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Recovery practices in Division 1 collegiate athletes in North America

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1 **Title: Recovery Practices in Division 1 Collegiate Athletes in North America**

2 **Running Title:** Recovery Beliefs: D1 Athletes

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16

17 **Abstract**

18 Objectives: Establish current practice and attitudes towards recovery in a group of
19 Division-1 Collegiate athletes from North America.

20 Design: A 16-item questionnaire was administered via custom software via an
21 electronic format.

22 Participants: 152 student athletes from a Division-1 Collegiate school across 3
23 sports (Basketball, American Football, Soccer).

24 Main Outcome Measures: The approaches and attitudes to recovery in both training
25 and competition.

26 Results: Sleep, cold water immersion (CWI) and nutrition were perceived to be
27 the most effective modalities (88, 84 and 80% of the sample believed them to
28 have a benefit respectively). Over half the sample did not believe in using
29 compression for recovery. With regard to actual usage, CWI was the most used
30 recovery modality and matched by athletes believing in, and using, the approach
31 (65%). Only 24% of student athletes believed in, and used, sleep as a recovery
32 modality despite it being rated and perceived as the most effective.

33 Conclusions: Collectively, there is a discrepancy between perception and use of
34 recovery modalities in Collegiate athletes.

35

36 **Highlights**

37 - Use of recovery modalities at the collegiate level is not fully supported by
38 evidence

39 - Only a quarter of athletes both believed in, and used sleep for recovery

40 - The most used modality in both training and competition was cold water
41 immersion

42 - Two thirds of the participants relied on 'feel' to know they had recovered

43

44 **Key Words:** Belief; Cold Water Immersion; Sleep; College

45 **Introduction**

46 North American Division 1 (D1) Collegiate athletes compete in
47 unique circumstances; with a requirement to perform at a high
48 sporting level (Singer, 2008) and show their prowess on the field to
49 potentially further their professional career upon leaving college (e.g.
50 NFL). In addition to peak performance for competitive fixtures on the
51 sporting field they are typically required to do the same in academic
52 studies to maintain their eligibility (Aquilina, 2013). Student athletes
53 must balance the effects of training and the subsequent adaptation or
54 recovery periods to optimize physical condition, alongside the
55 associated mental pressures of academic studies (Romo, 2016). For
56 instance, athletes must ensure that adequate training (intensity and
57 type) is being performed to induce positive (e.g. muscular) adaption.
58 Conversely, athletes must also allow adequate recovery between these
59 sessions to both allow this supercompensation process to occur and
60 minimize the potential for injury.

61
62 While the use of recovery practices are commonplace in diverse
63 athletic populations, recovery remains an under-researched area
64 relative to training and competition, with many practices currently
65 used in applied settings not fully supported by peer-reviewed evidence

66 (Simjanovic, Hooper, Leveritt, Kellmann, & Rynne, 2009). This is
67 somewhat understandable given the multi-dimensional components of
68 recovery and that practitioners are typically early adopters of new
69 technology and training methods with the aim of gaining a
70 competitive advantage (Coutts, 2016). Indeed, despite numerous post-
71 exercise recovery options currently available for athletes (Crowther,
72 Sealey, Crowe, Edwards, & Halson, 2017), there remains no clear
73 definition of the most ‘appropriate’ modality, protocol and timing
74 according to the level of the athlete and their training goals (Barnett,
75 2006; Kellmann et al., 2018). Interestingly, there has been little
76 investigation into the attitudes and beliefs associated with the choice
77 and use of these practices – particularly within a collegiate setting.
78 For instance, many coaches/practitioners implement recovery
79 strategies without truly assessing the cost-benefit of such an approach
80 (Murray, Turner, Sproule, & Cardinale, 2017). They may implement
81 strategies based on personal experience rather than research evidence
82 (Simjanovic et al., 2009).

