



This is a peer-reviewed, final published version of the following document, Available online 3 October 2026 2211-2669/© 2026 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>). and is licensed under Creative Commons: Attribution 4.0 license:

Bedford, Steve, Wilson-Thain, Samantha, Barden, Craig ORCID logo
ORCID: <https://orcid.org/0000-0001-5504-2548> and Thain, Peter K. (2026) Practices and perceptions of recovery modalities in professional tennis players. Performance Enhancement & Health, 14 (5). p. 100467. doi:10.1016/j.peh.2026.100467

Official URL: <https://doi.org/10.1016/j.peh.2026.100467>

DOI: <http://dx.doi.org/10.1016/j.peh.2026.100467>

EPrint URI: <https://eprints.glos.ac.uk/id/eprint/16562>

Disclaimer

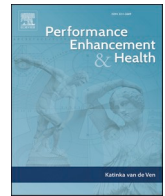
The University of Gloucestershire has obtained warranties from all depositors as to their title in the material deposited and as to their right to deposit such material.

The University of Gloucestershire makes no representation or warranties of commercial utility, title, or fitness for a particular purpose or any other warranty, express or implied in respect of any material deposited.

The University of Gloucestershire makes no representation that the use of the materials will not infringe any patent, copyright, trademark or other property or proprietary rights.

The University of Gloucestershire accepts no liability for any infringement of intellectual property rights in any material deposited but will remove such material from public view pending investigation in the event of an allegation of any such infringement.

PLEASE SCROLL DOWN FOR TEXT.



Research Paper

Practices and perceptions of recovery modalities in professional tennis players

Steve Bedford^a, Samantha Wilson-Thain^b, Craig Barden^{c,*}, Peter K. Thain^d^a Recovery Advantage, England, UK^b School of Life Sciences, University of Warwick, Gibbet Hill Campus, Coventry, CV4 7AJ, UK^c School of Education, Health and Science, University of Gloucestershire, Oxstalls Campus, Gloucester, GL2 9HW, UK^d School of Life and Health Sciences, Birmingham City University, Birmingham, B15 3TN, UK

ARTICLE INFO

Key words:

Tennis

Surveys and questionnaires

Athletic performance

Post-exercise recovery techniques

ABSTRACT

Objective: To explore professional tennis players' perceptions, behaviours, use and barriers related to recovery strategies during a Grand Slam tournament window**Design:** Cross-sectional study**Methods:** Forty-three professional tennis players completed an online survey during a Grand Slam tournament window. Data are reported descriptively using frequencies and percentages, and open-ended responses were analysed thematically.**Results:** Sleep and massage were perceived as the two most effective recovery strategies (93% and 88.4%, respectively). Massage (86.0%) and ice baths (74.4%) were the most used recovery strategies. Stretching had the highest percentage of participants using it after every match and/or training session (93.1%), followed by nutrition/supplements (91.3%). Foam rolling was predominantly chosen for its ease of accessibility (50%). Coach/peer influence most strongly affected the use of sleep optimisation strategies (41.2%). Limited availability was the most frequently reported barrier for massage (60%). Lack of motivation and low perceived effectiveness were the primary barriers for stretching (36.4%) and foam rolling (42.9% and 39.3%, respectively). Discomfort was the main barrier to using ice baths (55.6%).**Conclusion:** This study assessed perceptions and self-reported recovery behaviours rather than athletes' objective knowledge. There is a potential need to strengthen athlete and practitioner education, improve access to evidence-based support, and address the structural and motivational constraints that limit the consistent application of effective recovery strategies.

1. Introduction

Professional tennis is characterised by high-intensity intermittent efforts, extended match durations, global travel and demanding tournament schedules. The physiological load of match play includes glycogen depletion (Troyer et al., 2020), muscle damage (Hornery et al., 2007; Ojala & Häkkinen, 2013), and neuromuscular fatigue (Lyons et al., 2013), which compromise performance consistency (Amatori et al., 2020; Lambrich & Muehlbauer, 2025).

High-speed, multi-directional movements within tennis require exceptional neuromuscular control to maintain stroke precision and postural stability making players susceptible to the detrimental effects of

fatigue (Martin et al., 2016; Zhou et al., 2025). Beyond these acute match-related responses, professional players contend with chronic stressors such as travel-related circadian disruption, impaired sleep, and thermoregulatory strain, which further undermine recovery capacity (Lever et al., 2020; Marazziti et al., 2025). Although it is recommended that players require over 24 h of rest to fully recover after competition (Ojala & Häkkinen, 2013), tournament formats rarely allow for this. For example, during the 2012 Australian Open, Novak Djokovic and Rafael Nadal each accumulated over 12 h of match play across 13 days before contesting a final lasting nearly 6 h (Reid & Duffield, 2014).

Evidence from other sports highlights the magnitude of these recovery challenges. In rugby, systematic reviews describe substantial

* Corresponding author.

E-mail addresses: steve@recoveryadvantage.org (S. Bedford), samantha.wilson-thain@warwick.ac.uk (S. Wilson-Thain), cbarden@glos.ac.uk (C. Barden), peter.thain@bcu.ac.uk (P.K. Thain).@mrthain (P.K. Thain)<https://doi.org/10.1016/j.peh.2026.100467>

Received 5 May 2026; Received in revised form 15 September 2026; Accepted 30 September 2026

Available online 3 October 2026

2211-2669/© 2026 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

neuromuscular and endocrine fatigue post-match, with recovery extending 48–72 h (Tavares et al., 2017; Aben et al., 2022). Football players similarly experience significant eccentric muscle damage, hormonal disruption, and delayed onset muscle soreness, requiring multimodal recovery strategies (Abaïdia & Dupont, 2018; Clarke & Noon, 2019). Across sports, the use of recovery modalities has become increasingly prevalent. In tennis, Poignard et al. (2020) reported that 86.3% of professional players used between two and five recovery modalities concurrently. Comparable trends are seen in elite soccer, where most La Liga teams employ at least one structured recovery strategy (Altarriba-Bartes et al., 2021). Within golf, there is wide variation in practice owing to the logistical constraints, travel, and tradition (Bishop et al., 2025). Interestingly, within basketball, nutrition has been identified as a key component of recovery, where adherence is often dictated by perception and contextual barriers rather than evidence (Davis et al., 2022). Collectively, these findings reflect the broader principle that recovery is not only a physiological process but also an applied, context-dependent behaviour shaped by athletes' beliefs, environments, and constraints. Incorporating a variety of recovery strategies can help minimise muscle soreness and perceived fatigue, enabling athletes to resume training sooner and with greater quality (Driller & Leabeater, 2023).

Within tennis, tournament organisers (particularly at events offering >250 ranking points) often provide access to a wide range of recovery modalities, including cold-water immersion, massage therapy, and compression garments. Although many of these practices have established physiological rationales, their real-world application is strongly influenced by personal preference, accessibility, and cultural norms (Crowther et al., 2017). Many strategies and devices aim to simultaneously target physiological, biomechanical, neurological, or psychological aspects of recovery, but a core mechanism for most is the reduction of perceived soreness and enhancement of subjective recovery (Driller & Leabeater, 2023). Effective recovery reduces injury risk and may enhance performance (Bezuglov et al., 2021). However, perceptions and beliefs play a crucial role in decision-making, where athletes may base decisions on attitudes, confidence, and the endorsement of peers or staff rather than on objective markers of recovery. Furthermore, recovery strategy selection is often driven by ease of use, availability, and time efficiency, with possible barriers to implementation being practical rather than evidence based.

Recently, Rowlands et al (2025) identified three major barriers that high-performance athletes and coaches encounter when implementing recovery behaviours: lack of education; difficulty balancing priorities; and sleep restrictions. Understanding how players conceptualise, select, and evaluate recovery modalities is therefore essential for informing effective and sustainable practice within the sport. Professional tennis offers a unique case study in which acute physiological demands, chronic stressors, and contextual factors converge. Therefore, the aim of the present study was: 1) to evaluate the perceived effectiveness of commonly used modalities and identify strategies players implement; 2) identify key determinants of selection; and 3) identify the barriers to implementing recovery strategies.

