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### **Running coaches and running group leaders' engagement with, and beliefs and perceived barriers to prehabilitation and injury prevention strategies for runners**

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1 **Running coaches and running group leaders' engagement with, and beliefs and perceived**  
2 **barriers to prehabilitation and injury prevention strategies for runners**

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16

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24 **Abstract**

25 Objectives: To identify which pre-and post-run injury risk reduction activities and prehabilitation  
26 (prehab) strategies Coaches and Running Group Leaders (Coaches/RGLs) engage in with runners; to  
27 explore their beliefs on why runners get injured; to identify Coaches/RGLs confidence providing  
28 injury prevention activities, and what they believe are effective for reducing risk of injury to identify  
29 their perceived barriers to including prehab in running coaching/training.

30 Design: Survey

31 Participants: UK Coaches/RGLs (N=100)

32 Outcome measures: Online questionnaire with open, closed and Likert scale questions.

33 Results: Most Coaches/RGLs performed active warm-ups (97%), cool-downs (94%) and gave injury  
34 prevention advice (91%) during training. Fewer coaches/RGLs incorporated prehab (67%) and advice  
35 on recovery strategies (84%). Although they collectively exhibited a wide range of knowledge,  
36 individually there was less consistency and confidence providing this. Prehab was rated as very  
37 important for injury risk reduction, with supervision recommended to facilitate runner engagement.  
38 Coaches/RGLs found conflicting advice, time, environment, and resistance from runners as barriers  
39 to incorporating prehab into training.

40 Conclusion: Coaches/RGLs believe prehab is important for runners however lack of confidence and  
41 knowledge appeared to limit the wider inclusion of prehab with runners. Coaches/RGLs welcomed  
42 reputable information on prehab from evidence-based sources. This may assist in reducing injury.

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44 **Keywords: Running Related Injury; load management; strength training**

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47 **Highlights**

- 48 • Coaches/RGLs confidence and perceptions to prehab are influenced by external barriers.
- 49 • Coaches/RGLs believe strength training makes their runners more resilient to RRI.
- 50 • Stretching is the main recovery strategy used by Coaches/RGLs.
- 51 • Primary injury prevention advice to runners was on training errors and footwear.
- 52 • Coaches/RGLs would benefit from runners reporting RRI early to best manage training loads.

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## 1. INTRODUCTION

69 Running participation is associated with both mental health (Keating et al., 2018) and physical  
70 benefits (Lee, Brellenthin, Thompson, 2017), with runners having 27% lower all cause, 23% lower  
71 cardiovascular and 30% lower cancer mortality than non-runners (Pedisic et al., 2019). However,  
72 injuries in runners are common, with the proportion of lower limb running related injury (RRI)  
73 ranging from 19.4% to 79.3% (van Gent et al., 2007), or 7.7 and 17.8 RRI per 1000 h running for  
74 recreational runners and novice runners respectively (Videbaek, Bueno, Nielsen, 2015). To reduce  
75 injuries in runners, sports physiotherapists are increasingly adopting an approach known as  
76 prehabilitation (prehab) to educate, prepare and condition for the physical demands of a sport.

77 Prehab is commonly used in a medical setting to physically prepare an individual for an intervention  
78 such as surgery in order to achieve a better outcome by identifying and addressing known risk  
79 factors (Banugo & Amoako, 2017; Durrand, Singh, Danjoux, 2019). Similarly, in sport, prehab is a  
80 specific conditioning adjunct based on current knowledge of injuries associated with an individual  
81 sport and incorporated into an athletes' usual training (Meir, Diesel, Archer, 2007). It is a proactive  
82 rather than reactive intervention used to enhance an athletes' functional capacity and tolerance for  
83 load, improve neuromuscular response, and increase conditioning with the aim to reduce risk of  
84 injury and maximize performance. It typically includes neuromuscular facilitation, endurance and  
85 strength training, plyometrics, and balance along with functional movements. In addition, it must be  
86 progressive in difficulty, preferably beginning in younger athletes and those new to sport (Vincent &  
87 Vincent, 2019), incorporate education, and be multimodal in approach to accommodate multiple risk  
88 factors (Durrand et al., 2019).