83

84 Recent work has shown that athletes may not be aware of the intended
85 effects of a specific recovery modality on their physical status though
86 around two-thirds perform some type of recovery after sport

87 (Crowther et al., 2017). Anecdotal evidence suggests that it is typical
88 for D1 student-athletes to follow the direction of their technical and/or
89 strength coach, rather than display autonomous thought, around the
90 choice of recovery practice, which may reflect the coach-athlete
91 relationship (Murray et al., 2017). It is clear that negative subjective
92 impressions of a recovery intervention have been shown to impact its
93 effectiveness (Higgins, Heazlewood, & Climstein, 2011). Spanish
94 basketball players were shown to have varying perception of recovery
95 strategies and so individual approaches were recommended (Moreno,
96 Ramos-Castro, Rodas, Tarragó, & Capdevila, 2015). Knowledge of
97 athletes' perceptions, regarding recovery strategies, within a collegiate
98 setting, would be useful in maximising athlete compliance with and
99 belief in particular modalities and help create better education
100 practices around recovery for optimal performance.

101

102 Integrating athletes' belief systems into their recovery, or developing
103 education programs around a chosen method, may contribute to
104 planning more effective interventions and aid selection strategies for
105 implementation (Van Wilgen & Verhagen, 2012). For instance, while
106 athletes in one sport or group may have a tendency to act
107 homogeneously in regards to recovery practices, the reasons for this

108 may be affected by the immediate environment and climatic
109 conditions, which in turn affects their beliefs (Institute of Medicine &
110 National Research Council, 2011). Given the limitations on current
111 knowledge around the interaction of these factors, the purpose of this
112 study was to establish current practice around and attitudes towards
113 recovery in a group of D1 Collegiate athletes from North America.

114

115 **Methods**

116 *Participants*

117 A convenience sample of 152 athletes from a D1 college across 3
118 sports (Men's Basketball $n=10$, Men's Football $n=116$, Women's
119 Soccer $n=26$) participated in this study. A total of 161 athletes were
120 invited across the 3 team rosters (9 declined to complete the survey;
121 response rate of 94%). There was no penalty for not completing the
122 survey. Participants were invited to complete the study over a 2-
123 month period (September & October 2016) with a requirement for it
124 to be completed only once. The support staff for each team differed
125 and so there were no common influencers on the student athletes
126 across sports. The age range of the participants was between 18 and
127 24 years (20.5 ± 1.5 years). The study had ethical approval from the

128 Moray House School of Education, University of Edinburgh, Ethics
129 Committee and the rights of the participants were protected.

130

131 ***Experimental Protocol and Procedures***

132 *Research Instrument*

133 Utilising an online questionnaire and the same approach that was
134 taken previously in an adolescent population (Murray et al., 2017) the
135 purpose of the study was to establish current practice and attitudes
136 towards recovery in collegiate athletes. Additional questions not
137 present in the original instrument were added within the *beliefs*
138 section prior to data collection on the effectiveness of foam rolling
139 and compressive massage as these are routinely used in the D1
140 population (Behara & Jacobson, 2017; Zwerling, 2014). The
141 questionnaire comprised of 17 questions in four sections:
142 *demographic information; current practice; beliefs; and evidence*
143 (Supplementary File 1). Questions utilised six open, and eleven
144 closed, answers. Subjects could return to prior questions until the
145 survey was completed.

146

147 A combination of open and closed questions was used to maximize
148 the response rate, yet enable more detail from the answers (Thomas,

149 Nelson, & Silverman, 2011). The open ended questions enabled
150 athletes to express opinions and elaborate on beliefs (Portney &
151 Watkins, 2009).

152

153 *Demographics*

154 In the first three questions the participant's name, gender and
155 experience level within their chosen sport were assessed. In terms of
156 experience, the participants chose the appropriate option from less
157 than 18 months to more than 10 years.

158

159 *Open Questions*

160 The first of the open-ended questions asked the participant which
161 sport they competed in (question 4). The next concerned the
162 participant's current practice of recovery post-training and competition
163 (questions 5 & 6). The fourth was an optional expansion on the
164 limited response of *experience*, *evidence* or *both* outlining why the
165 participant undertook the specified recovery strategy (question 8). In
166 the final evidence section, participants were asked to state how they
167 knew they had recovered (question 17).