2. Methods

This cross-sectional survey investigated professional tennis player's perceptions and behaviours related to recovery strategies.

2.1. Participants

Players were recruited during the practice week of a Grand Slam tennis event in 2025. Players who are competing in the tournament, arrive throughout the practice week, which is the week before the tournament commences. The lead author promoted the study at the event via word and mouth, and players shared knowledge of the study via personal communication. Posters with a QR code to the online

questionnaire were displayed in the locker-room and treatment areas for two days during this practice week. Participation was voluntary. Before completing the questionnaire, players were required to read an information sheet and provide informed consent. The anonymous questionnaire was distributed in English through Qualtrics. The principal researcher was present and available to answer any questions. All procedures conformed to the standards of the Declaration of Helsinki, and the study was approved by the University of Gloucestershire school research ethics committee (EDS.SPRT.20062401).

2.2. Data collection

The questionnaire comprised 22 questions organised into five sections: demographic and details; perceptions; behaviours; use; and barriers related to recovery strategies, as adapted from Murray et al. (2017). Questions utilised a combination of open and closed answers (questionnaire is provided within the Supplementary Material).

Demographic questions included sex, nationality, age, playing discipline (singles/doubles) and years of experience. Participants were also asked a closed question regarding their access to support services with the following options available: sport and exercise scientist; nutritionist; physiotherapist; massage; performance analyst; strength and conditioning; fitness coach.

Perceptions of all recovery strategies were assessed using a 5-point scale (no effect, minor, neutral, moderate, major) as outlined in Murray et al. (2017). Participants then responded to an open-ended follow-up question regarding how they determine when they have recovered. Behavioural data were collected by identifying which recovery strategies participants used through a closed-ended question offering the following options: active recovery (e.g., submaximal jogging, cycling, swimming, or active stretching); nutrition/supplements; compression garments; massage; foam rolling; stretching; hot bath; ice bath; and sleep optimising strategies. An additional open-ended option allowed participants to report other methods. For each strategy selected, participants indicated their reasons for implementation using predefined options as adapted from Fleming et al. (2018): scientific literature; coach or peer influence; time efficiency; cost efficiency; availability; and personal preference. Participants were also asked what they felt each strategy helped with, selecting from: muscle soreness; sleep quality; perceived fatigue; and stress. The implementation of each strategy was assessed by asking participants how frequently they used the recovery method during the tournament window, with predefined response options: after every match; after every training session; or occasionally.

Barriers to practice were examined for strategies that participants did not report using, with items adapted from Pernigoni et al. (2022). Participants selected from the following options: too time-consuming; lack of available devices or facilities; too far to travel; lack of motivation; do not perceive a benefit or find it effective; no prior experience or confidence in using the strategy; discomfort; or insufficient scientific evidence supporting its effects. A final open-ended question asked whether participants' recovery practices differed outside of the Grand Slam tournament window.

2.3. Data analysis

After data screening, incomplete questionnaire entries were removed. Some responses were excluded because they were completed in an unusually short time and appeared likely to be automated, while others contained too many unanswered items. The final sample comprised $n = 43$ participants. Given the cross-sectional, descriptive design of the study, data are presented as frequencies and percentages. A co-author coded open-ended responses into subcategories to support the thematic analysis.

3. Results

3.1. Demographics

Forty-three elite international tennis players completed the survey during the practice week before a Grand Slam event and were included in the study (43/194 = 22% response rate). Of the respondents, 63% ($n = 27$) were male and 37% ($n = 16$) were female, ranging from 20 to 43 years of age (player age = 30.5 ± 5.8 years; player experience = 11.4 ± 5.8 years). They represented 24 countries, although nationality is not reported in detail to preserve anonymity. Most participants specialised in singles ($n = 19$, 44%) or doubles ($n = 18$, 42%), while six competed in both disciplines (14%).

Nearly all participants ($n = 40$, 93%) had access to a physiotherapist/massage therapist whilst on the tour, with 84% using a strength and conditioning/fitness coach ($n = 36$). Use of other support staff included a nutritionist ($n = 24$, 56%), sport and exercise scientist ($n = 12$, 28%) and a performance analyst ($n = 7$, 16%).

3.2. Perceptions and use

Participants perceived that sleep and massage were the two most effective recovery strategies (93.0% and 88.4%, respectively when combining ratings of major and moderate effect), whilst foam rolling and hot baths were perceived to be the least effective (Table 1).

Massage ($n = 37$, 86.0%) and ice baths ($n = 32$, 74.4%) were the most used recovery strategies, with hot baths ($n = 7$, 16.3%), foam rolling ($n = 12$, 27.9%) and compression garments ($n = 13$, 30.2%) used the least (Table 2). Stretching had the highest percentage of participants using it after every match and/or training session ($n = 27$, 93.1%), followed by nutrition/supplements ($n = 21$, 91.3%).

When combining a player's perception towards effectiveness (+ = major or moderate effect, - = minor, neutral or no effect), and their behaviour (+ = used, - = not used), massage had the highest +/+ value, with 79% of participants believing it was effective and using it (Fig. 1). This was followed by ice baths (+/+ = 65%) and active recovery (+/+ = 63%). Sleep optimising strategies had the highest $\pm$ score (53%), with 93% of participants believing sleep optimising strategies were an effective recovery strategy but only 40% actively using them. Further breakdown of all recovery strategies can be seen in Fig. 1.

When participants rated perceived improvements from recovery strategies, reduced muscle soreness was the most frequently reported benefit for seven of the nine strategies (Table 3). Stress reduction was the primary perceived benefit of sleep optimising strategies ($n = 17$, 100%) and hot baths ($n = 6$, 85.7%). Among those using sleep optimising strategies and hot baths, 88.2% ($n = 15$) and 57.1% ($n = 4$), respectively, perceived improvements in sleep quality. Additionally, 76.5% ($n = 13$) and 76.0% ($n = 19$) indicated that sleep optimising strategies and nutrition, respectively, improved fatigue.

3.3. Reasons for use

When participants were asked why they used recovery strategies during tournament play, they reported a range of reasons (Table 4). Scientific literature was the primary reason for adopting nutrition/

Table 2

Frequency of use of each recovery strategy during the tournament window.

	Used Strategy	After every match/ training session	Occasionally
Massage	86.0% (95% CI: 73–93%; $n = 37$)	57.1% (95% CI: 41–72%; $n = 20$)	42.9% (95% CI: 28–59%; $n = 15$)
Ice Bath	74.4% (95% CI: 60–85%; $n = 32$)	38.7% (95% CI: 24–56%; $n = 12$)	61.3% (95% CI: 44–76%; $n = 19$)
Active Recovery	69.8% (95% CI: 55–81%; $n = 30$)	75.0% (95% CI: 57–87%; $n = 21$)	25.0% (95% CI: 13–43%; $n = 7$)
Stretching	69.8% (95% CI: 55–81%; $n = 30$)	93.1% (95% CI: 78–98%; $n = 27$)	6.9% (95% CI: 2–22%; $n = 2$)
Nutrition	58.1% (95% CI: 43–72%; $n = 25$)	91.3% (95% CI: 73–98%; $n = 21$)	8.7% (95% CI: 2–27%; $n = 2$)
Sleep	39.5% (95% CI: 26–55%; $n = 17$)	76.5% (95% CI: 53–90%; $n = 13$)	23.5% (95% CI: 10–47%; $n = 4$)
Compression	30.2% (95% CI: 19–45%; $n = 13$)	8.3% (95% CI: 1–35%; $n = 1$)	91.7% (95% CI: 65–99%; $n = 11$)
Foam Rolling	27.9% (95% CI: 16–43%; $n = 12$)	72.7% (95% CI: 43–90%; $n = 8$)	27.3% (95% CI: 10–57%; $n = 3$)
Hot Bath	16.3% (95% CI: 8–30%; $n = 7$)	28.6% (95% CI: 8–64%; $n = 2$)	71.4% (95% CI: 36–92%; $n = 5$)

Note. Data are presented as percentage (95% Wilson confidence interval; n = number of participants). The 'Used Strategy' column uses the total sample ($n = 43$). Frequency of use is based on valid responses to the frequency question for each strategy; participants who declined to answer were excluded from the relevant denominator.

supplement strategies ($n = 15$, 60.0%). Foam rolling was mainly chosen for its ease of accessibility ($n = 6$, 50%), with massage ($n = 13$, 35.1%) and stretching ($n = 11$, 36.7%) also frequently selected for this reason, albeit not the main reason. Coach/peer influence most strongly affected the use of sleep optimising strategies ($n = 7$, 41.2%). Personal preference was the most common reason for using seven of the nine strategies.

