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2

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4

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6

7 **Authors:** Adam Field<sup>1</sup>, Liam D. Harper<sup>1</sup>, Bryna C.R. Christmas<sup>2</sup>, Peter M. Fowler<sup>3</sup>, Alan  
8 McCall<sup>4,5</sup>, Darren J. Paul<sup>6</sup>, Karim Chamari<sup>7</sup>, Lee Taylor<sup>8,9,10,6\*</sup>

9

10 <sup>1</sup>University of Huddersfield, School of Human and Health Sciences, Huddersfield, HD1 3DH,  
11 United Kingdom.

12 <sup>2</sup>Qatar University, College of Education, Department of Physical Education, Doha, Qatar.

13 <sup>3</sup>Queensland University of Technology, School of Exercise and Nutrition Sciences, Brisbane,  
14 Australia.

15 <sup>4</sup>Arsenal Football Club, Research & Development Department, London, UK.,

16 <sup>5</sup>Edinburgh Napier University, Research & Development Department, Edinburgh, UK.

17 <sup>6</sup>ASPETAR – Athlete Health and Performance Research Centre, Qatar Orthopaedic and Sports  
18 Medicine Hospital, Doha, Qatar.

19 <sup>7</sup>ASPETAR – Aspetar Sport Injury and Illness Prevention Programme (ASPREV), Qatar  
20 Orthopaedic and Sports Medicine Hospital, Doha, Qatar.

21 <sup>8</sup>Loughborough University, School of Sport, Exercise and Health Sciences, Loughborough,  
22 UK.

23 <sup>9</sup>University of Technology Sydney (UTS), Human Performance Research Centre, Sydney,  
24 Australia.

25 <sup>10</sup>University of Technology Sydney (UTS), Sport & Exercise Discipline Group, Faculty of  
26 Health, Sydney, Australia.

27

28 **\*Author responsible for correspondence:**

29 Dr Lee Taylor, School of Sport, Exercise and Health Sciences, Loughborough University,  
30 Epinal Way, Loughborough, LE11 3TU UK, (+44) 1509 226388, [l.taylor2@lboro.ac.uk](mailto:l.taylor2@lboro.ac.uk)

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38

39 **Abstract**

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

62 **Key words**

63 Football · Practitioner · Coach · Applied practice · Qualitative research

64

65

## 66 **Introduction**

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

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

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

## 94 **Methods**

### 95 *Participants*

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

### 105 *Survey*

106 The survey was created using an online resource (Qualtrics.<sup>XM</sup> online software, Utah, USA;  
107 <https://www.qualtrics.com/uk/>). The questions were developed based on the research teams'

108 experience of working in professional soccer, knowledge of the literature and previous  
109 experience of survey design. The questions were piloted within the research team and two  
110 external practitioners to check face validity. Three new questions were subsequently added,  
111 one question type was rephrased to improve clarity and another item was reformatted to  
112 enhance usability. Cronbach's alpha was employed retrospectively to measure internal  
113 consistency of each individual construct. Acceptable alpha values ranging from 0.74 (95%  
114 Confidence Interval 0.70—0.79) to 0.80 (0.74—0.83) were observed.<sup>8</sup>

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

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

### 133 ***Survey analyses***

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

142 Open-ended questions were analysed manually using inductive content analysis.<sup>10</sup> This  
143 approach involved the lead researcher reading the qualitative responses several times to ensure  
144 data familiarisation.<sup>9</sup> Responses were arranged and initially treated as independent-meaning  
145 units. Those with more than one identifiable idea were contemplated and potentially separated,  
146 with answers containing insufficient information omitted from analyses.<sup>7</sup> Comparable meaning  
147 units derived from each section of the survey were grouped into raw data themes.<sup>11</sup>  
148 Commonalities between raw data themes were identified and organised into broader sub-  
149 themes in a high order concept.<sup>12</sup> This process continued until data saturation had occurred  
150 with emergent themes developed and classified as general dimensions.<sup>7, 9</sup> To audit theme  
151 credibility, independent validation was employed by two researchers at several stages,  
152 enhancing the accuracy of data interpretation.<sup>9</sup> Where ambiguity around interpretation existed,

153 a third researcher was consulted, and constructive debate ensued until a consensus was reached.  
154 Finally, deductive analyses were carried out to affirm the authenticity of the themes developed  
155 from the inductive approach.<sup>10</sup>