168

169 *Closed questions*

170 The first closed question asked participants why they currently
171 undertook the specified recovery strategy, from a choice of *evidence*,
172 *experience or both* (question 7). Subsequently they were asked to rate
173 their opinion on a range of common recovery methods' effectiveness
174 (questions 9 – 16). Belief of effectiveness was assessed via closed
175 questions assessing the athlete's perceived benefit of a technique. A 5-
176 point scale of *no effect*, *minor*, *neutral*, *moderate* or *major* was used to
177 reflect the participants' beliefs. The answers were assigned a
178 numerical value (5 = most benefit, 1 = least). If the athlete rated the
179 effectiveness as 4 or 5 then this was coded as a *benefit* otherwise it
180 was coded as *no benefit*. Answers coded as 3 remained *neutral*. This
181 reduction to nominal levels (Lavrakas & Battaglia, 2008) was taken
182 to avoid any bias from central tendency, acquiescence or social
183 desirability.

184

185 **Statistical Analyses**

186 The absolute values of responses were calculated from the
187 information contained in the returned questionnaires. For the open
188 questions, the answers were subsequently coded on completion of all
189 questionnaires by the lead author into subcategories for subsequent
190 analysis of the frequency of occurrence. Coding accounted for all

191 answers given across the sample groups. Closed questions were
192 assigned a numerical value based on their response and assessed as
193 continuous data. Analysis occurred using Minitab 17.0 (Pennsylvania,
194 USA). Differences between groups were assessed between frequency
195 of responses using the chi-square test (χ^2), one-way ANOVA or t-tests
196 of the proportional data as appropriate. A multivariate analysis was
197 made to cluster the type of recovery groups. Alpha was set at $p < 0.05$.

198

199 **Results**

200 *Demographics*

201 Across the cohort 35% had more than 10 years' experience in their
202 chosen sport. The other groups had: 3-5 years' experience (22%); 5-
203 10 years (19%); <18 months (14%); and 18 months to 3 years (10%).
204 This shows a significant greater than even split with more 10+ year
205 athletes and less athletes with <18-months (35% v 14%; $p < 0.001$).

206

207 *Effectiveness*

208 There was a significant difference in the level of belief across
209 different modalities ($p < 0.01$; table 1). There was a belief that sleep,
210 and CWI immersion could benefit recovery while the participants did
211 not believe that compression could benefit recovery (table 1).

212

213

*** Table 1 near here ***

214

Use

215

There were no significant differences between training and

216

competition for the use of any of the recovery modalities in terms of

217

frequency ($p>0.05$; table 2). Across all athletes 12 (8%) and 21 (14%)

218

reported that they did not undertake a recovery strategy.

219

220

*** Table 2 near here ***

221

222

Belief

223

Almost a quarter of the participants (24%) believed in and used sleep

224

as a recovery strategy (table 3). Around two-thirds of the sample

225

(63%) did not use sleep as a recovery strategy, despite believing in it

226

as an appropriate recovery strategy. Conversely, the belief and use of

227

cold water immersion (CWI) aligned with two-thirds of the sample

228

(65%) using and believing in CWI. Nutrition practices did not mirror

229

beliefs as 65% didn't list it as a recovery practice despite believing in

230

it. Belief in, and use of, contrast therapy did match with 62% neither

231

using nor believing in it.

232

233 *** Table 3 near here ***

234

235 *Assessment of recovery*

236 There was no difference in the number of recovery modalities used
237 after training or competition (Training: 2.3 ± 0.1 v Competition:
238 2.3 ± 0.1). The majority of athletes relied on subjective feel to
239 determine if they had recovered (59%), whereas 25% listed their
240 subsequent performance as how they determined if they had
241 recovered.

242

243 ***Reasons***

244 Most athletes indicated that they chose their method of recovery based
245 on both evidence and experience (74%); a fifth of athletes cited their
246 own experience as the main reason with only 5% using an evidence
247 base. Cluster analysis for post-training recovery responses showed 3
248 main groups in terms of their responses: a *traditional* group who
249 favoured sleep, nutrition and hydration; a *manual therapy* group who
250 favoured active recovery, massage and rest, and a *mixed-modality*
251 group who favoured hot, cold, contrast and the input of technologies
252 such as neuromuscular electrical stimulation or sequential
253 compressive massage. These groups were slightly different in post-

254 competition strategies with one group choosing active recovery, sleep,
255 nutrition, and hydration; a second group favouring massage, heat and
256 further training; and a third group using all of the intervention
257 modalities.