3.4. Qualitative – perceptions of feeling “recovered”

Following the coding of open responses to the question 'How do you know you have recovered?', the following themes emerged: Subjective Physical Sensation; Sleep Quality; Energy; Mood; Use of Wearable technology. These findings indicate that perception of recovery is multidimensional, with physical, cognitive and emotional indicators (Fig. 2).

The most prominent theme was athletes' subjective assessment, with muscle soreness serving as a critical physical cue—around 60% of athletes relied on this to gauge recovery. Sleep quality and performance, along with the resulting sense of energy, were also strong indicators and were mentioned more frequently by male participants than female participants.

Approximately 14% of respondents specifically referenced wearable technology as a supplement to subjective measures, citing tools such as Whoop and other devices that track metrics like heart rate variability, sleep quality, resting heart rate, and respiratory rate. For a smaller proportion (5%), mood state was noted as an indicator, typically in combination with physical sensations.

Table 1

Participants perceived effectiveness of different recovery strategies.

Effect/ Strategy	Massage	Ice Bath	Active Recovery	Stretching	Nutrition	Sleep	Compression	Foam Rolling	Hot Bath
Major effect	72.1%	46.5%	25.6%	37.2%	37.2%	90.7%	16.3%	7.0%	16.3%
Moderate effect	16.3%	30.2%	48.8%	34.9%	34.9%	2.3%	37.2%	37.2%	25.6%
Minor effect	2.3%	0.0%	0.0%	11.6%	7.0%	0.0%	16.3%	7.0%	7.0%
Neutral	9.3%	18.6%	25.6%	14.0%	20.9%	4.7%	27.9%	46.5%	46.5%
No effect	0.0%	4.7%	0.0%	2.3%	0.0%	2.3%	2.3%	2.3%	4.7%

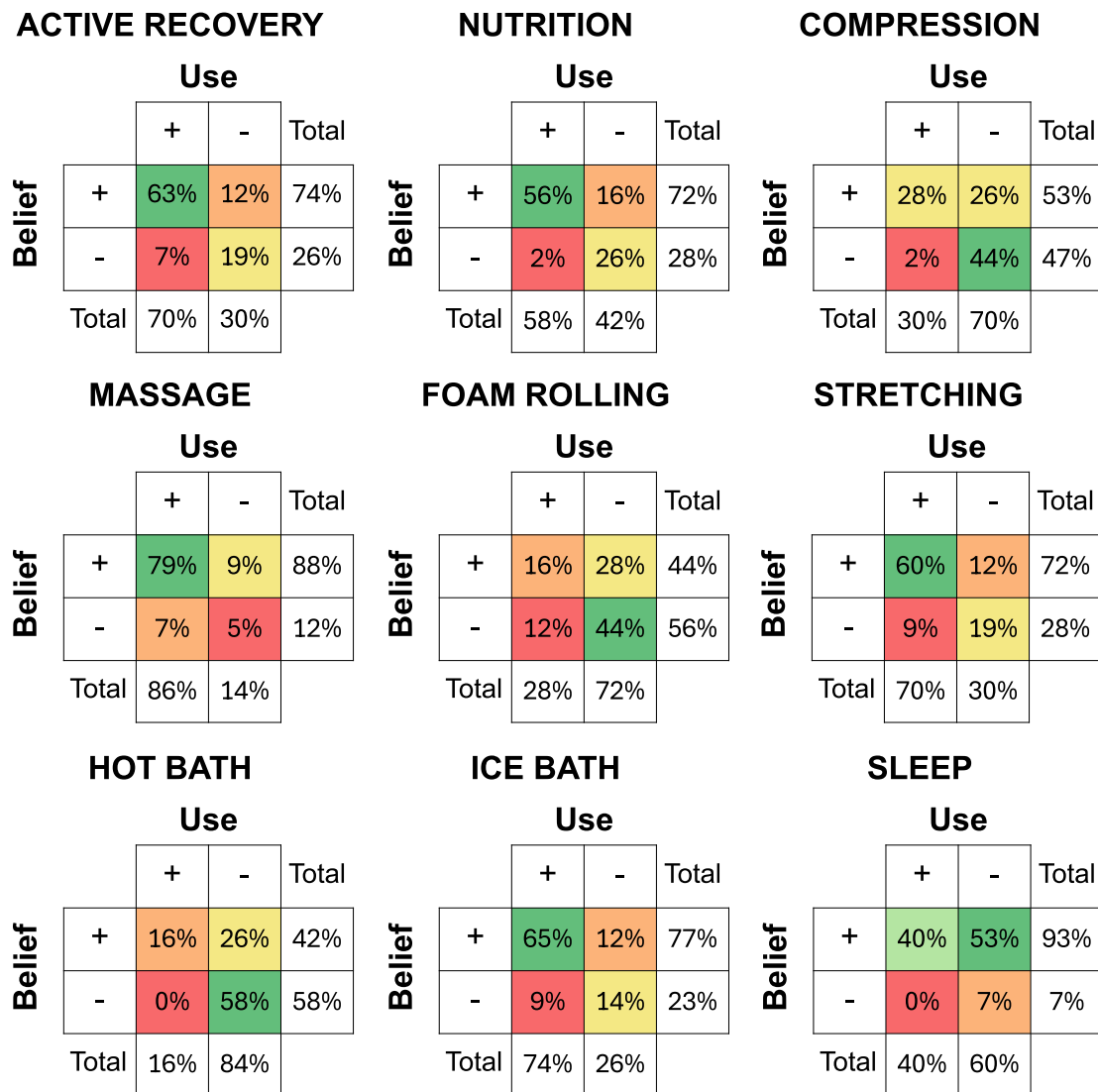


Fig. 1. 2x2 charts illustrating player perceptions of strategy effectiveness (+ = yes, - = no) and their use of the strategy (+ = yes, - = no).

3.5. Barriers to recovery strategy use

Barriers to implementing recovery strategies are presented in Table 5. Limited availability was the most frequently reported barrier for massage 60.0% ($n = 3$), hot baths 54.8% ($n = 17$) and compression garments 37.0% ($n = 10$). Lack of motivation and low perceived effectiveness were the primary barriers for stretching ($n = 4$, 36.4% respectively) and foam rolling ($n = 12$, 42.9% and $n = 11$, 39.3% respectively). Discomfort was the main barrier to ice baths ($n = 5$, 55.6%), while motivation was the main barrier for stretching ($n = 4$, 36.4%).

3.6. Changes outside of the tournament window

When participants were asked to recall what differed in their recovery strategy outside of the tournament window, 65% ($n = 22$) respondents said that it remained the same. Eleven participants did not respond or gave an unclear response such as “no idea” or “X”. For the remaining 29% ($n = 10$), there were a limited number of reasons for change, predominantly focused on access outside of the tournament window, time and knowledge of appropriate recovery strategies available.

