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Abstract

Purpose: To survey soccer practitioners' recovery strategy: (i) use, (ii) perceived effectiveness and (iii) factors influencing their implementation in professional soccer. **Methods**: A cross-sectional convenience sample of professional soccer club/confederation practitioners completed a web-based survey (April—July 2020). Pearson's Chi-square and Fisher's exact tests with Cramer's V (φ-c) assessed relationships and their strength respectively, between the perceived effectiveness and frequency of strategy use. **Results**: 80 soccer practitioners (13 countries) completed the survey. The three most important recovery objectives were 'alleviating muscle damage/fatigue', 'minimising injury risk' and 'performance optimisation'. Most frequently used strategies were active recovery, structured recovery day, extra rest day, massage, cold water therapy and carbohydrate provision [predominately on matchday (MD) and MD+1]. Relationships were identified between perceived effectiveness and frequency of strategy use for sleep medication ($p<0.001$, φ-c=0.48), carbohydrate provision ($p=0.007$, φ-c=0.60), protein provision ($p=0.007$, φ-c=0.63), an extra rest day ($p<0.001$, φ-c=0.56) and a structured recovery day ($p=0.049$, φ-c=0.50). **Conclusions**: The study demonstrates that professional soccer practitioners have a range of objectives geared towards enhancing player recovery. A disconnect is apparent between the perceived effectiveness of many recovery strategies and their frequency of use within an applied setting. Novel data outline that strategies are most frequently employed around matchday. Challenges to strategy adoption are mainly competing disciplinary interests and resource limitations. Researchers and practitioners should liaise to ensure the complexities involved with operating in an applied environment are elucidated and apposite study designs are adopted; in-turn facilitating the use of practically effective and compatible recovery modalities.

Key words

Football · Practitioner · Coach · Applied practice · Qualitative research

Introduction

Recovery strategies are imperative in team sports[1] and elite soccer[2], where players can compete in ≥60 competitive matches per season with fixture congestion and limited recovery time between matches (2—4 days).[3] Insufficient recovery can impede match performance[2], negatively affect player health[4] and increase overuse injury-risk.[2] Indeed, teams with lower injury rates within season are more successful in domestic leagues and cup competitions.[5] Soccer practitioners are thus responsible for implementing an effective and evidence-informed battery of interventions to accelerate performance recovery.[2] Recovery strategy efficacy, whilst well documented in sub- and non-elite soccer populations[2] (and other team sports[1]), is lacking in elite soccer populations. Further, recovery strategies adopted by professional soccer clubs/federations are not apparent (unlike recovery monitoring strategies[6]), in addition to information on practitioners' use, perceived effectiveness and barriers they encounter regarding the employment of such strategies.

A recent systematic and meta-analytical review reported that cold water immersion and compression garment intervention moderately improves countermovement jump height recovery at 48 h post-match in soccer players.[4] However, empirical evidence suggests recovery strategies that coaches perceived to be effective and their practical application are largely based on their own previous experiences, observations and instinct as opposed to robust scientific literature.[1] Indeed, failing to integrate research into practice (i.e. evidence-based practice) could have a detrimental effect on player recovery and performance in soccer, given that applying evidence-informed recommendations are advised for maximising performance and recovery outcomes.[7] Therefore, data pertaining to the use of recovery strategies in professional soccer, their perceived effectiveness among practitioners, when they are used, and the barriers to their implementation, are required.

The aims of this study were to: (i) establish the recovery strategy objectives of professional soccer teams and their practitioners; (ii) determine where these strategies are implemented within a weekly microcycle; (iii) assess practitioners perceived effectiveness of such strategies; and (iv) understand the barriers that impact their use.

Methods

Participants

Institutional ethical approval (SREP/2017/007) was granted in advance of survey distribution. A convenience sample of soccer club representatives were contacted via email or social media and asked to share the survey with the staff member responsible for implementing recovery strategies within their team. A weblink was provided, along with a password required for survey access and a short description explaining the research purpose. Participants were requested to confirm they were ≥18 years and provide informed consent before proceeding to the survey questions. Practitioner demographic information was collected and related to their job role, competitive level, and league in which their team competed, with the survey limited to one response per team.

Survey

The survey was created using an online resource (Qualtrics.^{XM} online software, Utah, USA; https://www.qualtrics.com/uk/). The questions were developed based on the research teams' experience of working in professional soccer, knowledge of the literature and previous experience of survey design. The questions were piloted within the research team and two external practitioners to check face validity. Three new questions were subsequently added, one question type was rephrased to improve clarity and another item was reformatted to enhance usability. Cronbach's alpha was employed retrospectively to measure internal consistency of each individual construct. Acceptable alpha values ranging from 0.74 (95% Confidence Interval 0.70—0.79) to 0.80 (0.74—0.83) were observed.[8]

The initial question asked practitioners to list their three main recovery-strategy objectives in order of perceived importance (1^{st}—3^{rd}).[9] This was followed by a further 15 sections, each containing two closed questions with one open sub-item. Questions were presented in groups of three, with the same questions asked for each of the 15 recovery strategies [(1) sleep promotion *via* hygiene, (2) sleep promotion *via Melatonin and/or Circadin*®, (3) sleep promotion *via* medication, (4) strategies to enhance immunity/prevent illness, (5) cold water therapy, (6) hot therapy, (7) massage, (8) active recovery, (9) compression garments, (10) intermittent pneumatic compression, (11) non-steroidal anti-inflammatory drugs (NSAIDs), (12) carbohydrate provision, (13) protein provision, (14) extra rest day, (15) structured recovery day].

1) The first of the three questions involved respondents indicating on a continuum which day(s) a strategy was used during a one-week microcycle, which comprised eight points and were each labelled with descriptive anchors.
2) If the option 'never' was selected, an open field was displayed, inviting practitioners to expand on the reason(s) as to why a strategy was not adopted. Open ended questions enabled practitioners to elaborate and provide context for a given response.
3) Practitioners were then required to rate their perceived effectiveness on a scale comprising equal intervals.