258

259 **Discussion**

260 This study aimed to establish current practice and attitudes towards
261 recovery in D1 Collegiate athletes. As reported in previous research
262 with older athlete populations (Crowther et al., 2017; Tavares,
263 Healey, Smith, & Driller, 2017), there are a wide range of recovery
264 modalities used by D1 collegiate athletes. The use of some of the
265 recovery modalities is not fully supported by the current evidence
266 base, for example CWI was used widely despite mixed support in the
267 literature (Tipton, Collier, Massey, Corbett, & Harper, 2017). In
268 contrast, active recovery was hardly utilised reflecting the lack of
269 evidence that active recovery enhances recovery between training
270 sessions (Barnett, 2006). There was no difference in the recovery
271 approaches used post-training and post-competition.

272

273 Importantly, we have identified some clear discrepancies between the
274 beliefs and practices of the athletes in terms of recovery, especially in

275 relation to sleep and nutrition. This data presents several interesting
276 challenges and opportunities for researchers and practitioners. In this
277 cohort of student-athletes the highest rated recovery intervention by
278 participants was sleep; however, in contrast the most used
279 intervention was cold water immersion. Furthermore, although sleep
280 was rated the most important, it was only the fourth most used
281 modality by student athletes. Two-thirds of the sample believed in
282 sleep but didn't mention it as a modality that they used to recover,
283 with only 24% of athletes believed in, and used, sleep.

284

285 Within the literature the recommendation for young adults (18-25 yrs)
286 is to get 7 to 9 hours of sleep per night (Hirshkowitz et al., 2015).
287 Recent work has suggested that due to training schedules and life
288 constraints, some athletes sleep far less than this recommendation
289 (Sargent, Halson, & Roach, 2014) and collegiate student-athletes are
290 possibly the most at-risk (healthy) population for sleep disruption
291 (Carney, Edinger, Meyer, Lindman, & Istre, 2006).

292

293 Athletes have rated sleep as critical to optimal performance (Venter,
294 2012) and recovery (Tavares et al., 2017) and in this population that
295 belief seemed to hold true. In stark contrast to this, however, only a

296 quarter of athletes both believed in, and used, sleep as a recovery
297 modality. It is possible that extraneous factors exist which may
298 compromise athletes' ability to obtain sleep. More than 70% of
299 college students have been reported to obtain less than 8 hours of
300 sleep per night during the week (Lund, Reider, Whiting, & Prichard,
301 2010). Furthermore, the commencement of university classes
302 (Hershner & Chervin, 2014) within the sportingseason could pose a
303 risk to sleep quality with early morning training starts (Fullagar,
304 Govus, Hanisch, & Murray, 2016). This threat may be accentuated at
305 times of high stress and anxiety (for example exams or end of school
306 year) (Mann, Bryant, Johnstone, Ivey, & Sayers, 2015). Other
307 possibilities could include the increase in technology use and blue
308 light providing general brain activation later in the evening (Cajochen
309 et al., 2011). However, these theories remain speculative and further
310 research is required to assess the mechanisms behind the discrepancy
311 between the belief and usage of sleep in collegiate student athletes.

312
313 There may also exist a possibility in which student-athletes
314 misinterpreted the language surrounding timing of sleep as a recovery
315 strategy. The language used in definition of activities has been shown
316 to be important in education of athletes (Banna, Richards, & Brown,

317 2016). For instance, whilst participants reported they were less likely
318 to use sleep compared to its perceived importance, they may have
319 been referring to purely sleep at night rather than the combination of
320 naps (for instance in the afternoon following an early training
321 session), or vice versa. Future analyses which depicts sleep in greater
322 detail with regards to recovery use and perceived importance would
323 aid such understanding. Athletes should understand their sleep needs
324 and should be educated regarding aspects such as sleep hygiene and
325 potential positive effects of sleep extension (Fullagar et al., 2014).