### 156 *Statistical analyses*

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

### 163 **Results**

164 A total of 80 soccer practitioners fully completed the survey. An initial 100 responses to the  
165 survey were received from April 2020 to July 2020, though a further 20 respondents (20%)  
166 were excluded from analyses due to incomplete survey data. Practitioners worked for  
167 professional senior domestic league (e.g. a team in the English Premier League) teams ( $n = 52$ ,  
168 65%), international teams ( $n = 14$ , 18%), professional academy teams ( $n = 12$ , 15%) or semi-  
169 professional teams ( $n = 2$ , 3%). Table 1 details the practitioner roles at the time of completion.  
170 A full breakdown of the confederations and leagues in which teams competed is provided in  
171 Table 2.

172 \*\*\*INSERT TABLE 1\*\*\*

173 \*\*\*INSERT TABLE 2\*\*\*

### 174 *Recovery objectives*

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

177 \*\*\*INSERT TABLE 3\*\*\*

### 178 *Frequency, timing and perceived effectiveness of strategy use*

#### 179 *Sleep strategies*

180 Fifty-three practitioners (66%) used sleep hygiene, whilst the remaining ( $n = 27$ , 34%) did not  
181 implement this strategy. Many practitioners did not use Melatonin and/or Circadin<sup>®</sup> ( $n = 48$ ,  
182 60%), while the remaining respondents reported use of this strategy ( $n = 32$ , 40%). Sleep  
183 medication was used by 34% of teams ( $n = 27$ ), with the remainder not adopting this strategy  
184 ( $n = 53$ , 66%). A significant relationship was observed between perceived effectiveness and  
185 frequency of strategy use for sleep medication ( $\phi$ -c = 0.48,  $p < 0.001$ ), though no associations  
186 were identified for sleep promotion *via* sleep hygiene or Melatonin and/or Circadin<sup>®</sup>. Sleep  
187 hygiene and Melatonin and/or Circadin<sup>®</sup> were implemented most frequently on MD-1, whilst  
188 sleep medication was prescribed mostly on MD (Figure 1).

189 \*\*\*INSERT FIGURE 1\*\*\*

190 *Enhancing immunity and illness prevention*

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

195 *Hydrotherapy strategies*

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

202 *Non-steroidal anti-inflammatory drugs*

203 Twenty-six teams (32%) used NSAIDs, though non-adoption was more commonly reported (n  
204 = 54, 68%). Frequency of use was not linked with perceived effectiveness, with NSAIDs  
205 mostly adopted on MD.

206 *Nutritional strategies*

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

212 \*\*\*INSERT FIGURE 2\*\*\*

213 *Massage and active recovery*

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

217 *Compression strategies*

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

223 *Extra rest day and structured recovery day*

224 Most teams used an extra rest day and a structured recovery day (both, n = 75, 94%), with  
225 fewer reportedly not using these strategies (both, n = 5, 6%). The strategies were largely

226 implemented on MD+1, with significant relationships between frequency of use and perceived  
227 effectiveness identified for an extra rest day ( $\phi$ -c = 0.56,  $p < 0.001$ ) and a structured recovery  
228 day ( $\phi$ -c = 0.50,  $p = 0.049$ ).