‘I don’t use any recovery outside of tournaments because I mainly don’t have access and lack of motivation’.

‘Yes, because when I am home training I have access to more things for recovery’.

‘I’ve never had much information on how to recover properly. I’ve learned by watching other players or listening to my coaches, but it hasn’t been a priority in my career due to a lack of information’.

4. Discussion

To the best of our knowledge, this study is the first to investigate professional tennis players’ perceptions, use, behaviours and barriers related to recovery strategies during the practice week of a Grand Slam tournament. By integrating reported use with subjective evaluations of effectiveness, the findings reveal inconsistencies between the athletes’ perceived effectiveness of recovery strategies and their actual recovery strategy selection. Such inconsistencies may be attributed to external factors such as coach/peer influence and availability of the recovery strategies.

Professional tennis players reported using a broad range of recovery modalities during the tournament window; however, their perceived

Table 3
Perceived improvements of post-match recovery strategies during tournament play.

	Muscle Soreness	Fatigue	Stress	Sleep Quality
Massage (N = 37)	91.9% (95% CI: 79–97%; n = 34)	54.1% (95% CI: 38–69%; n = 20)	62.2% (95% CI: 46–76%; n = 23)	45.9% (95% CI: 31–61%; n = 17)
Ice Bath (N = 32)	87.5% (95% CI: 72–95%; n = 28)	68.8% (95% CI: 52–82%; n = 22)	25.0% (95% CI: 13–42%; n = 8)	43.8% (95% CI: 28–60%; n = 14)
Active Recovery (N = 30)	83.3% (95% CI: 66–93%; n = 25)	36.7% (95% CI: 21–54%; n = 11)	26.7% (95% CI: 14–44%; n = 8)	13.3% (95% CI: 5–30%; n = 4)
Stretching (N = 30)	96.7% (95% CI: 83–99%; n = 29)	46.7% (95% CI: 30–64%; n = 14)	20.0% (95% CI: 10–37%; n = 6)	13.3% (95% CI: 5–30%; n = 4)
Nutrition (N = 25)	76.0% (95% CI: 57–89%; n = 19)	76.0% (95% CI: 57–89%; n = 19)	36.0% (95% CI: 20–57%; n = 9)	60.0% (95% CI: 41–76%; n = 15)
Sleep (N = 17)	52.9% (95% CI: 31–74%; n = 9)	76.5% (95% CI: 53–90%; n = 13)	100.0% (95% CI: 82–100%; n = 17)	88.2% (95% CI: 66–97%; n = 15)
Compression (N = 13)	92.3% (95% CI: 67–99%; n = 12)	53.8% (95% CI: 29–76%; n = 7)	0.0% (95% CI: 0–23%; n = 0)	23.1% (95% CI: 8–50%; n = 3)
Foam Rolling (N = 12)	100.0% (95% CI: 76–100%; n = 12)	16.7% (95% CI: 5–45%; n = 2)	0.0% (95% CI: 0–24%; n = 0)	0.0% (95% CI: 0–24%; n = 0)
Hot Bath (N = 7)	71.4% (95% CI: 36–92%; n = 5)	14.3% (95% CI: 3–51%; n = 1)	85.7% (95% CI: 49–97%; n = 6)	57.1% (95% CI: 25–84%; n = 4)

Note. Data are presented as percentage (95% Wilson confidence interval; *n* = number of participants reporting the perceived improvement). *N* represents the total number of participants reporting use of that recovery strategy. Participants could select more than one response; therefore, percentages within each recovery strategy may total more than 100%.

effectiveness of these strategies varied considerably. Consistent with previous research in both team and individual sports (Crowther et al., 2017; Murray et al., 2017), athletes demonstrated a strong reliance on traditional, practitioner-led methods. Nearly all athletes had access to physiotherapy or massage (93%), and most were supported by strength and conditioning or fitness coaches (84%), and nutritionists (56%). In contrast, far fewer reported access to sport and exercise scientists (28%) or performance analysts (16%). This support-staff distribution reflects a tendency to conceptualise recovery predominantly through a physical rather than an integrated performance-science lens. Similar to previous studies, massage (86.0%) (Bezuglov et al., 2021) and ice bath (74.4%) (Poignard et al., 2020; Namdev & Nimoda, 2025) were the most used strategies, whereas hot bath (16.3%), foam rolling (27.9%) and compression garments (30.2%) were among the least utilised. In agreement with a recent study on water polo players (Barrenetxea-Garcia et al., 2024), stretching (93.1%) was the most consistently applied method following matches and training sessions, closely followed by targeted nutrition and supplement use (91.3%).

Massage showed the strongest alignment between perceived effectiveness and reported use: 79% of players both perceived it as effective and reported regular use (Fig. 1). Ice bath and active recovery showed moderate concordance. Sleep displayed the clearest gap between belief and practice. Although 93% of players considered sleep an effective recovery modality, only 40% reported regularly implementing sleep optimising strategies. This discrepancy mirrors findings in water polo (Barrenetxea-Garcia et al., 2024) and highlights the difficulty of translating perceived importance into routine behaviour. One possible explanation is that some players may not have used specific sleep strategies, such as white noise machines, eye masks and ear plugs, because they did not perceive their sleep as problematic. However, the present study did not measure perceived sleep problems, so this explanation should be treated as a hypothesis.

Table 4
Reasons for implementing post-match recovery strategies during tournament play.

	Personal Preference	Coach/Peer Influence	Scientific Literature	Easily Available	No reason
Massage (N = 37)	78.4% (95% CI: 63–89%; n = 29)	10.8% (95% CI: 4–25%; n = 4)	24.3% (95% CI: 13–40%; n = 9)	35.1% (95% CI: 22–51%; n = 13)	0.0% (95% CI: 0–9%; n = 0)
Ice Bath (N = 32)	62.5% (95% CI: 45–77%; n = 20)	28.1% (95% CI: 16–45%; n = 9)	46.9% (95% CI: 31–64%; n = 15)	18.8% (95% CI: 9–35%; n = 6)	6.2% (95% CI: 2–20%; n = 2)
Active Recovery (N = 30)	–	–	–	–	–
Stretching (N = 30)	63.3% (95% CI: 46–78%; n = 19)	26.7% (95% CI: 14–44%; n = 8)	26.7% (95% CI: 14–44%; n = 8)	36.7% (95% CI: 22–54%; n = 11)	6.7% (95% CI: 2–21%; n = 2)
Nutrition (N = 25)	56.0% (95% CI: 37–73%; n = 14)	28.0% (95% CI: 14–48%; n = 7)	60.0% (95% CI: 41–77%; n = 15)	16.0% (95% CI: 6–35%; n = 4)	4.0% (95% CI: 1–20%; n = 1)
Sleep (N = 17)	82.4% (95% CI: 59–94%; n = 14)	41.2% (95% CI: 22–64%; n = 7)	58.8% (95% CI: 36–78%; n = 10)	17.6% (95% CI: 6–41%; n = 3)	0.0% (95% CI: 0–18%; n = 0)
Compression (N = 13)	76.9% (95% CI: 50–92%; n = 10)	0.0% (95% CI: 0–23%; n = 0)	15.4% (95% CI: 4–42%; n = 2)	23.1% (95% CI: 8–50%; n = 3)	0.0% (95% CI: 0–23%; n = 0)
Foam Rolling (N = 12)	33.3% (95% CI: 14–61%; n = 4)	25.0% (95% CI: 9–53%; n = 3)	16.7% (95% CI: 5–45%; n = 2)	50.0% (95% CI: 25–75%; n = 6)	0.0% (95% CI: 0–24%; n = 0)
Hot Bath (N = 7)	100.0% (95% CI: 65–100%; n = 7)	14.3% (95% CI: 3–51%; n = 1)	0.0% (95% CI: 0–35%; n = 0)	14.3% (95% CI: 3–51%; n = 1)	0.0% (95% CI: 0–35%; n = 0)

Note. Data are presented as percentage (95% Wilson confidence interval; *n* = number of participants selecting each reason). *N* represents the total number of participants reporting use of that recovery strategy. Participants could select multiple reasons; therefore, percentages within each recovery strategy may exceed 100%. – indicates data not available owing to an error with the questionnaire.