Survey analyses

Raw data were exported to Microsoft Excel (Microsoft Corp, Redmond, WA, USA). Due to the cross-sectional and observational research design, data were analysed descriptively. To evaluate the perceived importance of recovery objectives — the frequency with which practitioners selected each rank position (1^{st}, 2^{nd}, 3^{rd}) was converted to a proportion (%).[7] A list of options ['Matchday (MD)+3', 'MD+2', 'MD+1', 'MD', 'MD-1', 'MD-2', 'MD-3', 'never'] were provided for multiple-choice questions, with respondents asked to select which day(s) individual strategies were implemented. To indicate their perceived effectiveness for a strategy, participants selected a number from 1 ('not at all effective') to 10 ('highly effective').

Open-ended questions were analysed manually using inductive content analysis.[10] This approach involved the lead researcher reading the qualitative responses several times to ensure data familiarisation.[9] Responses were arranged and initially treated as independent-meaning units. Those with more than one identifiable idea were contemplated and potentially separated, with answers containing insufficient information omitted from analyses.[7] Comparable meaning units derived from each section of the survey were grouped into raw data themes.[11] Commonalities between raw data themes were identified and organised into broader sub-themes in a high order concept.[12] This process continued until data saturation had occurred with emergent themes developed and classified as general dimensions.[7, 9] To audit theme credibility, independent validation was employed by two researchers at several stages, enhancing the accuracy of data interpretation.[9] Where ambiguity around interpretation existed, a third researcher was consulted, and constructive debate ensued until a consensus was reached. Finally, deductive analyses were carried out to affirm the authenticity of the themes developed from the inductive approach.[10]

Statistical analyses

Statistical analyses were performed using IBM SPSS Statistics 26 for Windows (SPSS Inc., Chicago, IL, USA). Pearson's Chi-square tests were used to evaluate the strength of relationship between strategy use and the perceived effectiveness of the strategy.[6] Fisher's exact test with Cramer's V (φ-c) was used when 20% of expected frequencies were >5. Cramer's V was used to indicate the strength of association with 0.10, 0.30 and 0.50 representing a small, medium and large association, respectively.[6] Alpha was set at $p \leq 0.05$.

Results

A total of 80 soccer practitioners fully completed the survey. An initial 100 responses to the survey were received from April 2020 to July 2020, though a further 20 respondents (20%) were excluded from analyses due to incomplete survey data. Practitioners worked for professional senior domestic league (e.g. a team in the English Premier League) teams (n = 52, 65%), international teams (n = 14, 18%), professional academy teams (n = 12, 15%) or semi-professional teams (n = 2, 3%). Table 1 details the practitioner roles at the time of completion. A full breakdown of the confederations and leagues in which teams competed is provided in Table 2.

INSERT TABLE 1

INSERT TABLE 2

Recovery objectives

Table 3 illustrates the frequency of practitioners that ranked their perceived level of importance for each recovery strategy objective.

INSERT TABLE 3

Frequency, timing and perceived effectiveness of strategy use

Sleep strategies

Fifty-three practitioners (66%) used sleep hygiene, whilst the remaining (n = 27, 34%) did not implement this strategy. Many practitioners did not use Melatonin and/or Circadin® (n = 48, 60%), while the remaining respondents reported use of this strategy (n = 32, 40%). Sleep medication was used by 34% of teams (n = 27), with the remainder not adopting this strategy (n = 53, 66%). A significant relationship was observed between perceived effectiveness and frequency of strategy use for sleep medication (φ-c = 0.48, $p < 0.001$), though no associations were identified for sleep promotion *via* sleep hygiene or Melatonin and/or Circadin®. Sleep hygiene and Melatonin and/or Circadin® were implemented most frequently on MD-1, whilst sleep medication was prescribed mostly on MD (Figure 1).

INSERT FIGURE 1

Enhancing immunity and illness prevention

Most practitioners (n = 70, 87%) used strategies to enhance immunity/prevent illness within the microcycle, whilst the remaining 10 practitioners (13%) 'never' adopted this approach. No significant relationships were identified for frequency of use and perceived effectiveness, with this strategy being used commonly on MD and MD+1 (Figure 2).

Hydrotherapy strategies

The majority of respondents adopted cold water treatments (n = 73, 91%), while a much smaller number did not adopt this strategy (n = 7, 9%). Hot therapy strategies were implemented by 55 practitioners (69%), with 25 teams (31%) not using this strategy. No significant relationships were established between frequency of use and perceived effectiveness for either strategy, with cold water treatments used mostly on MD and MD+1, and hot therapy used frequently on MD+1.

Non-steroidal anti-inflammatory drugs

Twenty-six teams (32%) used NSAIDs, though non-adoption was more commonly reported (n = 54, 68%). Frequency of use was not linked with perceived effectiveness, with NSAIDs mostly adopted on MD.

Nutritional strategies

Many teams used carbohydrate (n = 72, 90%) and protein provision (n = 78, 85%), with both strategies administered most frequently on MD. Non-use of carbohydrate (n = 8, 10%) and protein provision (n = 12, 15%) was less frequently reported. Significant relationships were identified for frequency of use and perceived effectiveness for both strategies (carbohydrate: φ-c = 0.60, protein: φ-c = 0.63, both, p = 0.007).

INSERT FIGURE 2

Massage and active recovery

The majority of teams used massage (n = 74, 92%) and active recovery (n = 78, 97%). No significant associations were observed for frequency of use and perceived effectiveness, with both strategies used most frequently on MD+1 (Figure 3).

Compression strategies

Compression garments were used by 58 teams (72%), with fewer practitioners reporting that this strategy was 'never' used (n = 22, 28%). Intermittent pneumatic compression was adopted by 57% of teams (n = 46), with less than half (n = 34, 43%) 'never' using this system. No significant relationships were observed for either strategy, with both interventions used mostly on MD+1.

