Force Development (RFD). The recovery protocols investigated—stretching, walking, and sitting—are characterized by low-velocity and low-impact movements. Consequently, they fail to provide the neural drive or mechanical stimulus necessary to influence the neuromuscular system's explosive capacity. This study's results critically support the assertions of Warneke et al. (2024), who noted that stretching interventions are insufficient to elicit acute improvements in vertical jump power. While stretching is often perceived as a recovery aid, our findings further reinforce the evidence from Yildiz et al. (2020), which suggests that static stretching may induce a stretch-induced force deficit. This phenomenon potentially offsets any recuperative benefits by temporarily reducing muscle-tendon stiffness, thereby neutralizing any advantage stretching might have had over passive sitting or walking. The non-significant findings in this study also highlight a clear distinction between acute recovery and chronic adaptation. While Xu et al. (2025) and Gee et al. (2021) have demonstrated that long-term (8-week) integrated plyometric and strength training significantly enhances jumping and agility (Hu et al., 2025), this study demonstrates that short-term recovery modalities do not possess the same power-enhancing efficacy. Unlike high-velocity training, which optimizes the Stretch-Shortening Cycle (SSC), the investigated recovery methods serve only as metabolic or psychological rests rather than performance-enhancing stimuli. In summary, the results validate the physiological reality that leg power is a highly specific physical attribute requiring high-velocity stimuli to maintain or develop. For Sepak Takraw athletes, whose performance relies on explosive spikes and blocks, these findings suggest that while walking,

stretching, and sitting are vital for general cardiovascular recovery, they cannot be expected to acutely restore or improve explosive power levels. This underscores the need for coaches to distinguish between protocols meant for "metabolic clearing" and those meant for "neuromuscular readiness."

Recommendations

Implementing a brief 2-minute walking recovery significantly enhances heart rate deceleration compared to sitting rest. Coaches can utilize both walking and sitting as strategic recovery tools in tournament settings to help Sepak Takraw athletes regain physiological homeostasis, thereby maintaining high performance levels throughout the competition.

Research Limitations

The findings of this study should be interpreted with consideration of certain limitations. First, the duration of the recovery intervention was limited to 2 minutes, which may not fully capture the long-term physiological shifts or cumulative recovery effects. Second, the relatively small sample size of 12 Sepak Takraw players may restrict the generalizability of the results to a broader athletic population or other sporting contexts.

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