Players most often monitored recovery subjectively, with approximately 60% relying on muscle soreness, while others referred to sleep quality, perceived performance and general energy, particularly in male participants. Only 14% reported using objective monitoring tools such as wearable technologies (i.e. Whoop) to track heart rate variability, sleep quality, resting heart rate, and respiratory rate (Fig. 2). A small proportion also cited mood state as an additional cue, typically combined with physical sensations.

Open-ended responses showed that two-thirds of participants reported no difference in their recovery routines outside the tournament window. Those who did report changes mainly cited reduced access, limited time, and lack of knowledge regarding effective recovery strategies. Athletes described barriers such as inadequate motivation, restricted access to modalities outside competition, and insufficient education. Comments such as, “I don’t use any recovery outside of tournaments because I mainly don’t have access and lack of motivation,” and, “I’ve never had much information on how to recover properly... it hasn’t been a priority in my career due to a lack of information,” align with observations by Rowlands et al. (2025), who noted that inadequate guidance early in athletes’ careers contributes to inconsistent recovery behaviours later on.

The findings support previous reports of a misalliance between scientific evidence and athlete beliefs (Crowther et al., 2017; Pernigoni et al., 2022; Barrenetxea-Garcia et al., 2024). This was most evident in

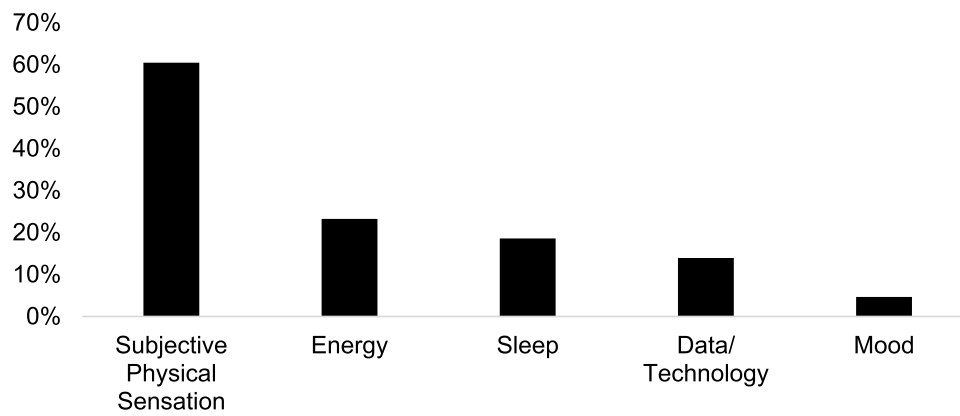


Fig. 2. Percentage of participants mentioning themed indicators of recovery.

Table 5
Barriers to using recovery strategies.

	Expensive	Time-consuming	Availability of devices/facilities	Distance to access facilities	Lack of motivation	No benefit/effectiveness	Lack of experience/confidence	Lack of scientific literature	Discomfort
Massage (N = 5)	40.0% (95% CI: 12–77%; n = 2)	0.0% (95% CI: 0–43%; n = 0)	60.0% (95% CI: 23–88%; n = 3)	40.0% (95% CI: 12–77%; n = 2)	0.0% (95% CI: 0–43%; n = 0)	0.0% (95% CI: 0–43%; n = 0)	20.0% (95% CI: 4–62%; n = 1)	0.0% (95% CI: 0–43%; n = 0)	20.0% (95% CI: 4–62%; n = 1)
Ice Bath (N = 9)	0.0% (95% CI: 0–30%; n = 0)	0.0% (95% CI: 0–30%; n = 0)	11.1% (95% CI: 2–44%; n = 1)	11.1% (95% CI: 2–44%; n = 1)	33.3% (95% CI: 12–65%; n = 3)	11.1% (95% CI: 2–44%; n = 1)	0.0% (95% CI: 0–30%; n = 0)	11.1% (95% CI: 2–44%; n = 1)	55.6% (95% CI: 27–81%; n = 5)
Active Recovery (N = 13)	38.5% (95% CI: 18–65%; n = 5)	38.5% (95% CI: 18–65%; n = 5)	30.8% (95% CI: 13–58%; n = 4)	23.1% (95% CI: 8–50%; n = 3)	7.7% (95% CI: 1–33%; n = 1)	23.1% (95% CI: 8–50%; n = 3)	15.4% (95% CI: 4–42%; n = 2)	0.0% (95% CI: 0–23%; n = 0)	7.7% (95% CI: 1–33%; n = 1)
Stretching (N = 11)	9.1% (95% CI: 2–38%; n = 1)	18.2% (95% CI: 5–48%; n = 2)	9.1% (95% CI: 2–38%; n = 1)	9.1% (95% CI: 2–38%; n = 1)	36.4% (95% CI: 15–65%; n = 4)	36.4% (95% CI: 15–65%; n = 4)	0.0% (95% CI: 0–26%; n = 0)	9.1% (95% CI: 2–38%; n = 1)	18.2% (95% CI: 5–48%; n = 2)
Nutrition (N = 18)	16.7% (95% CI: 6–39%; n = 3)	11.1% (95% CI: 3–33%; n = 2)	11.1% (95% CI: 3–33%; n = 2)	5.6% (95% CI: 1–26%; n = 1)	11.1% (95% CI: 3–33%; n = 2)	22.2% (95% CI: 8–45%; n = 4)	44.4% (95% CI: 25–66%; n = 8)	5.6% (95% CI: 1–26%; n = 1)	5.6% (95% CI: 1–26%; n = 1)
Sleep (N = 23)	4.3% (95% CI: 1–22%; n = 1)	4.3% (95% CI: 1–22%; n = 1)	17.4% (95% CI: 7–37%; n = 4)	4.3% (95% CI: 1–22%; n = 1)	17.4% (95% CI: 7–37%; n = 4)	8.7% (95% CI: 3–26%; n = 2)	47.8% (95% CI: 29–67%; n = 11)	8.7% (95% CI: 3–26%; n = 2)	4.3% (95% CI: 1–22%; n = 1)
Compression (N = 27)	11.1% (95% CI: 4–28%; n = 3)	14.8% (95% CI: 6–33%; n = 4)	37.0% (95% CI: 22–56%; n = 10)	14.8% (95% CI: 6–33%; n = 4)	14.8% (95% CI: 6–33%; n = 4)	37.0% (95% CI: 22–56%; n = 10)	25.9% (95% CI: 13–46%; n = 7)	0.0% (95% CI: 0–12%; n = 0)	11.1% (95% CI: 4–28%; n = 3)
Foam Rolling (N = 28)	3.6% (95% CI: 1–18%; n = 1)	17.9% (95% CI: 8–36%; n = 5)	0.0% (95% CI: 0–12%; n = 0)	7.1% (95% CI: 2–23%; n = 2)	42.9% (95% CI: 26–61%; n = 12)	39.3% (95% CI: 23–58%; n = 11)	7.1% (95% CI: 2–23%; n = 2)	10.7% (95% CI: 4–26%; n = 3)	10.7% (95% CI: 4–26%; n = 3)
Hot Bath (N = 31)	0.0% (95% CI: 0–11%; n = 0)	3.2% (95% CI: 1–16%; n = 1)	54.8% (95% CI: 38–71%; n = 17)	16.1% (95% CI: 7–33%; n = 5)	9.7% (95% CI: 3–25%; n = 3)	22.6% (95% CI: 11–40%; n = 7)	19.4% (95% CI: 9–34%; n = 6)	3.2% (95% CI: 1–16%; n = 1)	6.5% (95% CI: 2–17%; n = 2)