229 \*\*\*INSERT FIGURE 3\*\*\*

## 230 Discussion

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

247 \*\*\*INSERT TABLE 4\*\*\*

248 Strategies used to promote sleep were not perceived to be effective, nor used frequently within  
249 a 7-day microcycle. Contrary to the current findings, contemporary survey research  
250 demonstrates that sleep is widely regarded as the most effective strategy by  
251 practitioners/coaches in individual<sup>14</sup> and team sports<sup>15, 16</sup>, and the most commonly employed  
252 strategy in soccer.<sup>17</sup> A separate assessment in Division 1 North-American collegiate athletes  
253 identified sleep as the most effective strategy, yet was used by few (~20%) of the team sport  
254 athletes surveyed.<sup>18</sup> It is acknowledged that the contrasting observations are likely  
255 multifaceted, but are possibly attributed to the differentiation of sleep strategies (hygiene,  
256 remedies, medication, etc.) in the current study versus generalising sleep in the previous  
257 investigations.<sup>14, 15, 17, 18</sup> An extensive array and quantity of barriers were reported for sleep  
258 promotion versus all other strategies in the present study, with the most consistent theme being  
259 that sleep strategies were specific to individual athletes. This directly opposes evidence  
260 suggesting recovery strategies are typically orchestrated for an entire team, as opposed to  
261 managed on an individual basis.<sup>2</sup> Therefore, considering the large inter-individual variation in  
262 player sleep habits and patterns<sup>19</sup>, the revelation that sleep strategies are individualised is  
263 endorsed by the literature<sup>2, 19, 20</sup> and can support practitioner decision-making to promote  
264 favourable sleep onset and maintenance moving forward. Interestingly, although culture-  
265 specific nuances have shown to further reduce the time available for sleep<sup>21</sup>, cultural barriers  
266 were not reported in the current research, possibly due to the increasingly common cross-  
267 cultural players and staff operating within elite soccer. It was also revealed that sleep  
268 facilitation strategies are predominantly implemented on the night prior to (MD-1), and on the



269 night of a match (MD; Figure 1). Such timing of use appears prudent, since sleep is integral for  
270 optimal performance<sup>19, 21</sup> and recovery management.<sup>21, 22</sup> Therefore, the trend for microcycle  
271 prescription of sleep facilitation strategies can be useful for practitioners to periodise and  
272 structure weekly training schedules.

273 Cold water therapies were perceived to be effective ( $7.6 \pm 1.7$ ), but there was a lack of  
274 association with its frequency of use (Table 4). The discrepancy between perceived  
275 effectiveness and strategy application is consistent with contemporary survey research  
276 involving athletes<sup>15, 18</sup> and coaches.<sup>1, 14</sup> Cold water therapy is reported to reduce muscle  
277 soreness<sup>23</sup> and enhance performance<sup>24</sup>, with conflicting reports that regular cold water  
278 immersion and interference of the natural cellular processes involved with repair and  
279 regeneration may hinder long-term chronic adaptations.<sup>25</sup> However, context should be applied  
280 when prescribing cold water therapy treatments as the influence of this strategy on exercise  
281 performance and adaptations are distinct<sup>26</sup>, and as such, the prescription of cold-water  
282 treatments should be largely dependent on the stage of the season. For instance, during pre-  
283 season, adaptation to training is key, with cold water treatments perhaps blunting the adaptive  
284 responses.<sup>25</sup> However, amid fixture-dense schedules, priority should be performance recovery  
285 (as opposed to concerns regarding adaptations) for the subsequent match<sup>3</sup>, with cold water  
286 techniques having some efficacy in these regards.<sup>24</sup> Therefore, the lack of compatibility  
287 between perceived effectiveness and use of a strategy, both in the current and previous studies<sup>1,  
288 14, 15, 18</sup>, is likely reflective of the equivocal evidence base and lack of explicit evidence-led  
289 recommendations endorsing the strategy for accelerating recovery and performance  
290 enhancement. Therefore, it is unclear on what grounds practitioners make their recovery  
291 strategy choices, though previous research reveals that the practicality and accessibility of a  
292 recovery modality also influences its application which possibly explains the inconsistencies  
293 between the current scientific literature and industry practice.<sup>1</sup> Therefore, the revelation that  
294 resource constraints was a common challenge to cold therapy implementation in the present  
295 study supports the logistical challenges that hinder practice, rather than whether the strategy is  
296 perceived to be effective. It is advised that teams at a resource disadvantage (e.g., non-elite  
297 populations) seek feasible surrogates to cryotherapy chambers and plunge pools (e.g., cost-  
298 effective ice-bath containers or cold showers etc). However, although overcoming this  
299 logistical challenge for those with effective perceptions of cold water treatments is feasible,  
300 maintaining optimal water temperature is imperative<sup>24, 25</sup>.