Extra rest day and structured recovery day

Most teams used an extra rest day and a structured recovery day (both, n = 75, 94%), with fewer reportedly not using these strategies (both, n = 5, 6%). The strategies were largely implemented on MD+1, with significant relationships between frequency of use and perceived effectiveness identified for an extra rest day (φ-c = 0.56, $p < 0.001$) and a structured recovery day (φ-c = 0.50, $p = 0.049$).

INSERT FIGURE 3

Discussion

The purpose of this study was to explore practitioner objectives and perceived effectiveness of recovery strategy use. The frequency and distribution of prescription across a training microcycle and the challenges to recovery strategy adoption were also assessed. The objectives most frequently identified for recovery strategy use were 'alleviating muscle damage and fatigue', 'minimising injury-risk' and 'performance optimisation' (Table 3). A wide range of recovery strategies are used within soccer across several competitive levels and countries, with active recovery, structured recovery and extra rest days most frequent. Discordance between practitioner perceptions of the effectiveness of a technique and the association with its frequency of use was established; with the challenges to adoption (primarily hierarchical and resource constraints) better reflective of implementation. All strategies were used most frequently on MD or MD+1 (Table 4), which supports the hypothesis that practitioners are aware of the duration-dependent nature of recovery.[2] Therefore, our findings build on previous research examining professional team sport recovery modality adoption within a training micro-cycle weekly schedule[13], with the current data specific to the applied soccer environment. Considered within an operational context, these works help guide practitioner recovery strategy decision making processes and facilitate evidence-led recovery practices.

INSERT TABLE 4

Strategies used to promote sleep were not perceived to be effective, nor used frequently within a 7-day microcycle. Contrary to the current findings, contemporary survey research demonstrates that sleep is widely regarded as the most effective strategy by practitioners/coaches in individual[14] and team sports[15, 16], and the most commonly employed strategy in soccer.[17] A separate assessment in Division 1 North-American collegiate athletes identified sleep as the most effective strategy, yet was used by few (~20%) of the team sport athletes surveyed.[18] It is acknowledged that the contrasting observations are likely multifaceted, but are possibly attributed to the differentiation of sleep strategies (hygiene, remedies, medication, etc.) in the current study versus generalising sleep in the previous investigations.[14, 15, 17, 18] An extensive array and quantity of barriers were reported for sleep promotion versus all other strategies in the present study, with the most consistent theme being that sleep strategies were specific to individual athletes. This directly opposes evidence suggesting recovery strategies are typically orchestrated for an entire team, as opposed to managed on an individual basis.[2] Therefore, considering the large inter-individual variation in player sleep habits and patterns[19], the revelation that sleep strategies are individualised is endorsed by the literature[2, 19, 20] and can support practitioner decision-making to promote favourable sleep onset and maintenance moving forward. Interestingly, although culture-specific nuances have shown to further reduce the time available for sleep[21], cultural barriers were not reported in the current research, possibly due to the increasingly common cross-cultural players and staff operating within elite soccer. It was also revealed that sleep facilitation strategies are predominantly implemented on the night prior to (MD-1), and on the night of a match (MD; Figure 1). Such timing of use appears prudent, since sleep is integral for optimal performance[19, 21] and recovery management.[21, 22] Therefore, the trend for microcycle prescription of sleep facilitation strategies can be useful for practitioners to periodise and structure weekly training schedules.

Cold water therapies were perceived to be effective (7.6 ± 1.7), but there was a lack of association with its frequency of use (Table 4). The discrepancy between perceived effectiveness and strategy application is consistent with contemporary survey research involving athletes[15, 18] and coaches.[1, 14] Cold water therapy is reported to reduce muscle soreness[23] and enhance performance[24], with conflicting reports that regular cold water immersion and interference of the natural cellular processes involved with repair and regeneration may hinder long-term chronic adaptations.[25] However, context should be applied when prescribing cold water therapy treatments as the influence of this strategy on exercise performance and adaptations are distinct[26], and as such, the prescription of cold-water treatments should be largely dependent on the stage of the season. For instance, during pre-season, adaptation to training is key, with cold water treatments perhaps blunting the adaptive responses.[25] However, amid fixture-dense schedules, priority should be performance recovery (as opposed to concerns regarding adaptations) for the subsequent match[3], with cold water techniques having some efficacy in these regards.[24] Therefore, the lack of compatibility between perceived effectiveness and use of a strategy, both in the current and previous studies[1, 14, 15, 18], is likely reflective of the equivocal evidence base and lack of explicit evidence-led recommendations endorsing the strategy for accelerating recovery and performance enhancement. Therefore, it is unclear on what grounds practitioners make their recovery strategy choices, though previous research reveals that the practicality and accessibility of a recovery modality also influences its application which possibly explains the inconsistencies between the current scientific literature and industry practice.[1] Therefore, the revelation that resource constraints was a common challenge to cold therapy implementation in the present study supports the logistical challenges that hinder practice, rather than whether the strategy is perceived to be effective. It is advised that teams at a resource disadvantage (e.g., non-elite populations) seek feasible surrogates to cryotherapy chambers and plunge pools (e.g., cost-effective ice-bath containers or cold showers etc). However, although overcoming this logistical challenge for those with effective perceptions of cold water treatments is feasible, maintaining optimal water temperature is imperative[24, 25].