Note. Data are presented as percentage (95% Wilson confidence interval; *n* = number of participants selecting the barrier). *N* represents the total number of participants reporting use of that recovery strategy. Participants could select multiple barriers; therefore, percentages within each recovery strategy may exceed 100%.

the high prevalence of stretching, despite substantial evidence questioning its effectiveness for post-exercise recovery (Afonso et al., 2021; Calleja-González et al., 2021). Its popularity may reflect its accessibility, familiarity, and minimal equipment requirements. Active recovery was also frequently used during the tournament window to reduce the symptoms of muscle soreness (Table 3), consistent with previous research (Barrenetxea-Garcia et al., 2024). Outside of the tournament window, however, participants used it less often because of limited availability, time constraints, and being expensive. The survey did not measure why participants viewed active recovery as expensive; therefore, it is only possible to speculate that some associated it with access to facilities or equipment, such as a stationary bike or swimming pool (Table 5). Although the literature supports the ability of active recovery to improve gas exchange (Crowther et al., 2017) and reduce soreness and inflammation (Fares et al., 2022), some studies have reported no reduction in delayed-onset muscle soreness (Van Hooran & Peake, 2018). In addition, foam rolling is strongly supported for improving

tissue properties and reducing delayed onset muscle soreness (Nakamura et al., 2021; Scudamore et al., 2021), yet nearly half of players perceived it as having no effect or gave a neutral response.

Cold therapy continues to be justified as it has been shown to be more effective than active recovery, contrast water therapy and warm water immersion in reducing muscle soreness following strenuous exercise (Moore et al., 2023) and may be particularly effective for managing the high mechanical and metabolic demands of tennis (Kovacs & Baker, 2014). Recent studies in soccer have demonstrated reductions in muscle damage, inflammation, and perceived exertion following cold-water immersion (Namdev & Nimoda, 2025), though conflicting evidence persists regarding its ability to mitigate inflammation and cellular stress in muscle following resistance exercise (Peake et al., 2017). Massage, used by 86.0% of players in this study, remains one of the most valued strategies and is supported by robust research for reducing muscle soreness (Dupuy et al., 2018; Li et al., 2025) within established routines (Bezuglov et al., 2021; Crowther et al., 2017). Sleep was widely

perceived as beneficial for recovery and stress reduction, consistent with literature demonstrating its essential role in physiological, cognitive, and psychological restoration (Rae et al., 2017; O'Donnell et al., 2018). Inadequate sleep has well-documented consequences, including impaired reaction time, decision-making, motivation and inflammatory responses (Malliou et al., 2025; Marazziti et al., 2025). Despite this, only 40% of players actively prioritised sleep, and nearly half reported a lack of confidence to optimise sleep behaviours (Table 5). Players reported similar uncertainty around nutrition and supplements, highlighting a potential need for more targeted education. Evidence for compression garments remains mixed (Riexinger et al., 2021; Stedje & Armstrong, 2021), although athletes often perceive them as helpful (Brown et al., 2022). In this study, players associated compression garments mainly with the relief of muscle soreness.

The frequent use of multiple modalities aligns with previous findings in tennis (Poignard et al., 2020; Wiewelhove et al., 2021) and other sports (Braun-Trocchio et al., 2022; Barrenetxea-Garcia et al., 2024; Bishop et al., 2025). Evidence supports combining strategies such as cold-water immersion, compression, and sleep hygiene (Kovacs & Baker, 2014; Florin et al., 2021; Duffield et al., 2014), but congested match schedules can limit consistent implementation. Wiewelhove et al. (2021) similarly noted that athletes value massage, ice bath, and active recovery, yet struggle to apply them regularly due to time pressures, discomfort, or limited facilities. Habitual recovery routines may reduce cognitive load and encourage adherence (Rowlands et al., 2025). Comparable trends have been documented in basketball, where active recovery, massage, foam rolling, and stretching are among the most positively perceived and most frequently used strategies for reducing injury risk, increasing readiness for subsequent training or competition, and minimising cumulative fatigue (Pernigoni et al., 2022).

Collectively, these findings suggest that elite tennis players' recovery behaviours, are shaped by a combination of perceived benefit, accessibility, personal preference, and coach/peer influence. Although multi-modal approaches may offer enhanced perceptual and physical benefits, these were inconsistently adopted outside tournament settings. Structured recovery education, particularly regarding sleep optimisation and evidence-informed modality selection, may help narrow the gap between perceptions and best practice. Increasing access to sport and exercise science professionals and nutritionists within individual athlete teams may further support informed decision-making across training and competition contexts. However, it is important to note that the present study did not directly measure players' scientific literacy or awareness of the underlying evidence base. Therefore, the data should be interpreted cautiously, rather than imply athletes knowingly prioritise tradition over science. Furthermore, it is possible that recovery selection is made based on time pressures and a reliance on trusted practitioners dominating decisions rather than simply a lack of knowledge. Future work should therefore examine not only what recovery strategies athletes use, but how players understand recovery mechanisms, evaluate competing sources of information, and translate perceived effectiveness into consistent practice across tournament and non-tournament settings.

4.1. Limitations

Several known limitations exist through the use of cross-sectional surveys, including poor response rates, response bias and recall bias. The response rate in this study was low, however it was similar to previous studies conducted in this topic area (Crowther et al., 2017). We attempted to reduce response bias by making the survey available to all players, regardless of injury status or playing level. However, some players may have been unable to complete the survey due to it only being available in English limiting the generalisability of the findings. Recruitment also relied mainly on direct communication from the lead author, personal player communication, and posters displayed in locker-room and treatment areas. As players completed the survey

during the practice week of a Grand Slam tournament, recall bias was likely limited. However, Grand Slam facilities may differ from those available at other tournaments, so the findings may reflect this specific context rather than professional tennis more broadly.

The survey used was an amalgamation of surveys previously used to investigate recovery in tennis and other sports, providing face validity. Where necessary, questions and statements were slightly changed to make them specific to tennis. However, the survey used was not re-validated or its internal consistency assessed.

While the descriptive statistics illustrates our results categorised by professional tennis players preparing to compete in a Grand Slam tournament, these variables were not thoroughly examined for more in-depth statistical analysis due to our small sample size. As such, further analysis between male and female participants, and other sub-groups, was not conducted. In addition, the interpretations of strategies to improve sleep may have not been obviously clear to all participants, for example, the use of white noise, eye masks, ear plugs, medications etc. Finally, an error in the branching of the online survey meant that reasons for using active recovery could not be reported in detail.

5. Conclusion

To the best of the authors' knowledge, this is the first study to examine the reported use, perceived effectiveness, and barriers to recovery strategy engagement among professional tennis players during the practice week of Grand Slam tournament. The findings reveal a variation in behaviours and perceptions towards recovery modalities, between the scientific evidence underpinning recovery modalities and the ways in which players select and evaluate them. Recovery selection was dominated by accessible and easily implemented modalities, while more resource-intensive modalities were constrained by practicality, availability, or cost. There is a potential need to improve athlete education and improve access to evidence-based interventions at professional tennis events, to help players better integrate recovery into their performance routines, optimise training and competition readiness, and support long-term athletic development.

6. Practical implications

- The use of recovery strategies does not always match perceived effectiveness.
- Recovery strategies are mostly chosen for perceived reductions in muscle soreness.
- Recovery strategy selection is rarely informed by scientific literature.
- Tennis should enhance athlete and coach education on effective recovery strategies.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRedit authorship contribution statement

Steve Bedford: Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Samantha Wilson-Thain:** Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization. **Craig Barden:** Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization. **Peter K. Thain:** Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare no conflicts of interest.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.phe.2026.100467](https://doi.org/10.1016/j.phe.2026.100467).