301 Out of the 80 respondents, 70 used strategies to enhance immunity/prevent illness (zinc, sleep,  
302 probiotics), which was prescribed frequently across the weekly schedule, though most common  
303 on MD and MD+1 (Figure 2). Studies have reported that performing  $\geq 90$  min of high-intensity  
304 exercise reduces circulating lymphocytes, suppresses immune function and increases  
305 susceptibility to illnesses such as upper respiratory tract infection.<sup>27</sup> Although the findings are  
306 derived from a different exercise stimulus, the activity profile of soccer match-play is largely  
307 comparable (i.e.,  $\geq 90$  min of high-intensity exercise). Therefore, the timing of adoption in the  
308 current study (i.e., acute use following matches) suggests that some practitioners prescribe such  
309 strategies (e.g., vitamin C, E and B6 supplementation) to acutely (i.e., reactively) stimulate an  
310 immune response based on data from other modalities. This is concerning as a reactive  
311 approach to enhancing immunity and preventing illness may not be favourable for overall  
312 health and athlete recovery.<sup>7</sup> However, contrastingly, the qualitative findings suggest that the  
313 strategy is prescribed as a 'generalised approach' (i.e., daily). Although this contradicts the  
314 quantitative data, this suggests that some practitioners proactively promote this strategy across  
315 the training week. Therefore, according to the qualitative responses, these strategies are not  
316 only viewed as recovery enhancing, but also applied daily with an agenda to prevent illness

317 and augment immune function. As such, the premise that recovery is part of a wider strategy  
318 to facilitate the holistic health and well-being of an athlete is a positive finding. Moving  
319 forward, a long-term approach to behavioural changes and player education on illness  
320 prevention strategies is advised. However, the high ratings of effectiveness ( $7.5 \pm 2.2$ ) may be  
321 counterintuitive to the evidence-base given the absence of research investigating illness  
322 prevention techniques and their impact as recovery strategies in professional soccer. Thereby,  
323 it appears that practitioners use this strategy based on general health recommendations or  
324 experience of working in the field, with such application possibly not considered optimal for  
325 recovery and performance.<sup>7</sup> As such, it is apparent that practitioners may know what strategy  
326 they wish to employ yet practically be unable to implement it and/or high-quality externally-  
327 valid evidence may not be available to inform their practice. A key take-home message,  
328 therefore, from these data is not that practitioners are making ill-informed decisions, but rather  
329 they are likely not able to employ the precise recovery strategies they wish, and the currently  
330 available research does not facilitate evidence-based practice.

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

348 \*\*\*INSERT TABLE 5\*\*\*

349 Hierarchical challenges, resource constraints and interference with adaptive responses were  
350 cited as major barriers to uptake. To tackle the staffing and cost-related barriers, those assigned  
351 with recovery promotion should communicate effectively to ensure strategy use is directed  
352 towards the best interests of the player and cost-effective solutions are implemented. Barriers  
353 specific to individual strategies are discussed above, though using strategies on an individual  
354 player basis was applicable to 9 out of 15 strategies. This is an encouraging finding as failing  
355 to tailor strategies to meet specific athlete needs may hinder recovery due to the large inter-  
356 individual variation for regeneration periods<sup>2</sup>, thus, where appropriate, individualised practice  
357 is recommended.<sup>18</sup> Strategy adoption was also found to be limited by a paucity of scientific  
358 evidence (e.g., “no empirical or scientific evidence of effectiveness”). Empirical research has  
359 also demonstrated that athlete preferences do not closely align with scientific  
360 recommendations.<sup>15</sup> Therefore, it is important to consider that practitioners may endeavour to  
361 execute recovery protocols based on robust evidence, although, player-related barriers (player  
362 compliance, dependency concerns and player education) can prevent implementation. In order  
363 to facilitate evidence-informed use of recovery strategies, research should be easily accessible

364 to practitioners (open-access journals) and geared towards addressing some of the player-  
365 centred barriers identified from the survey (Table 6).

366 \*\*\*INSERT TABLE 6\*\*\*

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

## 385 **Practical applications**

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

## 395 **Conclusions**

396 These novel questionnaire data offer a practically appropriate initial step towards providing  
397 applied insights into recovery strategy use in professional soccer. Synergy between the highest  
398 ranked recovery objectives and performance-facing data-driven challenges to practice are  
399 evident. Although, the underlying factors influencing the coaches' value of a strategy are  
400 unclear, the mismatch between strategy adoption and perceptions of effectiveness are evident.  
401 Utilising recovery interventions based on accessibility or anecdotal experiences rather than  
402 scientific sources is likely to be detrimental for optimising player recovery. This substantiates  
403 the need for education programmes designed to guide practitioners in making evidence-  
404 informed decisions. The novelty associated with detailing distribution of each strategy  
405 throughout the training week can be used by practitioners to carefully design 7-day schedules  
406 around optimising recovery. The survey findings also provide information about the challenges  
407 in research translation across varying playing levels and soccer leagues, with researchers