89 A reduction in sport-specific injuries using exercise-based injury prevention programmes has been  
90 demonstrated in other sports (Brunner et al., 2019; Lauersen, Bertelen, Andersen, 2014; Thorburg et  
91 al., 2017). In contrast, injury prevention programmes specifically for RRI also utilizing an exercise-  
92 based approach (Baltich, Emery, Whittaker, 2017; Bredeweg, Zijlstra, Bessem, 2012) and advice on

93 modification of running volume or intensity (Ramskov, Rasmussen, Sorensen et al., 2018) have not  
94 found similar benefits. Furthermore, a recent study evaluating the efficacy of an online injury  
95 prevention programme providing advice on how to reduce injury risk factors was not effective in  
96 reducing RRI, however a third of runners did not comply with the programme, therefore runners  
97 may need practical information that is more directed and personalized (Fokkema et al., 2019). Thus,  
98 RRI incidence remains high despite the specific injury prevention approaches that have been trialled.  
99 RRI's have a multifactorial aetiology due to their overuse nature (Clarsen, Myklebust, Bahr, 2013)  
100 and have many dimensions interlinked with both training errors and load tolerance (Bertelsen,  
101 Hulme, Petersen, 2017). Therefore, injury prevention programmes in runners focussed on just one  
102 factor may not be effective if used in isolation. Consequently, a multi-faceted approach to injury  
103 prevention such as prehab may be necessary, where a combination of training load management,  
104 preparations for sport, post-sport recovery, and an exercise-based intervention with education is  
105 utilised.

106 Despite the often-individual nature of running training, many runners opt to run with running groups  
107 or clubs. Coaches and running group leaders (Coaches/RGLs) have a vast range of experience and  
108 may be best placed to provide prehab for runners within a running club or group setting. Although  
109 Coaches and runners attitudes and beliefs towards risk factors for RRI have been evaluated  
110 (Johansen, Hulme, Damsted., 2017; Saragiotto, Yamato, Lopes, 2014), it is not clear what injury  
111 prevention practices are currently incorporated into regular running club sessions, or what  
112 Coaches/RGLs perceive to be efficacious for injury prevention. Pre-and post-training routines that  
113 Coaches/RGLs use for performance enhancement have been discussed previously, such as active  
114 warm-ups (McGowan, Pyne, Thompson, 2015) active cool-downs (van Hooren & Peake, 2018), and  
115 recovery strategies (Dupuy, Douzi, Bosquet, 2018), but it is less clear what prehab and injury  
116 prevention approaches Coaches/RGL's engage with.

117 Therefore, the current study aims to investigate (1) What pre-and post-run training  
118 routines/practices do running coaches/RGLs engage in with runners and which do they believe are

119 effective for injury risk reduction? (2) How confident are Coaches/RGLs in providing pre-and post-  
120 run injury prevention activities and advice? (3) What do Coaches perceive causes injury in runners?  
121 (4) What are the barriers to prehab/injury prevention in running clubs/groups as perceived by  
122 Coaches/RGLs? Thus, the rationale of the current study was to understand the current “state of  
123 play” of the use of injury risk reduction strategies from the perspective of Coaches/RGLs. This  
124 provides a crucial insight into real-life practices in injury risk reduction strategies in running groups,  
125 from which injury risk reduction practices may be developed going forwards to reduce the burden of  
126 injuries in runners.