Out of the 80 respondents, 70 used strategies to enhance immunity/prevent illness (zinc, sleep, probiotics), which was prescribed frequently across the weekly schedule, though most common on MD and MD+1 (Figure 2). Studies have reported that performing ≥90 min of high-intensity exercise reduces circulating lymphocytes, suppresses immune function and increases susceptibility to illnesses such as upper respiratory tract infection.[27] Although the findings are derived from a different exercise stimulus, the activity profile of soccer match-play is largely comparable (i.e., ≥90 min of high-intensity exercise). Therefore, the timing of adoption in the current study (i.e., acute use following matches) suggests that some practitioners prescribe such strategies (e.g., vitamin C, E and B6 supplementation) to acutely (i.e., reactively) stimulate an immune response based on data from other modalities. This is concerning as a reactive approach to enhancing immunity and preventing illness may not be favourable for overall health and athlete recovery.[7] However, contrastingly, the qualitative findings suggest that the strategy is prescribed as a 'generalised approach' (i.e., daily). Although this contradicts the quantitative data, this suggests that some practitioners proactively promote this strategy across the training week. Therefore, according to the qualitative responses, these strategies are not only viewed as recovery enhancing, but also applied daily with an agenda to prevent illness and augment immune function. As such, the premise that recovery is part of a wider strategy to facilitate the holistic health and well-being of an athlete is a positive finding. Moving forward, a long-term approach to behavioural changes and player education on illness prevention strategies is advised. However, the high ratings of effectiveness (7.5 ± 2.2) may be counterintuitive to the evidence-base given the absence of research investigating illness prevention techniques and their impact as recovery strategies in professional soccer. Thereby, it appears that practitioners use this strategy based on general health recommendations or experience of working in the field, with such application possibly not considered optimal for recovery and performance.[7] As such, it is apparent that practitioners may know what strategy they wish to employ yet practically be unable to implement it and/or high-quality externally-valid evidence may not be available to inform their practice. A key take-home message, therefore, from these data is not that practitioners are making ill-informed decisions, but rather they are likely not able to employ the precise recovery strategies they wish, and the currently available research does not facilitate evidence-based practice.

The benefits of consuming post-match carbohydrate and protein-enriched nutrition are established[28], and were reflected with the large (φ-c = 0.6—0.63) and significant associations (p = 0.007) with their perceived effectiveness and frequency of use in the current study. The current survey data are also indicative of infrequent hot therapy use (primarily in coaching versus science and medical staff; Table 5), with 'lack of evidence' a common barrier to application. Evidence that heat therapy is effective within athletic and clinical/rehabilitation focused paradigms is growing[29] although lacks specific research regarding elite soccer focused performance recovery promotion.[30] Another strategy that is vital for recovery, is rest, though there are no scientific studies to suggest that an extra rest day (i.e., two- vs one-day) is advantageous. Likewise, including a structured recovery day post-match, whereby players undergo a battery of recovery treatments seems appropriate, despite little evidence explicitly endorsing such practice. Assessing the efficacy of extra rest and structured recovery days is needed to facilitate evidence-informed decision-making processes. Robust scientific evidence for other strategies incorporated in the survey, such as massage, compression garments, NSAIDs and active recovery is lacking with reference to their recovery acceleration properties in elite soccer players.[2] Thus, the use of such strategies is possibly based on anecdotal experiences or evidence of their effectiveness following different sports or exercise modes.

INSERT TABLE 5

Hierarchical challenges, resource constraints and interference with adaptive responses were cited as major barriers to uptake. To tackle the staffing and cost-related barriers, those assigned with recovery promotion should communicate effectively to ensure strategy use is directed towards the best interests of the player and cost-effective solutions are implemented. Barriers specific to individual strategies are discussed above, though using strategies on an individual player basis was applicable to 9 out of 15 strategies. This is an encouraging finding as failing to tailor strategies to meet specific athlete needs may hinder recovery due to the large inter-individual variation for regeneration periods[2], thus, where appropriate, individualised practice is recommended.[18] Strategy adoption was also found to be limited by a paucity of scientific evidence (e.g., "no empirical or scientific evidence of effectiveness"). Empirical research has also demonstrated that athlete preferences do not closely align with scientific reccomendations.[15] Therefore, it is important to consider that practitioners may endeavour to execute recovery protocols based on robust evidence, although, player-related barriers (player compliance, dependency concerns and player education) can prevent implementation. In order to facilitate evidence-informed use of recovery strategies, research should be easily accessible to practitioners (open-access journals) and geared towards addressing some of the player-centred barriers identified from the survey (Table 6).

INSERT TABLE 6

Before reader interpretation of the presented data, some limitations should be considered. The degree to which the data represent the teams that did not participate remains uncertain. Although a precise response rate is not available, the researchers only obtained one response per team to ensure this did not skew the results.[9] It is also acknowledged that neither the educational nor experience level of practitioners are provided, though a convenience sample was used whereby personal networks were contacted, thus, the present data were deemed credible. Practitioner roles, leagues and teams were not equally represented, and thus no inferential statistics were carried out for comparison. However, as evidenced by the proportion of practitioners that responded to the survey, it appears that science and medical staff play a prominent role in the implementation of recovery strategies. It cannot be discounted that ambiguity around question interpretation may have occurred, especially pertaining to sleep variables (whether MD represented the night before or post-match), an extra rest/structured recovery day (erroneously reported on MD) and MD schedules (strategy use pre or post-match). Competing in a one-match microcycle has shown to alter training loads when compared with two- and three-game weekly schedules.[31] Therefore, our data do not reflect the patterns of recovery strategy use during two- and three-game microcycles, though it was deemed appropriate that a standardised approach was taken to facilitate the collection of consistent data across teams.

Practical applications

- There is currently a disassociation between recovery strategy use and practitioners' perceived effectiveness of the strategy. Robust evidence-based guidelines should be followed to ensure an evidence-informed approach to recovery practice is undertaken. This is challenging given the plethora of adopted interdisciplinary multi-stakeholder strategies implemented within professional soccer.
- Multiple barriers to practice implementation prevent their use within a 7-day microcyle. Practitioners should consult other members of the staff team and liaise with players to ensure these challenges (conflicting hierarchical interests and resource constraints) are overcome.