408 advised to accommodate practitioner barriers to carefully develop apposite study designs with  
409 translation potential. Those responsible for the application of recovery within their team must  
410 engage with the scientific literature to provide evidence-led recovery strategy practice targeted  
411 at optimising player recovery, holistic health and well-being, and performance. Ultimately, in  
412 order to implement effective recovery promotion techniques, it is advised that practitioners  
413 work across staff disciplines and closely with players to ensure practices are player-centred, a  
414 holistic approach to recovery is taken and factors that challenge the application of recovery  
415 strategies are addressed.

## 416 **Acknowledgements**

417 The authors would like to acknowledge the practitioners who willingly gave their time to  
418 complete the survey.

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507 **Figure captions**

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

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

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

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

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

**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)

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

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**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.

<b>Objective</b>	<b>1st</b>	<b>2nd</b>	<b>3rd</b>
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
<b>Total (%)</b>	<b>97</b>	<b>67</b>	<b>51</b>

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

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**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 microcycle.

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
<b>Mean</b>	<b>23</b>	<b>23</b>	<b>29</b>	<b>37</b>	<b>47</b>	<b>32</b>	<b>20</b>	<b>73</b>	<b>6.9 ± 1.9</b>

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

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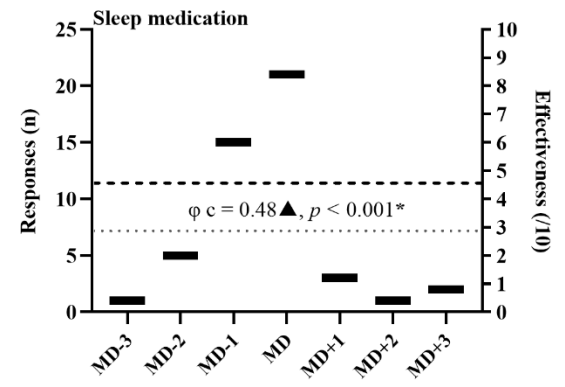
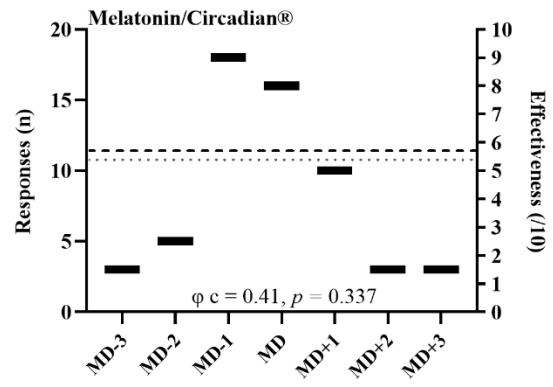
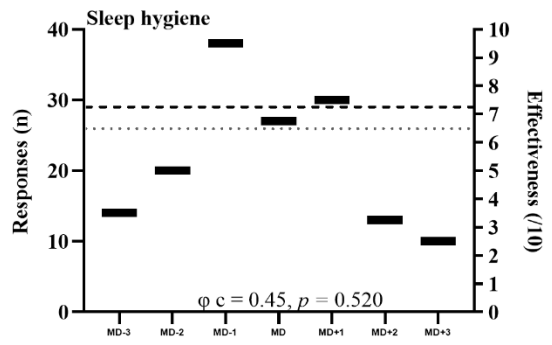
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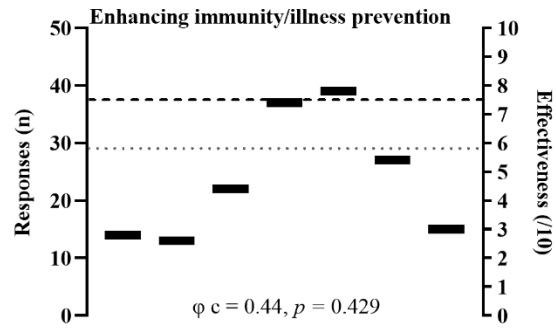
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**Table 6.** The barriers identified as influencing recovery strategy use. Strategies are presented in descending rank order with which they were identified.