127

## 128 **2. METHODS**

### 129 2.1 Participants

130 Coaches/RGLs from the United Kingdom (UK) were invited to take part in an online questionnaire.  
131 Recruitment was via emails sent to club secretaries (total n=345; England n=181, Scotland n=79,  
132 Northern Ireland n=51, Wales n=34) of all UK running clubs identified online  
133 ([www.scottishrunningguide.com](http://www.scottishrunningguide.com); [www.goodrungle.co.uk](http://www.goodrungle.co.uk); [www.athleticsni.org](http://www.athleticsni.org); [www.irun.wales](http://www.irun.wales))  
134 where a club email address was available. Club secretaries were asked to distribute the  
135 questionnaire to their Coaches/RGLs. Invitations to take part were also shared on social media, and  
136 Jog Scotland shared it on their Jog Leaders Facebook page. Inclusion criteria for participation were  
137 any running coach/RGL aged 18 or over. A running coach was defined as someone who offers  
138 training for a running or athletics club, and a running group leader supervises and motivates a  
139 running group in a less formal environment such as Jogscotland, RunTogether. Ethical approval was  
140 obtained from University of X (approval number 2478) and online informed consent was obtained  
141 from participants prior to starting the questionnaire.

### 142 2.2 Procedure

143 An online questionnaire was created using the platform Online Surveys. The questionnaire contained  
144 23 questions which included a mix of open, closed and Likert Scale questions. Eleven questions  
145 contained further sub-questions where additional information was sought and those not relevant  
146 could be bypassed for questionnaire brevity. After piloting the initial questionnaire in four  
147 coaches/RGLs with a range of experience, the questionnaire was further refined. The final  
148 questionnaire (see supplementary file) was made live and data was collected for 5 weeks during  
149 August-September 2019.

### 150 2.3 Survey

151 The questionnaire contained 4 categories:

- 152 1. Demographic details: Information on age, gender, training and experience as Coach/RGL,  
153 and the age, experience, frequency and type of training of runners in their running  
154 group was collected using closed ended questions.
- 155 2. Pre-and post-run injury prevention activities: This section explored how frequently the  
156 pre-and post-run injury prevention activities of warm-up, cool-down, recovery  
157 strategies, prehab, and other injury prevention advice were used by the Coaches/RGLs in  
158 their groups/training using a 5-category scale (never, occasionally, sometimes, most of  
159 the time, always). Those responding “never” were directed to the next question,  
160 whereas those who reported incorporating a pre-and post-run activity were asked for  
161 further details (type of activities and duration) using a free text format. In addition,  
162 participants were asked what they believed the importance of specific exercise  
163 interventions (core stability, flexibility, calf/ankle strengthening, thigh strengthening,  
164 gluteal/hip strengthening, plyometric, and single leg balance exercises) was using a 10-  
165 point Likert Scale, and when they thought these exercises should be performed (before,  
166 during, after training or on a separate day).



- 167 3. Beliefs on why runners got injured, and where runners should obtain injury prevention  
168 advice: Open ended questions were used to evaluate Coaches/RGLs views on causes of  
169 RRI and what runners commonly asked them about injuries. A 10-point Likert scale was  
170 used to establish how much they felt knowledge on injury prevention a runner should  
171 gain from different sources (coach/RGL, sports medicine practitioner/physiotherapist,  
172 sports masseur, personal trainer, internet, books, runners own experience).
- 173 4. Confidence in providing injury prevention activities and advice and perceived barriers to  
174 prehab: A 10-point Likert scale was used to explore Coaches/RGL's confidence in  
175 providing the main pre-and post-run activities from section 2 and how much they felt  
176 these activities and running experience was related to injury risk reduction. They were  
177 asked if they would find it beneficial to know more about prehab/ injury prevention  
178 strategies and if they answered no, an open-ended question allowed further detail to be  
179 provided. In addition, open-ended questions were used to ask how much time was  
180 realistic to spend on prehab and what barriers they could foresee incorporating prehab  
181 into a running session.

## 182 2.4 Data analysis

183 Data were exported to Microsoft Excel from Online Surveys. Frequency of responses for each  
184 category of categorical questions were obtained and these displayed as bar charts. Open question  
185 responses for pre-and-post-run activities were reviewed and grouped by similar type, and the  
186 number of responses per type displayed in tabular format and bar charts. The distribution of  
187 continuous data was assessed using a Shapiro-Wilk test and by visual inspection of the histograms  
188 and residual plots using SPSS (IBM v.25). Means and standard deviations ( $\pm$  SD) were reported for  
189 variables which were normally distributed and the median and interquartile range were reported for  
190 variables which were not normally distributed. Data from all Likert Scale questions were displayed  
191 using box and whisker plots.