Conclusions

These novel questionnaire data offer a practically appropriate initial step towards providing applied insights into recovery strategy use in professional soccer. Synergy between the highest ranked recovery objectives and performance-facing data-driven challenges to practice are evident. Although, the underlying factors influencing the coaches' value of a strategy are unclear, the mismatch between strategy adoption and perceptions of effectiveness are evident. Utilising recovery interventions based on accessibility or anecdotal experiences rather than scientific sources is likely to be detrimental for optimising player recovery. This substantiates the need for education programmes designed to guide practitioners in making evidence-informed decisions. The novelty associated with detailing distribution of each strategy throughout the training week can be used by practitioners to carefully design 7-day schedules around optimising recovery. The survey findings also provide information about the challenges in research translation across varying playing levels and soccer leagues, with researchers advised to accommodate practitioner barriers to carefully develop apposite study designs with translation potential. Those responsible for the application of recovery within their team must engage with the scientific literature to provide evidence-led recovery strategy practice targeted at optimising player recovery, holistic health and well-being, and performance. Ultimately, in order to implement effective recovery promotion techniques, it is advised that practitioners work across staff disciplines and closely with players to ensure practices are player-centred, a holistic approach to recovery is taken and factors that challenge the application of recovery strategies are addressed.

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Figure captions

Figure 1. Number of practitioners that use sleep hygiene via sleep promotion (A), Melatonin/Circadian® (B), and sleep medication (C) in proximity to matchday (MD) schedules (left y axis). Perceived effectiveness (right y axis) of practitioners that use (dashed line) and never use a strategy (dotted line) are reported. ▲ indicates medium association. * indicates significant relationship between frequency of use and perceived effectiveness ($p < 0.05$). Matchday (MD) represents the night following the match. MD-1 represents the night before the match.

Figure 2. Number of practitioners that use enhancing immunity/illness prevention (A), cold water therapy (B), hot therapy (C), non-steroidal anti-inflammatory drugs (D), carbohydrate (E) and protein (F) in proximity to matchday (MD) schedules (left y axis). Perceived effectiveness (right y axis) of practitioners that use (dashed line) and never use a strategy (dotted line) are reported. ■ indicates large association. * indicates significant relationship between frequency of use and perceived effectiveness ($p < 0.05$).

Figure 3. Number of practitioners that use massage (A), intermittent pneumatic compression (B), compression garments (C), active recovery (D), structured recovery day (E) and structured recovery day (F) in proximity to matchday (MD) schedules (left y axis). Perceived effectiveness (right y axis) of practitioners that use (dashed line) and never use a strategy (dotted line) are reported. ■ indicates large association. * indicates significant relationship between frequency of use and perceived effectiveness ($p < 0.05$).

Table 1. Total number of survey responses according to practitioner roles

Role	Responses
Science Staff	**32**
Sport Scientist	18
Head of science & medicine	12
Head of Performance/fitness & conditioning	2
Medical Staff	**33**
Team doctor	18
Sport therapist/physiotherapist	12
Head of medical department	1
Orthopaedic surgeon	1
Massage therapist	1
Coaching staff	**15**
Strength & conditioning coach	7
Fitness coach	5
Physical development/performance coach	2
Head coach	1
Total	**80**

Table 2. The number of survey responses received from team practitioners according to the football confederation and affiliated leagues in which their team compete (country tier; no. of responses)

Union of European Football Associations	Asian Football Confederation	Confederation of African Football	Football federation Australia	South American Football Confederation
International associations (n = 5)	International associations (n = 5)	International associations (n = 2)	International associations (n = 1)	Brasilian ampeonato Brasileiro Série A (1st tier; n = 1)
English Premier League (1st tier; n = 11)	Qatar Stars League (1st tier; n = 10)	Tunisian Professional League 1 (1st tier; n = 4)	Australian A League (1st tier; n = 3)	
English Championship (2nd tier; n = 4)	Qatar Second Division (2nd tier; n = 1)	Tunisian Professional League 2 (2nd tier; n = 1)		
English League One (3rd tier; n = 2)	Iranian Persian Gulf Pro League (1st tier; n = 2)	Algerian Professional League 1 (1st tier; n = 3)		
English League Two (4th tier; n = 2)	Japanese J1 League (1st tier; n = 2)	Algerian Professional League 2 (2nd tier; n = 1)		
English National League (5th tier; n = 1)	Indian Super League (1st tier; n = 1)			
English BetVictor Premier League (7th tier; n = 1)	Thai League 1 (1st tier; n = 1)			
English Academy Professional Development Leagues (n = 12)				
League of Ireland Premier Division (1st tier; n = 1)				
French Ligue 1 (1st tier; n = 1)				
Russian Premier League (1st tier; n = 1)				
Dutch Eredivisie (1st tier; n = 1)				

Table 3. Practitioners' perceived importance of recovery objectives in descending rank order. Data are presented as frequency (%) of practitioners that ranked each objective first, second and third.

Objective	**1st**	**2nd**	**3rd**
Alleviating muscle damage/fatigue	24	12	10
Minimise injury-risk	19	14	5
Performance optimisation	13	11	4
Nutrition centred	5	7	8
Readiness for upcoming match	10	6	3
Facilitate adaptation	8	6	4
Conditioning maintenance	3	4	6
Psychological relief	5	1	6
Sleep centred	6	4	2
Health focused	4	2	3
Total (%)	**97**	**67**	**51**

Note. In ranking positions where totals do not reach 100%—the remaining % represents the frequency of blank responses.

Table 4. Distribution of use and the perceived effectiveness rating of each recovery strategy. Data are presented as the proportion (%) of practitioners that use a strategy on a specific day across a weekly microcyle.