326

327 The most used modality in this population in both training and
328 competition was CWI. This is similar to international team sport
329 athletes in previous studies (Crowther et al., 2017; Venter, 2012). The
330 reported reason for using CWI in other populations was to reduce
331 swelling and inflammation (Crowther et al., 2017), although previous
332 research studies have shown that this is not the case (Ingram, Dawson,
333 Goodman, Wallman, & Beilby, 2009) and any positive effects of CWI
334 are small and more applicable to single sprints rather than endurance
335 or team sport performance (Poppendieck & Faude, 2013). Hence the
336 choice to use CWI as an intervention may be more influenced by the
337 perceived outcome; for example being perceived in a positive light as

338 has been shown in track athletes (Omoniyi et al., 2017), rather than
339 the actual physiological effect (Murray & Cardinale, 2015).

340

341 A quarter of athletes (27%) believed in, and used, foam rolling. Other
342 questionnaire based studies did not assess this modality specifically,
343 but soccer athletes have mentioned massage (Venter, 2012) to be
344 important for recovery, as did a high percentage of international team
345 sport athletes (Crowther et al., 2017). In contrast 44% of athletes
346 believed in the modality but did not use it. Foam rolling is believed to
347 have similar effects to massage which include relief of muscle tension,
348 increased flexibility and range of motion (ROM) (Cheatham, Kolber,
349 Cain, & Lee, 2015). The associated discomfort with the modality may
350 contribute to why it was not more widely used (Behara & Jacobson,
351 2017). Changing the perception of this discomfort may help with the
352 implementation. (Leknes et al., 2013)

353

354 Within an adolescent population in the UK 36-38% used foam rolling,
355 in contrast to under 5% in Asia (Murray et al., 2017). Interestingly,
356 there is limited evidence on the physiological benefits of foam rolling,
357 however some studies have shown that ROM is improved by foam
358 rolling (MacDonald et al., 2013; Macdonald, Button, Drinkwater, &

359 Behm, 2014). Longer application of foam rolling has been shown to
360 positively affect both range of motion and perceived soreness in the
361 short-term (Jay et al., 2014), although this was not in trained
362 participants. In contrast, it has been shown that a single bout of foam
363 rolling had no statistically significant effect on muscle contractility
364 markers or temperature in adolescent athletes (Murray, Jones,
365 Horobeanu, Turner, & Sproule, 2016).

366

367 Most athletes in the current sample did not use compression as a
368 recovery method. Their belief was split evenly in terms of in favour or
369 not. This concurs with previous research into the efficacy of
370 compression garments used post-exercise. Compression has produced
371 equivocal results on performance when tested on well-trained athletes
372 (Ali, Caine, & Snow, 2007; Davies, Thompson, & Cooper, 2009).

373 This though may be affected by belief status as it was found that
374 'believers' found a positive effect on performance when wearing
375 compression compared to 'non-believers', despite no significant
376 difference in muscle soreness or fatigue (Brophy-Williams, Driller,
377 Kitic, Fell, & Halson, 2016). As previously mentioned, the placebo
378 effect in sport may be present with the use of any recovery modality
379 (Beedie & Foad, 2009) and strongly influences perception of recovery

380 (Halson & Martin, 2013). This placebo effect is likely as expectancy
381 plays a major role in the success of interventions in the field of high-
382 performance sport (McClung & Collins, 2007).

383

384 While sleep is one of the few modalities that is free of cost, the
385 provision of recovery modalities at the D1 collegiate level means that
386 almost all the mentioned interventions were available, so feasibility is
387 likely less of an explanation. Within this study nutrition and hydration
388 were not noted as high use modalities, indeed 65% of athletes
389 believed in nutrition but did not utilise it in recovery. This may well
390 be as athletes viewed nutrition and hydration as part of their routine,
391 rather than a specific recovery component (for example there was no
392 conscious choice made around nutritional intake to reflect that they
393 were recovering or refuelling). This may have been due to the
394 terminology employed in the survey failing to differentiate the
395 multiple benefits for both performance and recovery. Alternatively
396 this could simply be a lack of understanding as it has been shown
397 previously that student athletes' knowledge around sport-nutrition is
398 less than adequate (Andrews, Wojcik, Boyd, & Bowers, 2016).