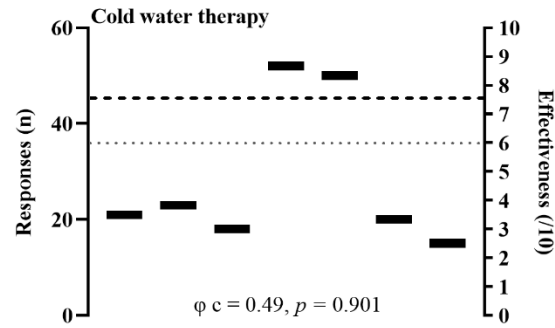
<b>Barrier identified</b>	<b>Recovery strategy</b>	<b>Survey example/s</b>
<b>Hierarchical interests</b>	Sleep hygiene (4%), Melatonin and/or Circadin <sup>®</sup> (2%), sleep medication (6%), NSAIDs (32%), carbohydrate (6%), protein (11%), structured recovery day (100%), extra rest day (100%)	“under the authority of medical staff”, “doctor doesn’t approve”, “dietician sorts this with individuals”, “managers preference”, “coach decides”
<b>Resource constraints</b>	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”
<b>Individualised use</b>	Sleep hygiene (24%), Melatonin and/or Circadin <sup>®</sup> (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”
<b>Blunting adaptation</b>	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”
<b>Lack of evidence</b>	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”
<b>Generalised approach</b>	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”
<b>Player education</b>	Sleep hygiene (18%), Melatonin and/or Circadin <sup>®</sup> (44%), sleep medication (42%)	“we provide education for players to practice this to become a daily habit”
<b>Player compliance</b>	Sleep hygiene (18%), Melatonin and/or Circadin <sup>®</sup> (2%), sleep medication (4%)	“lack of players co-operation”, “players reluctant to take medication”
<b>Dependency concerns</b>	Melatonin and/or Circadin <sup>®</sup> (8%), sleep medication (10%)	“I do not want my players developing a reliance on this hormone to sleep”
<b>Other priorities</b>	Sleep hygiene (6%), Melatonin and/or Circadin <sup>®</sup> (2%), sleep medication (2%)	“developing/focusing on other areas within the team at this moment”
<b>Practitioner knowledge</b>	Intermittent pneumatic compression (8%)	“I do have much knowledge in relation to such systems”