References

- Abaidia, A. E., & Dupont, G. (2018). Recovery strategies for football players. *Swiss Sport & Exercise Medicine*, 66(4), 28–36. <https://doi.org/10.34045/SSEM/2018/28>
- Aben, H. G. J., Hills, S. P., Cooke, C. B., Davis, D., Jones, B., & Russell, M. (2022). Profiling the post-match recovery response in male rugby: A systematic review. *Journal of Strength and Conditioning Research*, 36(7), 2050–2067. <https://doi.org/10.1519/JSC.0000000000003741>
- Afonso, J., Clemente, F. M., Nakamura, F. Y., Morouço, P., Sarmento, H., Inman, R. A., & Ramirez-Campillo, R. (2021). The effectiveness of post-exercise stretching in short-term and delayed recovery of strength, range of motion and delayed onset muscle soreness: A systematic review and meta-analysis of randomized controlled trials. *Frontiers in Physiology*, 12, Article 677581. <https://doi.org/10.3389/fphys.2021.677581>
- Altarrriba-Bartes, A., Peña, J., Vicens-Bordas, J., Casals, M., Peirau, X., & Calleja-González, J. (2021). The use of recovery strategies by Spanish first division soccer teams: a cross-sectional survey. *The Physician and Sportsmedicine*, 49(3), 297–307. <https://doi.org/10.1080/00913847.2020.1819150>
- Amatori, S., Gobbi, E., Moriando, G., Gervasi, M., Sisti, D., Rocchi, M. B., & Perroni, F. (2020). Effects of a tennis match on perceived fatigue, jump and sprint performances on recreational players. *Open Sports Sciences Journal*, 13(1), 54–59. <https://doi.org/10.2174/1875399x02013010054>
- Barrenetxea-Garcia, J., Perazzetti, A., Nuell, S., Mielgo-Ayuso, J., de Villarreal, E. S., & Calleja-González, J. (2024). Perceptions and use of recovery strategies in water polo players and coaches: A worldwide survey. *Journal of Exercise Rehabilitation*, 20(3), 112–123. <https://doi.org/10.12965/jer.2448214.107>
- Bezuglov, E., Lazarev, A., Khaitin, V., Chegin, S., Tikhonova, A., Talibov, O., Gerasimuk, D., & Waskiewicz, Z. (2021). The prevalence of use of various post-exercise recovery methods after training among elite endurance athletes. *International Journal of Environmental Research and Public Health*, 18(21), Article 11698. <https://doi.org/10.3390/ijerph182111698>
- Bishop, C., Xu, J., Wilson, L., Close, G., Mountjoy, M., Dunne, D., Coughlan, D., Turner, A., & Murray, A. (2025). Recovery for professional and elite amateur golfers: A scoping review of evidence-based methods. *Sports Medicine*, 55, 2789–2807. <https://doi.org/10.1007/s40279-025-02297-0>
- Braun-Trocchio, R., Graybeal, A. J., Kreutzer, A., Warfield, E., Renteria, J., Harrison, K., Williams, A., Moss, K., & Shah, M. (2022). Recovery strategies in endurance athletes. *Journal of Functional Morphology and Kinesiology*, 7(1), Article 22. <https://doi.org/10.3390/jfmk7010022>
- Brown, F. C., Hill, J. A., van Someren, K., Howatson, G., & Pedlar, C. R. (2022). The effect of custom-fitted compression garments worn overnight for recovery from judo training in elite athletes. *European Journal of Sport Science*, 22(4), 521–529. <https://doi.org/10.1080/17461391.2021.1891294>
- Calleja-González, J., Mielgo-Ayuso, J., Miguel-Ortega, Á., Marqués-Jiménez, D., Del Valle, M., Ostojic, S. M., Sampaio, J., Terrados, N., & Refoyo, I. (2021). Post-exercise recovery methods focus on young soccer players: A systematic review. *Frontiers in Physiology*, 12, Article 505149. <https://doi.org/10.3389/fphys.2021.505149>
- Clarke, N., & Noon, M. (2019). Fatigue and recovery in football: A review. *Sports*, 7(8), Article 192. <https://doi.org/10.3390/sports7080192>
- Crowther, R., Sealey, R., Crowe, M., Edwards, A., & Halson, S. (2017). Team sport athletes' perceptions and use of recovery strategies: A mixed-methods survey study. *BMC Sports Science, Medicine and Rehabilitation*, 9, Article 6. <https://doi.org/10.1186/s13102-017-0071-3>
- Davis, J. K., Oikawa, S. Y., Halson, S., Stephens, J., O'Riordan, S., Luhrs, K., Sopana, B., & Baker, L. B. (2022). In-season nutrition strategies and recovery modalities to enhance recovery for basketball players: A narrative review. *Sports Medicine*, 52(5), 971–993. <https://doi.org/10.1007/s40279-021-01606-7>
- Driller, M., & Leabeater, A. (2023). Fundamentals or icing on top of the cake? A narrative review of recovery strategies and devices for athletes. *Sports*, 11(11), Article 213. <https://doi.org/10.3390/sports11110213>
- Duffield, R., Murphy, A., Kellett, A., & Reid, M. (2014). Recovery from repeated on-court tennis sessions: Combining cold-water immersion, compression, and sleep interventions. *International Journal of Sports Physiology and Performance*, 9(2), 273–282. <https://doi.org/10.1007/s00421-012-0359-9>
- Dupuy, O., Douzi, W., Theurot, D., Bosquet, L., & Dugué, B. (2018). An evidence-based approach for choosing post-exercise recovery techniques to reduce markers of muscle damage, soreness, fatigue, and inflammation: A systematic review with meta-analysis. *Frontiers in Physiology*, 9, Article 403. <https://doi.org/10.3389/fphys.2018.00403>
- Fares, R., Vicente-Rodríguez, G., & Olmedillas, H. (2022). Effect of active recovery protocols on the management of symptoms related to exercise-induced muscle damage: A systematic review. *Strength & Conditioning Journal*, 44(1), 71–83. <https://doi.org/10.1519/SSC.0000000000000643>
- Fleming, J. A., Naughton, R. J., & Harper, L. D. (2018). Investigating the nutritional and recovery habits of tennis players. *Nutrients*, 10(4), Article 443. <https://doi.org/10.3390/nu10040443>
- Florin, T. D., Cristian, P., & Damian, P. (2021). Practical strategies of recovery in tennis. *Science, Movement and Health*, 21(2), 205–209.
- Hornery, D. J., Farrow, D., Mujika, I., & Young, W. (2007). An integrated physiological and performance profile of professional tennis. *British Journal of Sports Medicine*, 41(8), 531–536. <https://pmc.ncbi.nlm.nih.gov/articles/PMC2465445/>
- Kovacs, M. S., & Baker, L. B. (2014). Recovery interventions and strategies for improved tennis performance. *British Journal of Sports Medicine*, 48(Suppl 1), i18–i21. <https://doi.org/10.1136/bjsports-2013-093223>
- Lambrich, J., & Muehlbauer, T. (2025). Effects of fatigue on physiological, physical fitness, and stroke performance related parameters in healthy tennis players: A systematic review and meta-analysis. *Frontiers in Sports and Active Living*, 7, Article 1578914. <https://doi.org/10.3389/fspor.2025.1578914>
- Lever, J. R., Murphy, A. P., Duffield, R., & Fullagar, H. H. (2020). A combined sleep hygiene and mindfulness intervention to improve sleep and well-being during high-performance youth tennis tournaments. *International Journal of Sports Physiology and Performance*, 16(2), 250–258. <https://doi.org/10.1123/ijsspp.2019-1008>
- Li, H., Luo, L., Zhang, J., Cheng, P., Wu, Q., & Wen, X. (2025). The effect of percussion massage therapy on the recovery of delayed onset muscle soreness in physically active young men: A randomized controlled trial. *Frontiers in Public Health*, 13, Article 1561970. <https://doi.org/10.3389/fpubh.2025.1561970>
- Lyons, M., Al-Nakeeb, Y., Hankey, J., & Nevill, A. (2013). The effect of moderate and high-intensity fatigue on groundstroke accuracy in expert and non-expert tennis players. *Journal of Sports Science & Medicine*, 12(2), 298–308. <https://pmc.ncbi.nlm.nih.gov/articles/PMC3761827/>
- Malliou, V. J., Pafis, G., Ispirlides, I., Daskalaki, K., & Katsikas, C. (2025). The impact of injury severity on sleep quality in soccer players. *European Journal of Sport Sciences*, 4(3), 1–8.
- Marazziti, D., Gemignani, A., Parra, E., Gurrieri, R., Alf, G., Aquino, G., Miniati, M., & Palagini, L. (2025). Sleep pattern alterations in professional tennis players. *Journal of Sleep Research*, 35, Article e70085. <https://doi.org/10.1111/jsr.70085>
- Martin, C., Bideau, B., Delamarche, P., & Kulpa, R. (2016). Influence of a prolonged tennis match play on serve biomechanics. *PLOS One*, 11(8), Article e0159979. <https://doi.org/10.1371/journal.pone.0159979>
- Moore, E., Fuller, J. T., Bellenger, C. R., Saunders, S., Halson, S. L., Broatch, J. R., & Buckley, J. D. (2023). Effects of Cold-Water Immersion Compared with Other Recovery Modalities on Athletic Performance Following Acute Strenuous Exercise in Physically Active Participants: A Systematic Review, Meta-Analysis, and Meta-Regression. *Sports Medicine (Auckland, N.Z.)*, 53(3), 687–705. <https://doi.org/10.1007/s40279-022-01800-1>
- Murray, A. M., Turner, A. P., Sproule, J., & Cardinale, M. (2017). Practices and attitudes towards recovery in elite Asian and UK adolescent athletes. *Physical Therapy in Sport*, 25, 25–33. <https://doi.org/10.1016/j.ptsp.2016.12.005>
- Nakamura, M., Yasaka, K., Kiyono, R., Onuma, R., Yahata, K., Sato, S., & Konrad, A. (2021). The acute effect of foam rolling on eccentrically induced muscle damage. *International Journal of Environmental Research and Public Health*, 18(1), Article 75. <https://doi.org/10.3390/ijerph18010075>
- Namdev, S., & Nimoda, A. (2025). A comparative study on the effects of different recovery strategies on delayed onset muscle soreness, metabolic markers, and performance outcomes in trained athletes using physiological testing protocols. *International Journal of Physical Education, Sports and Health*, 12(4), 199–204.
- O'Donnell, S., Beaven, C. M., & Driller, M. W. (2018). From pillow to podium: a review on understanding sleep for elite athletes. *Nature and Science of Sleep*, 243–253. <https://pmc.ncbi.nlm.nih.gov/articles/PMC6112797/>
- Ojala, T., & Häkkinen, K. (2013). Effects of the tennis tournament on players' physical performance, hormonal responses, muscle damage, and recovery. *Journal of Sports Science & Medicine*, 12(2), 240–248. <https://pubmed.ncbi.nlm.nih.gov/24149802/>
- Peake, J. M., Roberts, L. A., Figueiredo, V. C., Egner, I., Krog, S., Aas, S. N., Suzuki, K., Markworth, J. F., Coombes, J. S., Cameron-Smith, D., & Raastad, T. (2017). The effects of cold-water immersion and active recovery on inflammation and cell stress responses in human skeletal muscle after resistance exercise. *The Journal of Physiology*, 595(3), 695–711. <https://doi.org/10.1113/jp272881>
- Pernigoni, M., Conte, D., Calleja-González, J., Bocchia, G., Romagnoli, M., & Ferioli, D. (2022). The application of recovery strategies in basketball: A worldwide survey. *Frontiers in Physiology*, 13, Article 887507. <https://doi.org/10.3389/fphys.2022.887507>
- Poignard, M., Guilhem, G., de Larochelambert, Q., Montalvan, B., & Bieuzen, F. (2020). The impact of recovery practices adopted by professional tennis players on fatigue markers according to training type clusters. *Frontiers in Sports and Active Living*, 2, Article 109. <https://doi.org/10.3389/fspor.2020.00109>
- Rae, D. E., Chin, T., Dikgomo, K., Hill, L., McKune, A. J., Kohn, T. A., & Roden, L. C. (2017). One night of partial sleep deprivation impairs recovery from a single exercise training session. *European Journal of Applied Physiology*, 117(4), 699–712. <https://doi.org/10.1007/s00421-017-3565-5>
- Reid, M., & Duffield, R. (2014). The development of fatigue during match-play tennis. *British Journal of Sports Medicine*, 48(Suppl 1), i7–i11. <https://doi.org/10.1136/bjsports-2013-093196>
- Rieckner, A., Laun, F. B., Höger, S. A., Wiesmueller, M., Uder, M., Hensel, B., Forst, R., Hotfiel, T., & Heiss, R. (2021). Effect of compression garments on muscle perfusion in delayed-onset muscle soreness: A quantitative analysis using intravoxel incoherent motion MR perfusion imaging. *NMR in Biomedicine*, 34(6), Article e4487. <https://doi.org/10.1002/nbm.4487>
- Rowlands, I., Roderique-Davies, G., Greville, J., Stone, M., & Shearer, D. (2026). What motivates athletes to recover? A qualitative exploration of perceptions, behaviours, and barriers to recovery engagement. *Journal of Applied Sport Psychology*, 38, 615–640. <https://doi.org/10.1080/10413200.2025.2543753>
- Scudamore, E. M., Sayer, B. L., Church, J. B., Bryant, L. G., & Příbyslavská, V. (2021). Effects of foam rolling for delayed onset muscle soreness on loaded military task