399

400 The choice of recovery modality in team sport players may be
401 influenced by what coaches and support staff prefer (Wyk & Lambert,
402 2009). For instance, it has been shown that a high degree of
403 confidence in a coach's capabilities predicted enhanced commitment
404 for the athlete (Rey, Lago-Peñas, Lago-Ballesteros, & Casáis, 2012).
405 Therefore, the athlete may take what the coach says as the truth, for
406 example telling them that a particular modality is effective so the
407 athlete believes in it, hence having a positive effect on the athlete's
408 attitude during subsequent training sessions (Rey et al., 2012). This
409 may be a self-perpetuating phenomenon with coaches 'doing what
410 they have always done'. This is highlighted by the majority of
411 coaches' self-directed learning occurring with other coaches and
412 colleagues and a typically negative experience from formal learning
413 (~98%) (Stoszkowski & Collins, 2015). Thus, our finding that over
414 two thirds of athletes believe in sleep, nutrition and active recovery
415 but do not utilise it, could potentially impact practice of coaches and
416 support staff at the D1 level.

417

418 Choices around recovery strategy may also be influenced by what
419 athletes have observed at higher (professional) levels, as previous
420 work has shown that athletes replicate the behaviours of the elite

421 (Crowther et al., 2017). In previous work in adolescent populations
422 this was not the case, as Asian and UK populations only utilised cold
423 as a recovery modality 13% and 23% of the time respectively in
424 training, and within Asia less than 10% used it in competition
425 (Murray et al., 2017). While speculative, this may reflect some
426 cultural difference as Asian athletes do not see this practice at a more
427 senior level and hence don't replicate it. Though this could also be
428 perceptual as there is no difference in the perception of the importance
429 of recovery between amateur and elite rugby players but there was a
430 difference in the number of modalities used in a week (24 v 6)
431 (Tavares et al., 2017).

432
433 Perceptual recovery after games has been shown to take longer than
434 96 hours to return to pre-competition levels within collegiate athletes
435 (Fullagar et al., 2016). It has also been shown that individuals are able
436 to closely predict full recovery without the need for external
437 validation (Glaister, Pattison, Dancy, & McInnes, 2012). This raises
438 important questions around monitoring of recovery as this process
439 may affect the variable itself and its efficacy (for example a push to
440 monitor sleep may affect the actual quality and quantity achieved;
441 (Van-den-Bulck, 2015)). Within this population 59% relied on how

442 they felt to know they had recovered, supporting further exploration
443 of subjectivity within recovery as has shown to be effective in athlete
444 monitoring (Saw, Main, & Gustin, 2015). Future research should
445 establish if these self-perceptions are accurate in the educated athlete
446 and remove the need for continual objective monitoring and
447 intervention.

448

449 The differences between belief and practice highlight that the
450 education of athletes across their life cycle within the collegiate
451 setting is important. Developing a curriculum of knowledge ensures
452 that senior athletes set the social norms and impact positively on the
453 younger athletes. Education around these topics may not be needed
454 whereas emphasis on other chosen modalities may provide a better
455 return on investment of time. However, further work is required to
456 demonstrate a similar pattern in other D1 schools to highlight
457 potential differences between sub-cultures, sports, investment in
458 facilities and teaching/coaching practices. Further research should
459 focus on replicating these findings following an educational
460 intervention for both athletes and support staff that focuses on
461 developing knowledge around recovery practice. Effective approaches
462 to enhance coach education and continued professional development,

463 may increase the use of evidence-based, or at least evidence-informed,
464 approaches through enhanced belief of coaches transferring to
465 increased belief and use in athletes.

466

467 ***Limitations***

468 Given the responses of this study were subjective in nature, further
469 studies which investigate objective use of recovery modalities, and the
470 subsequent effect of these modalities on either upcoming exercise
471 sessions or cognitive performance, would strengthen future applied
472 practice. Indeed, investigating the combination of perceived and
473 objective effectiveness of recovery in combination would be the most
474 robust approach and may allow a minimal clinically important
475 difference (Atkinson, 2003) to be established for modalities for both
476 perceptual and objective measures.