Recovery strategy	MD-3	MD-2	MD-1	MD	MD+1	MD+2	MD+3	Use	Perceived effectiveness
Active recovery	14	19	18	19	71	53	16	97	7.9 ± 1.8
Structured recovery day	16	4	4	3	58	34	4	94	8.3 ± 1.6 *■
Extra rest day	8	5	3	4	56	41	6	94	8.3 ± 1.8 **■
Massage	41	41	55	48	69	55	38	92	6.9 ± 2.0
Cold water therapy	26	29	23	65	63	25	19	91	7.6 ± 1.7
Carbohydrate provision	38	38	53	81	53	38	38	90	8.3 ± 1.5
Enhance immunity/Illness prevention	16	15	28	46	50	35	23	87	7.5 ± 2.2
Protein provision	49	46	45	71	66	63	46	85	8.2 ± 1.5 **■
Compression garments	18	16	28	46	49	34	19	72	6.4 ± 2.0
Hot therapy	23	19	10	14	43	20	16	69	5.8 ± 2.3
Sleep hygiene	18	16	48	34	38	16	13	66	7.2 ± 1.9
Intermittent pneumatic compression	16	15	15	28	41	25	13	57	6.3 ± 1.8
Melatonin/Circadian®	4	6	23	20	13	4	4	40	5.8 ± 1.2
Sleep medication	1	6	19	26	4	1	3	34	4.7 ± 2.7 **▲
Non-steroidal anti-inflammatory drugs	8	9	24	33	13	10	10	32	5.0 ± 2.9
Mean	**23**	**23**	**29**	**37**	**47**	**32**	**20**	**73**	**6.9 ± 1.9**

▲ Represents a medium association, ■ represents a large association.

* Represents a significant association between frequency of use and perceived effectiveness at $p < 0.05$.

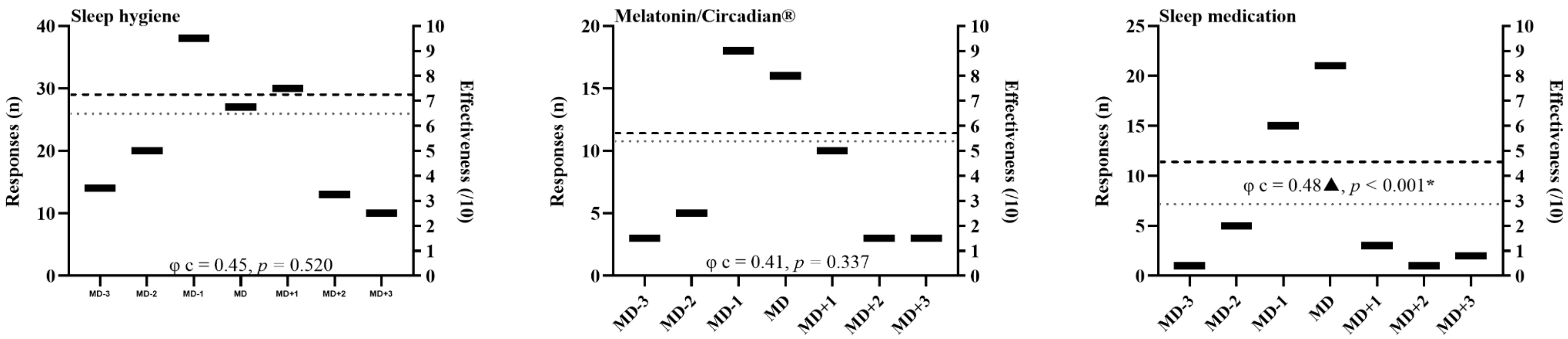
** Represents a significant association between frequency of use and perceived effectiveness at $p < 0.01$.

Table 5. The survey contribution of key staff members and the number that use each of the recovery strategies across the weekly microcycle