192 Thematic analysis of the qualitative responses was carried out in Microsoft Excel on the following  
193 three open questions: what do runners ask Coaches/RGLs about RRI; what do Coaches/RGLs  
194 perceive causes RRI; and what are barriers to prehab. This was performed using the grounded theory  
195 approach as described by Bradley, Curry, Devers, (2007) to develop code structure. Analysis of the  
196 data was a 3-step process. Firstly, qualitative responses were viewed and familiarized independently  
197 by a primary and secondary assessor by reading all responses and independently created codes for  
198 data that characterized the participants' responses through the re-reading and reflection on the  
199 emerging themes. Following this, the assessors discussed their codes and themes in-depth and  
200 agreed on the final codes for themes. The primary assessor carried out a second round of coding of  
201 all the responses using the finalized codes to ensure consistency in interpretation. Then the two  
202 assessors discussed and agreed on the finalized themes and quotations were identified under  
203 thematic headings.

204

### 205 **3. RESULTS**

#### 206 3.1 Participant characteristics

207 Of the 345 clubs contacted by email, 79 were returned undeliverable. On completion of data  
208 collection, 101 coaches/RGL's accessed the online questionnaire and consented to take part. One did  
209 not answer any questions after consenting, and this coach/RGL was excluded, leaving data from 100  
210 Coaches/RGLs in the final data set (mean  $\pm$  SD age 51.1 $\pm$  9.5 years; female n=58). Most coached at a  
211 running or athletics club (66%), and the remaining 34% were RGL's. The majority of coaches/RGL's  
212 had 1-10 years' experience (62%), 29% had more than 10 years' experience, and 9% had less than 1-  
213 year experience coaching or leading a running group. Across the 100 Coaches/RGLs, there were 255  
214 responses on the running disciplines they supervised: 5K improvers (n=58, 22.7%), 5-10K (n=52,  
215 20.4%), beginners e.g. Couch-to-5k (C25K) (n=45, 17.6%), half to full marathon (n=38, 15%), track-  
216 middle distance (n=25, 10%), track-sprints (n=16, 6.3%), ultradistance (n=14, 5.5%), and children

217 (n=7, 2.7%). The majority of Coaches/RGLs (73%) supervised two or more running disciplines. When  
218 asked if their runners ever ran with a current injury, 70% of coaches/RGLs replied 'yes'.

219 3.2. Frequency and types of warm-ups, cool-downs, prehab, recovery strategies and injury  
220 prevention advice

221 Most coaches/RGL's performed a warm-up (97%), cool-down (94%), and gave advice on injury risk  
222 reduction (91%). A further 84% gave advice on recovery strategies, and 67% either included prehab  
223 exercises during training or directed runners to exercises out-with training. The frequency of  
224 incorporating warm-ups, cool-downs, recovery strategies, prehab exercises, and injury prevention  
225 advice are shown in Figure 1.

226 < Insert Figure 1 here >

227 Table 1 provides more detail on the types of warm-ups, cool-downs, and prehab exercises  
228 Coaches/RGLs included in their sessions, and Figure 2 shows the range of responses and the  
229 frequency that these were reported for recovery strategies (Fig 2a) and injury prevention advice (Fig  
230 2b). Median (interquartile range) length of warm-ups and cool-downs were 15 (10) and 10 (5)  
231 minutes respectively. Coaches/RGLs thought prehab during a running session should ideally last 10  
232 (5) minutes.