- performance and perceived recovery. *Journal of Exercise Science & Fitness*, 19(3), 166–170. <https://doi.org/10.1016/j.jesf.2021.02.002>
- Stedje, H. L., & Armstrong, K. (2021). The effects of intermittent pneumatic compression on the reduction of exercise-induced muscle damage in endurance athletes: A critically appraised topic. *Journal of Sport Rehabilitation*, 30(4), 668–671. <https://doi.org/10.1123/jsr.2020-0364>
- Tavares, F., Smith, T. B., & Driller, M. (2017). Fatigue and recovery in rugby: A review. *Sports Medicine*, 47(8), 1515–1530. <https://doi.org/10.1007/s40279-017-0679-1>
- Troyer, W., Render, A., & Jayanthi, N. (2020). Exercise-associated muscle cramps in the tennis player. *Current Reviews in Musculoskeletal Medicine*, 13(5), 612–621. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7474720/>.
- Van Hooren, B., & Peake, J. M. (2018). Do we need a cool-down after exercise? A narrative review of the psychophysiological effects and the effects on performance, injuries, and the long-term adaptive response. *Sports Medicine*, 48(7), 1575–1595. <https://doi.org/10.1007/s40279-018-0916-2>
- Wiewelhove, T., Sz wajca, S., Busch, M., Döweling, A., Volk, N. R., Schneider, C., Meyer, T., Kellmann, M., Pfeiffer, M., & Ferrauti, A. (2022). Recovery during and after a simulated multi-day tennis tournament: Combining active recovery, stretching, cold-water immersion, and massage interventions. *European Journal of Sport Science*, 22(7), 973–984. <https://doi.org/10.1080/17461391.2021.1936196>
- Zhou, Y., Bai, Y., Liang, Y., Yang, K., & Yang, Y. (2025). Effects of neuromuscular training on tennis players: A systematic review and meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*, 17(1), 1–17. <https://doi.org/10.1186/s13102-025-01219-x>