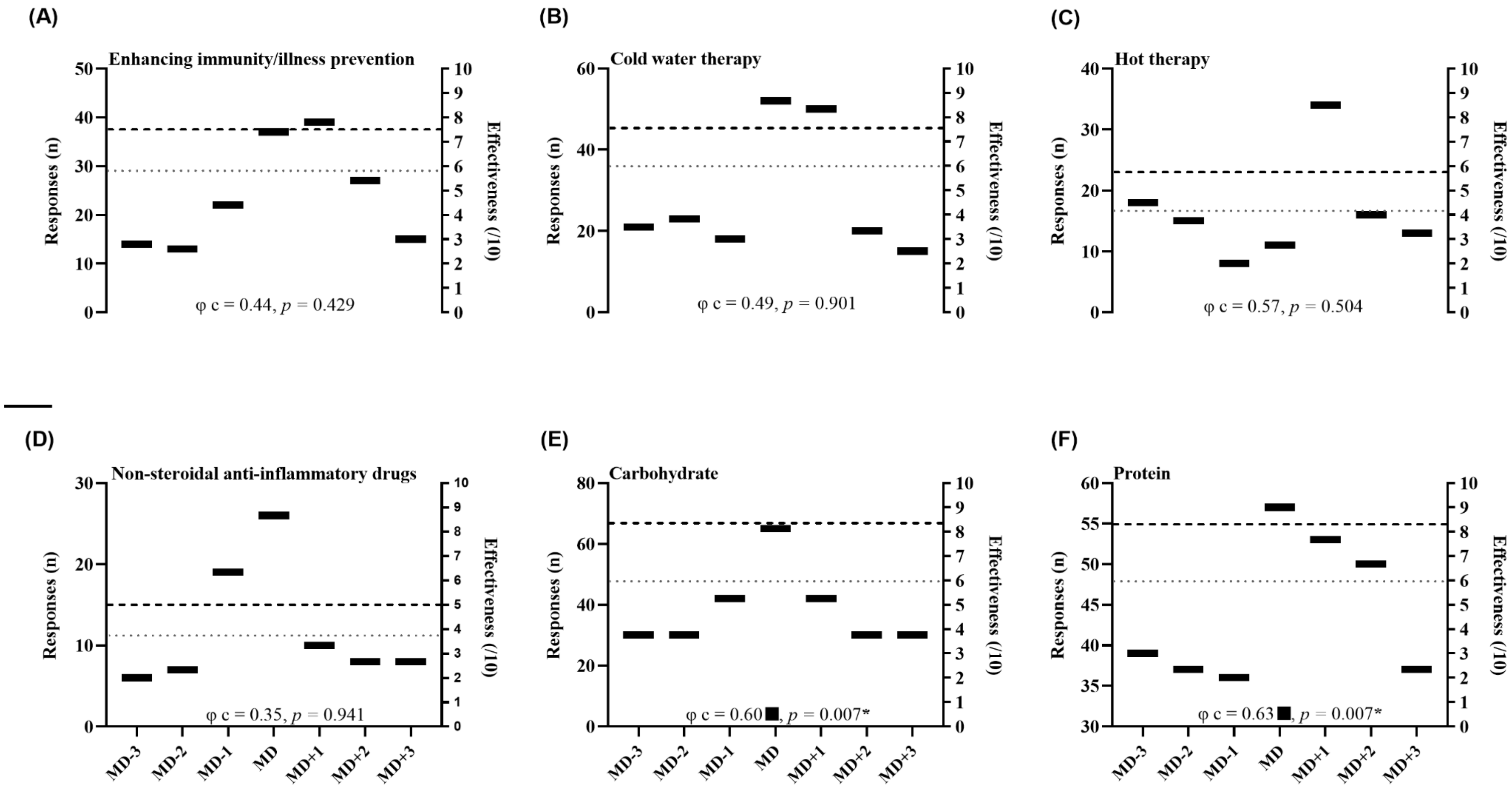
Recovery strategy (Number reporting use of a strategy)	Science Staff (n = 32)	Medical Staff (n = 33)	Coaching staff (n = 15)	Science staff vs Medical staff (%)	Science staff vs Coaching staff (%)	Medical staff vs Coaching staff (%)
Sleep hygiene (n = 53)	24	24	5	75 vs 73	75 vs 33	73 vs 33
Melatonin/ Circadian® (n = 32)	11	18	3	34 vs 55	34 vs 20	55 vs 20
Sleep medication (n = 26)	10	13	3	31 vs 39	31 vs 20	39 vs 20
Immunity/ Illness (n = 70)	29	31	10	91 vs 94	91 vs 67	94 vs 67
Cold water therapy (n = 73)	31	28	14	97 vs 85	97 vs 93	85 vs 93
Hot therapy (n = 55)	23	30	5	72 vs 91	72 vs 33	91 vs 33
Massage (n = 74)	31	33	10	97 vs 100	97 vs 67	100 vs 67
Active recovery (n = 78)	31	32	15	97 vs 97	97 vs 100	97 vs 100
Compression garments (n = 58)	28	20	10	88 vs 61	88 vs 67	61 vs 67
Intermittent pneumatic compression (n = 27)	9	15	3	28 vs 45	28 vs 20	45 vs 20
Non-steroidal anti-inflammatory drugs (n = 26)	2	23	1	6 vs 70	6 vs 7	70 vs 7
Carbohydrate (n = 72)	30	28	14	84 vs 85	82 vs 93	85 vs 93
Protein (n = 68)	28	26	14	88 vs 79	88 vs 93	79 vs 93
Extra rest day (n = 75)	31	30	14	97 vs 91	97 vs 93	91 vs 93
Structured recovery day (n = 75)	31	32	12	97 vs 97	97 vs 80	97 vs 80
Mean	**23**	**26**	**9**	**72 vs 77**	**72 vs 59**	**77 vs 59**

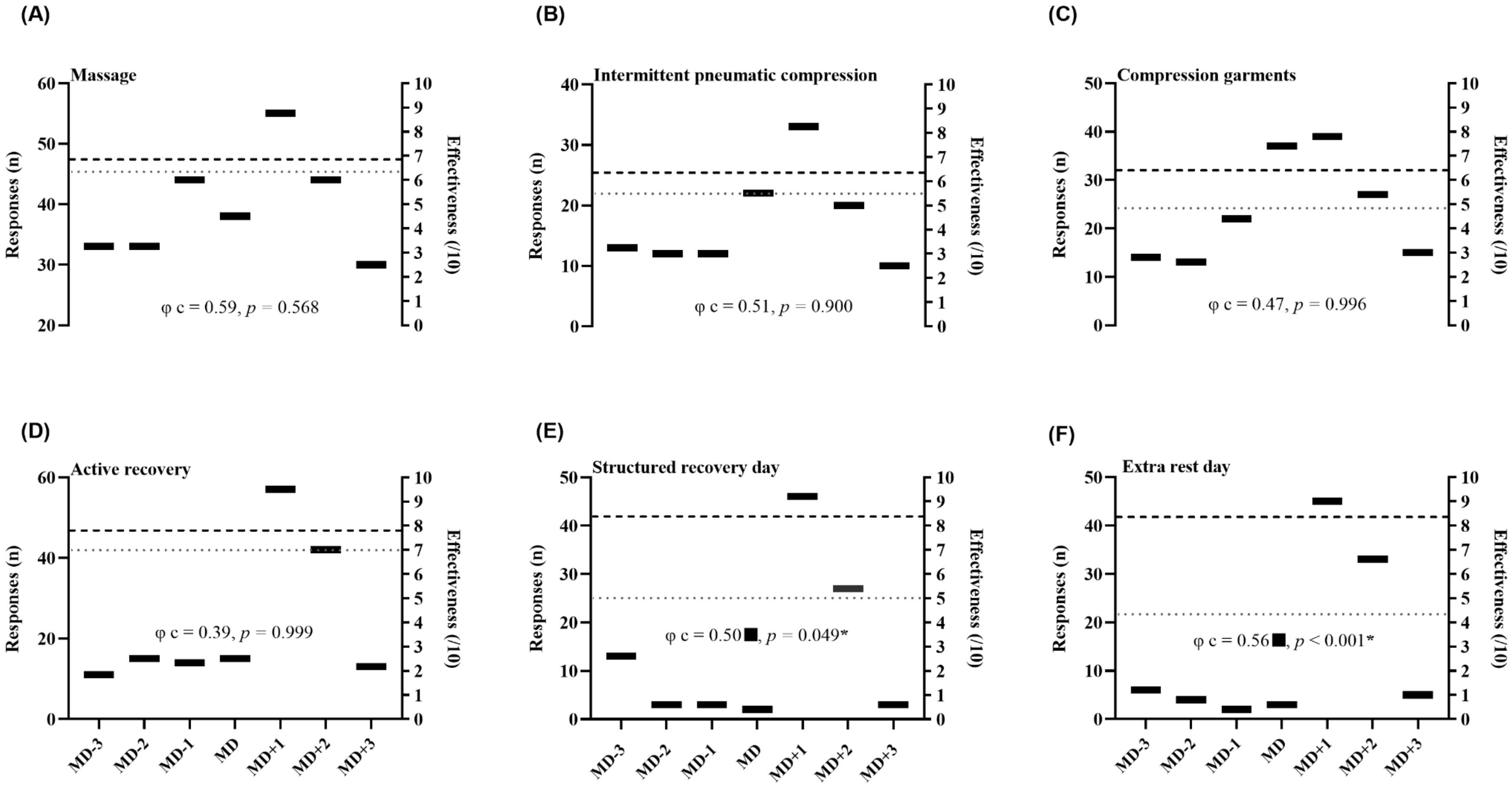
Table 6. The barriers identified as influencing recovery strategy use. Strategies are presented in descending rank order with which they were identified.