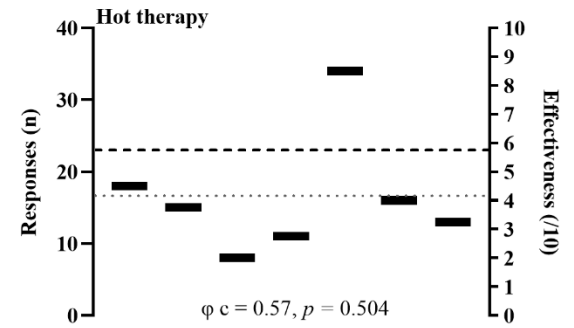
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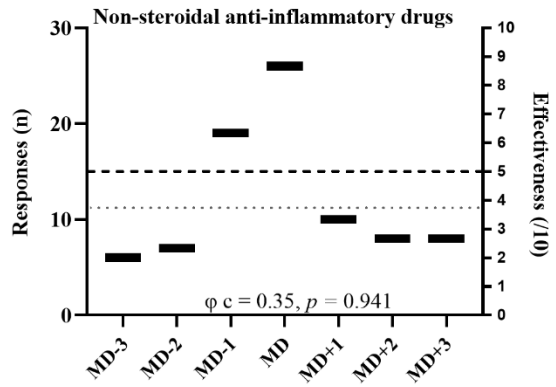
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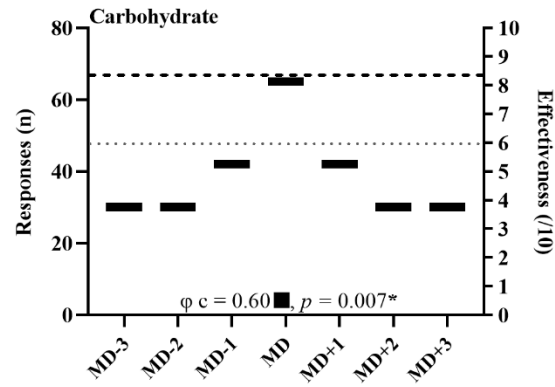
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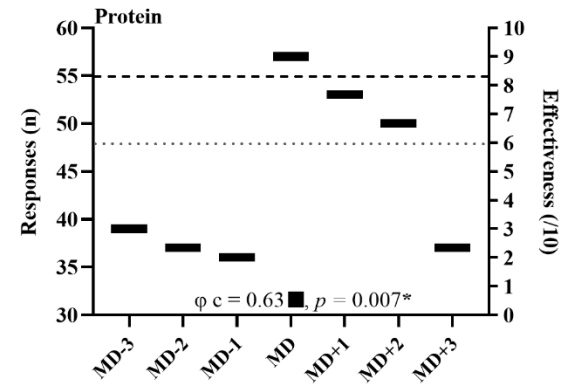
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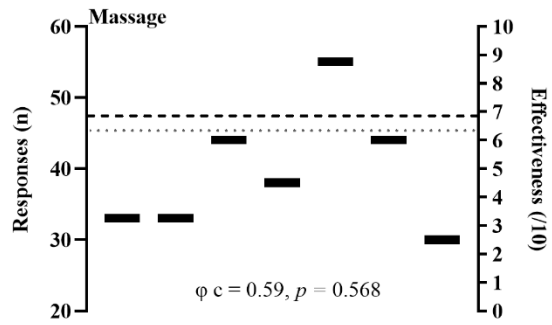
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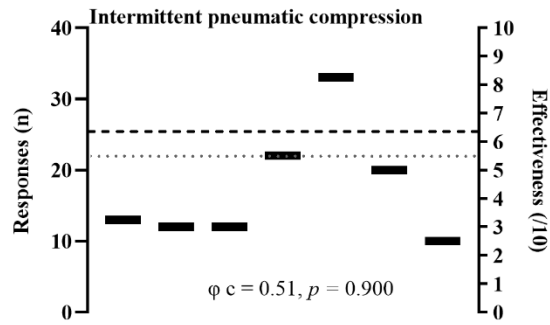
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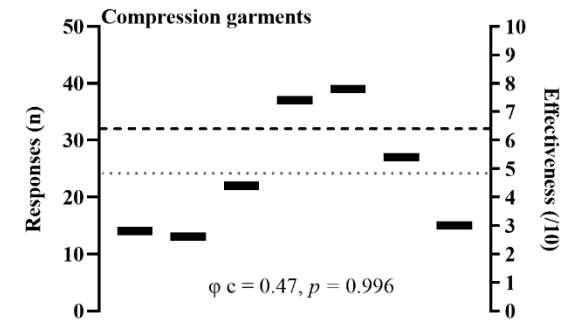
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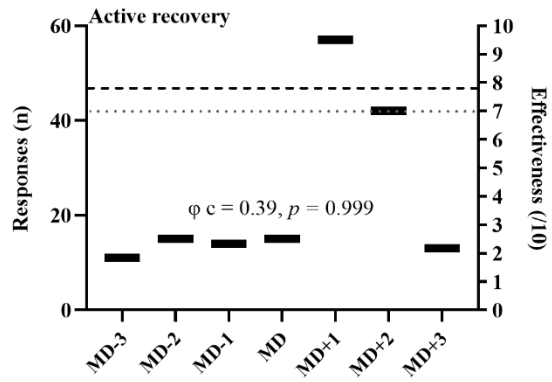
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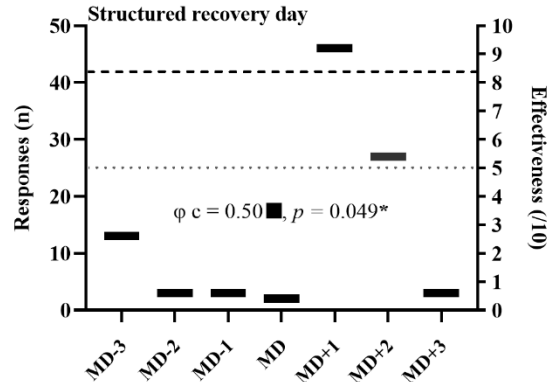
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