233 < Insert Table 1 here >

234 < Insert Figure 2a and Figure 2b here >

235 Although 67% of coaches/RGLs carried out prehab exercises with their runners, 95% said they would  
236 like to know more about prehab/ injury prevention strategies. Regarding timing of prehab, 80% of  
237 Coaches/RGLs responded that it should be feasible to spend time during training sessions on  
238 prehab/ injury prevention strategies. Specifically, 51% thought it should be performed both during  
239 and separate from a running session, 19% thought it should be part of the warm-up only, 16% felt it  
240 should be separate from a running session and on a different day, 6% felt it should be separate from

241 a running session but on the same day, 4% thought it should be during both the warm-up and cool-  
242 down at training, and a further 4% were not sure.

### 243 3.3. Coaches/RGLs beliefs and confidence on providing injury prevention strategies

244 Figure 3 shows the degree to which coaches/RGLs thought specific types of prehab exercises could  
245 reduce injury (Fig 3a); the degree to which they thought warm-ups, cool-downs, strength training,  
246 other sports and running experience were associated with likelihood of injury reduction (Fig 3b); the  
247 extent to which they thought runners should acquire their knowledge of injury prevention from a  
248 range of sources (Fig 3c); and how confident they were on giving advice on warm-ups, cool-downs,  
249 recovery strategies, prehab exercises, and injury management (Fig 3d).

250 < Insert Figure 3 here >

### 251 3.4 What runners ask about injury, Coaches/RGLs beliefs on cause of injury and barriers 252 to prehab

253 Four to five themes were identified across each of the three qualitative response questions:

254 What runners ask about injury: Runners asked for specific advice from Coaches/RGLs on  
255 injury regarding specificity of management, timescales for return to running, diagnosis, and  
256 injury prevention.

257 Coaches/RGLs beliefs on cause of injury: Coaches/RGLs predominantly believed the cause of  
258 injuries to be multifactorial, including training errors, lack of conditioning, individuality in  
259 relation to shoes, runners not warming-up/cooling-up; and runners continuing to run when  
260 injured and not following advice.

261 Barriers to prehab: Runners attitudes towards prehab but also Coaches/RGLs knowledge on  
262 why it was important and what to implement as well as having an appropriate environment  
263 and the time it added to a running session.

264 Table 2 lists the questions and themes, and shows example quotations for each theme.

265 < Insert Table 2 here >

266

## 267 **DISCUSSION**

268 This study is the first to investigate current pre-and post-run injury risk reduction practices used by  
269 running Coaches/RGLs, to identify Coaches/RGLs confidence on providing injury prevention  
270 activities, what they believe are effective strategies for reducing risk of injury and explore their  
271 perceived barriers to incorporating prehab. Following previous research (Johansen et al., 2017) we  
272 also explored their beliefs on why runners get injured using a more qualitative approach. A range of  
273 frequency and types of warm-up, cool-down, recovery strategies, prehab exercises, and other injury  
274 prevention advice was demonstrated by Coaches/RGLs. They viewed training errors, conditioning,  
275 terrain, environment, footwear, lack of warm-up or cool-down, and ignoring injury as causes of  
276 injury, and predominant advice they gave their runners to reduce likelihood of injury was on training  
277 errors and footwear. They were less confident giving injury management advice and prehab than  
278 performing warm-ups, cool-downs and giving recovery strategy advice, and reported barriers to  
279 incorporating prehab into training were knowledge, time, the environment and runner attitudes.

### 280 4.1 Injury prevention activities pre and post running

281 Although collectively Coaches/RGLs demonstrated a wide range of knowledge of prehab in the  
282 current study, individually there was less consistency in reports of specific methods. Coaches/RGLs  
283 strongly agreed that core, flexibility, ankle, thigh and gluteal strengthening, plyometric and single leg  
284 balance exercises were important for injury prevention, and that a runner who performs strength  
285 training and other fitness training is less likely to get injured. This suggests Coaches/RGLs believe  
286 strengthening and other training makes their runners more resilient to RRI despite not always

287 actively engaging with it. This concurs with Johansen et al., (2017) who reported 79% of running  
288 Coaches associated reduced strength as a risk factor for injury in runners.