Barrier identified	Recovery strategy	Survey example/s
Hierarchical interests	Sleep hygiene (4%), Melatonin and/or Circadin® (2%), sleep medication (6%), NSAIDs (32%), carbohydrate (6%), protein (11%), structured recovery day (100%), extra rest day (100%)	"under the authority of medical staff", "doctor doesn't approve", "dietician sorts this with individuals", "managers preference", "coach decides"
Resource constraints	Sleep hygiene (30%), cold water therapy (43%), hot therapy (40%), intermittent pneumatic compression (52%), compression garments (100%)	"lack of resources to monitor or manipulate light, temp, etc", "not feasible if considered in relation to similar recovery aids", "do not have access to such facilities"
Individualised use	Sleep hygiene (24%), Melatonin and/or Circadin® (42%), sleep medication (36%), enhance immunity/prevent illness (11%), massage (100%), active recovery (100%), NSAIDs (68%), carbohydrate (11%), protein (14%)	"we will prescribe it only in case of difficulty to sleep", "we provide these interventions when players report illness", "depending on individual playing time"
Blunting adaptation	Enhance immunity/prevent illness (6%), cold water therapy (57%)	"immersion can blunt adaptation and some players are responders and others are non-responders", "we believe antioxidant-like molecules may blunt exercise adaptations and slow recovery process after exercise"
Lack of evidence	Hot therapy (60%), intermittent pneumatic compression (40%)	"I do not believe that the literature is convincing with reference to aiding recovery", "no empirical or scientific evidence of effectiveness"
Generalised approach	Enhance immunity/prevent illness (83%), carbohydrate (83%), protein (75%)	"this is a general recommendation and not able to provide specific days within the weekly schedule"
Player education	Sleep hygiene (18%), Melatonin and/or Circadin® (44%), sleep medication (42%)	"we provide education for players to practice this to become a daily habit"
Player compliance	Sleep hygiene (18%), Melatonin and/or Circadin® (2%), sleep medication (4%)	"lack of players co-operation", "players reluctant to take medication"
Dependency concerns	Melatonin and/or Circadin® (8%), sleep medication (10%)	"I do not want my players developing a reliance on this hormone to sleep"
Other priorities	Sleep hygiene (6%), Melatonin and/or Circadin® (2%), sleep medication (2%)	"developing/focusing on other areas within the team at this moment"
Practitioner knowledge	Intermittent pneumatic compression (8%)	"I do have much knowledge in relation to such systems"



Sleep hygiene
Responses (n)
Effectiveness (/10)
φ c = 0.45, p = 0.520
MD-3
MD-2
MD-1
MD
MD+1
MD+2
MD+3
Melatonin/Circadian®
Responses (n)
Effectiveness (/10)
φ c = 0.41, p = 0.337
MD-3
MD-2
MD-1
MD
MD+1
MD+2
MD+3
Sleep medication
Responses (n)
Effectiveness (/10)
φ c = 0.48▲, p < 0.001*
MD-3
MD-2
MD-1
MD
MD+1
MD+2
MD+3


(A)
Enhancing immunity/illness prevention
Responses (n)
Effectiveness (/10)
φ c = 0.44, p = 0.429
(B)
Cold water therapy
Responses (n)
Effectiveness (/10)
φ c = 0.49, p = 0.901
(C)
Hot therapy
Responses (n)
Effectiveness (/10)
φ c = 0.57, p = 0.504
(D)
Non-steroidal anti-inflammatory drugs
Responses (n)
Effectiveness (/10)
φ c = 0.35, p = 0.941
(E)
Carbohydrate
Responses (n)
Effectiveness (/10)
φ c = 0.60■, p = 0.007*
(F)
Protein
Responses (n)
Effectiveness (/10)
φ c = 0.63■, p = 0.007*
MD-3
MD-2
MD-1
MD
MD+1
MD+2
MD+3



(A)
Massage
Responses (n)
Effectiveness (/10)
φ c = 0.59, p = 0.568
(B)
Intermittent pneumatic compression
Responses (n)
Effectiveness (/10)
φ c = 0.51, p = 0.900
(C)
Compression garments
Responses (n)
Effectiveness (/10)
φ c = 0.47, p = 0.996
(D)
Active recovery
Responses (n)
Effectiveness (/10)
φ c = 0.39, p = 0.999
(E)
Structured recovery day
Responses (n)
Effectiveness (/10)
φ c = 0.50, p = 0.049*
(F)
Extra rest day
Responses (n)
Effectiveness (/10)
φ c = 0.56, p < 0.001*
MD-3
MD-2
MD-1
MD
MD+1
MD+2
MD+3