477

478 This study focused on a subset of recovery techniques while others are
479 available and used by athletes. Indeed, future investigations could
480 investigate other, less popular, recovery techniques such as
481 photobiomodulation (de Oliveira et al., 2017), sensory deprivation
482 (Morgan, Salacinski, & Stults-Kolehmainen, 2013) or blood flow
483 restriction (Borne, Hauswirth, & Bieuzen, 2016). Taking the

484 participants' age into further account may help assessment directly
485 related to age and stage of development. In this study, we simply
486 recruited within an age bracket. Future research from a large sample
487 across differing schools and sports may benefit from insights into the
488 differing responses – here we did not find differences in beliefs across
489 sports, but a bigger sample size is needed to individualise sports. This
490 approach may also lend itself to a more structured interview style of
491 collection to avoid any potential misunderstandings around the
492 questions posed and this may also allow exploration in more detail as
493 who the key influencers are of practice (for example individual, captain
494 or coach). This approach though would need to consider both potential
495 sport and culture differences and may need a prohibitively large sample
496 size across Colleges and levels.

497

498 ***Conclusion***

499 This study describes athletes' recovery practices within a Division 1
500 collegiate setting and highlights the discrepancies between their
501 beliefs and their implementation. Collectively, there is a discrepancy
502 between perception and use of recovery modalities in Collegiate
503 athletes. It appears that the primary variances are around the belief
504 and use of sleep and CWI for recovery. The results of this study

505 suggest that there is a need to educate athletes on the benefits of
506 different facets of recovery.

507

508 As these athletes operate at the highest level within the NCAA,
509 practitioners now have an initial source of data describing recovery
510 practice within elite level student athletes. Strength & Conditioning
511 staff, sports scientists and coaches who work with collegiate athletes
512 at all levels may use this summary as a resource to inform and
513 improve their practice. Information presented in this article may also
514 influence the design of athlete education curriculums within NCAA
515 institutions around recovery modalities.

516

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731
732

733 **Table Captions**

734

735 **Table 1:** Belief in efficacy of treatments. Overall rating is a numerical
736 value out of 5 based on 5=most benefit, 1=least). For belief groups the
737 % of the overall sample and response count (in brackets) is given.

738

739 **Table 2:** Use of treatments. For each situation, the % of the overall
740 sample who used the treatment and the response count (in brackets) is
741 given.

742

743 **Table 3:** Belief of treatments relative to use. For each situation, the %
744 of the overall sample is given.

745

746 **Table 1**

| | <i>Overall rating</i> (/5) | <i>Benefit</i> % (#) | <i>Neutral</i> % (#) | <i>No Benefit</i> % (#) |
|----------------------------|-------------------------------|-------------------------|-------------------------|----------------------------|
| <i>Sleep</i> | 4.54 ^A | 87.5 (133) | 9.2 (14) | 3.3 (5) |
| <i>CWI</i> | 4.23 ^{A,B} | 83.6 (127) | 10.5 (16) | 5.9 (9) |
| <i>Nutrition</i> | 4.19 ^B | 79.6 (121) | 16.4 (25) | 3.9 (6) |
| <i>Contrast</i> | 3.99 ^{B,C} | 75.0 (114) | 19.1 (29) | 5.9 (9) |
| <i>Foam Roll</i> | 3.84 ^{C,D} | 71.1 (108) | 22.4 (34) | 6.6 (10) |
| <i>Compressive Massage</i> | 3.78 ^{C,D} | 65.8 (100) | 23.7 (36) | 10.5 (16) |
| <i>Active</i> | 3.75 ^{C,D} | 65.1 (99) | 28.3 (43) | 6.6 (10) |
| <i>Compression</i> | 3.61 ^D | 7.2 (11) | 38.8 (59) | 53.9 (82) |

747

748 *Values that do not share a letter are significantly different (p<0.05)