289 Overall, Coaches/RGLs reported moderate to high confidence ratings in providing warm-ups and  
290 cool-downs, and based on the types of warm-ups and cool-downs described, most followed current  
291 best practice (McGowan et al., 2015; van Hooren & Peake, 2018). Coaches/RGLs reported that  
292 performing warm-ups and cool-downs were important for injury reduction, and that omitting warm-  
293 ups and cool-downs could lead to RRI. However some Coaches/RGLs reported incorporating static  
294 stretching during their cool-downs, a passive approach which has not been found to reduce  
295 incidence of injury (van Hooren & Peake 2018).

296 Stretching also featured highly as a recovery strategy and was advised by nearly half of  
297 Coaches/RGLs to be undertaken out-with training sessions. Whilst the literature supports dynamic  
298 stretching for warm-ups, there is no evidence to suggest the addition of stretching to injury  
299 prevention programmes will gain further benefit (Lauersen et al.,2014), or that stretching for  
300 recovery can provide further improvement in performance or reduction of injury in endurance  
301 running (Baxter, McNaughton, Sparks., 2017). Despite these findings, recreational athletes' rate  
302 stretching as their most effective recovery strategy compared to more evidence-based strategies  
303 (Crowther, Sealey, Crowe et al., 2017).

304 Further research is needed to establish why runners and Coaches/RGLs perceive stretching as most  
305 beneficial. Brunner et al., (2019) and Lauersen et al., (2014) found multicomponent injury prevention  
306 programmes effective in a range of team sports, with programmes including strength and balance  
307 training more superior, and stretching providing no additional benefit. Although there is a need for  
308 further studies to identify an exercise approach that can reduce RRI similar to injury risk reduction in  
309 team sports, it may be argued that the time runners spend on additional stretching should be  
310 replaced by other types of prehab exercises. In addition to stretching, rest days and active recovery  
311 were also commonly reported factors for recovery in the current study although as highlighted by

312 Coaches/RGLs responses, rest from running does not necessarily mean complete cessation of  
313 activity.

#### 314 4.2 Coaches/RGLs beliefs on causes of injury and their advice on injury risk reduction

315 In addition to not warming-up or cooling down, coaches/RGLs perceived training errors, lack of  
316 conditioning, terrain, running shoes, and runners ignoring injury and advice to cause RRI. Despite  
317 this, the two most common types of advice they gave their runners focussed on training errors and  
318 footwear. Coaches/RGLs mentioned shoes in relation to both cause of injury and management of  
319 injury. A previous study investigating runners' beliefs on risk factors for RRI found runners also  
320 believed shoes to be associated with injury despite a lack of evidence for this (Saragiotto et al.,  
321 2014).

322 Training error advice was also reported by Coaches/RGLs in terms of running distance, frequency,  
323 intensity and volume, but perhaps training errors should be considered more in terms of load  
324 capacity and the body's ability to cope with modifications of training. Damsted, Glad, Nielsen et al.  
325 (2018) found an association between increased training load and increased RRI risk, but concluded  
326 that the threshold for sudden increases or decreases of training load associated with RRI has still not  
327 been identified in the literature. Similarly, training may be protective (Drew & Finch, 2016; Gabbett,  
328 2016) and further research is needed to identify if under-loading, or running regularly at a consistent  
329 pace may also pose a risk for injury in runners. Prescribing load on an individual basis (Soligard et al.,  
330 2016) highlights the complexity for Coaches/RGLs in identifying an optimal training load for  
331 musculoskeletal health in runners. As 91% of Coaches/RGLs in this current study gave advice to their  
332 runners on injury prevention, they are best placed to communicate load management advice to  
333 runners that is most specific to their training.

334 Not only can load monitoring be used to predict injury (Drew & Finch, 2016; Gabbett, 2016; Soligard  
335 et al., 2016), load management when injured can assist Coaches/RGLs and runners. Coaches/RGLs in  
336 the current study reported runners frequently asked whether or not they should run when injured.