749

750 **Table 2**

| | <i>Training</i> | <i>Competition</i> |
|---|-----------------|--------------------|
| | <i>% (#)</i> | <i>% (#)</i> |
| <i>CWI</i> | 55.9 (85) | 65.8 (100) |
| <i>Stretch</i> | 45.4 (69) | 38.8 (59) |
| <i>Foam Roll</i> | 30.9 (47) | 23.7 (36) |
| <i>Sleep</i> | 22.4 (34) | 20.4 (31) |
| <i>Nutrition</i> | 14.5 (22) | 10.5 (16) |
| <i>Compressive Massage</i> | 13.8 (21) | 17.1 (26) |
| <i>Professional (i.e. athletic trainer)</i> | 12.5 (19) | 10.5 (16) |
| <i>Hydration</i> | 11.8 (18) | 10.5 (16) |
| <i>Heat</i> | 8.6 (13) | 13.2 (20) |
| <i>Contrast</i> | 7.9 (12) | 13.2 (20) |
| <i>Rest</i> | 7.9 (12) | 11.8 (18) |
| <i>Massage</i> | 4.0 (6) | 1.3 (2) |
| <i>Compression</i> | 1.3 (2) | 2.0 (3) |
| <i>Neuromuscular Electrical Stimulation</i> | 1.3 (2) | 2.0 (3) |
| <i>Training</i> | n/a | 1.3 (2) |
| <i>Active Recovery</i> | 0.7 (1) | 3.3 (5) |

751

752

753 **Table 3**

| | <i>Belief & use by athlete (+/+)</i> | <i>No belief but use by athlete (-/+)</i> | <i>Belief but no use by athlete (+/-)</i> | <i>No belief or use by athlete (-/-)</i> |
|--|--|---|---|--|
| <i>Sleep^{a,b}</i> | 24.3 | 2.6 | 63.2 | 9.9 |
| <i>CWI^a</i> | 65.1 | 7.9 | 18.4 | 8.6 |
| <i>Nutrition^{a,b}</i> | 14.5 | 1.3 | 65.1 | 19.1 |
| <i>Contrast^{a,b}</i> | 16.2 | 1.3 | 23.7 | 61.8 |
| <i>Foam Roll^{a,b}</i> | 27.0 | 6.0 | 44.1 | 23.0 |
| <i>Compressive Massage^{a,b}</i> | 19.1 | 2.6 | 46.7 | 31.6 |
| <i>Active^{a,b}</i> | 2.0 | 1.3 | 63.2 | 33.6 |
| <i>Compression^{a,b}</i> | 2.0 | 0.0 | 52.0 | 46.0 |

754

755 ^aSignificant difference at $p < 0.01$ between belief groups756 ^bSignificant difference at $p < 0.01$ between non-belief groups

757

758

Supplementary File

Demographics

| | | | |
|---|--|--|--------|
| 1 | Name | | Open |
| 2 | Gender | Male Female | Closed |
| 3 | Experience in current position (i.e. years as an athlete)? | <18 mths 18mths - 3 years 3-5 years 5-10 years >10 years | Closed |

Current practice

| | | | |
|---|---|------------------------------|--------|
| 4 | Which sport & discipline do you primarily compete in? | | Open |
| 5 | What do you currently do to recover from training? | | Open |
| 6 | What do you currently do to recover from competition? | | Open |
| 7 | Why do you do this? | Evidence Experience Both | Closed |
| 8 | Please expand on the answer above... | | Open |

Beliefs

| | | | |
|----|--|---|--------|
| 9 | How would you rate the effectiveness of sleep on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 10 | How would you rate the effectiveness of nutrition on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 11 | How would you rate the effectiveness of compression on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 12 | How would you rate the effectiveness of active recovery on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 13 | How would you rate the effectiveness of contrast baths on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 14 | How would you rate the effectiveness of ice baths on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 15 | How would you rate the effectiveness of Normatec on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |
| 16 | How would you rate the effectiveness of Foam Rolling on recovery? | No Effect Minor Effect Neutral Moderate Effect Major Effect | Closed |

Evidence

| | | | |
|----|---|--|------|
| 17 | How do you know you or your athletes have recovered? <i>Please list markers you use, performance, physiological, psychological etc</i> | | Open |
|----|---|--|------|

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760