337 This suggests a dichotomous attitude by runners (should I run yes or no), rather than finding a  
338 training load adaptable and more cognisant of a loading sliding scale. In the current study, 70% of  
339 Coaches/RGLs reported that some runners run with an injury. Previous research found 86% of  
340 recreational runners with RRI continued to run despite affecting their performance (Linton &  
341 Valentin, 2018), therefore Coaches/RGLs as first point of contact could be educated on advising at a  
342 basic level what running is within safe parameters. For example, the Pain Monitoring Model could be  
343 used to monitor pain and load response (Sibernagel, Thomee, Eriksson et al., 2007) and employed  
344 with runners to show RRI does not necessarily mean complete cessation of running and help aid the  
345 decision when to suggest physiotherapy or reinforce physiotherapy advice.

346 Managing training load through injury may also help maintain adherence to running as injured  
347 runners are less likely to engage in other forms of physical activity (Davis & Gruber, 2020).  
348 Additionally, nearly half of Coaches/RGLs in the current study worked with C25K runners, and  
349 strongly agreed this cohort are more likely to get injured. A previous study found a third of novice  
350 runners were likely to stop running within 6 months mainly due to RRI (Fokkema et al., 2019). Novice  
351 runners have yet to acquire the experience to self-optimize their running (Moore, 2016), therefore,  
352 to gain the experience and resilience for running, this cohort may benefit more from prehab.

#### 353 4.3 Facilitating prehab and barriers to incorporating it into training

354 Almost all coaches/RGLs said they would find it beneficial as a Coach/RGL to learn more about  
355 prehab/injury prevention and thought it feasible within their coaching/running session to spend  
356 time addressing prehab. Coaches/RGLs also responded most frequently that prehab should be  
357 carried out by runners during training, suggesting supervision as a way of increasing engagement  
358 and adherence from runners who were resistant. This is supported by injury prevention research in  
359 other sports which firmly establishes supervision and adherence (Thorburg et al., 2017) important  
360 for implementing exercise programmes and performing these during a neuromuscular warm-up  
361 most effective for injury risk reduction (Herman, Barton, Malliaras et al., 2012). Therefore, prehab



362 exercises could be incorporated into the runners' routine during training sessions similarly to  
363 established supervised warm-ups/ cool-downs, However, Coaches/RGL's reported inconsistent and  
364 conflicting current advice on prehab, thus more direction is needed to understand what prehab  
365 exercises are most effective, when and how they could be incorporated in training, and why they are  
366 important for injury prevention.

367 Knowledge exchange is important for distributing information (Dahlstrom, Jacobsson, Timpka, 2015),  
368 but Coaches/RGLs thought runners should rely less on internet resources for injury prevention  
369 advice, and predominantly agreed medical practitioners/physiotherapists as most reliable sources.  
370 Additionally Coach/RGL's rated highly that injury prevention knowledge should be acquired both  
371 from the Coach/RGL, and through runners' own personal experiences, indicating a dual  
372 responsibility. Runners benefit from the experience, knowledge and supervision of Coach/RGL's, but  
373 runners running individually do not have this support. Therefore other methods of disseminating  
374 information or making such material easily accessible such as prehab workshops for runners should  
375 be considered.

#### 376 4.4 Limitations

377 A limitation of this study was that the questionnaire link was only sent out once to running club  
378 secretaries. Thus, the secretaries were relied on to distribute the link to Coaches/RGLs, as most  
379 running club websites did not have any direct email addresses for their Coaches/RGLs. In addition,  
380 the questionnaire was limited to UK Coaches/RGLs therefore the results may not be representative  
381 of other running Coaches/RGLs globally. There was a wide variation in Coaches/RGLs levels of  
382 experience therefore future work in a larger study cohort should identify if level of experience and  
383 knowledge of prehab are related.

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**CONCLUSION**

Coach/RGL's are in an ideal position to adopt a composite injury reduction approach ensuring good practice with injury prevention strategies such as warm-ups, cool-downs, recovery strategies, prehab and education with their runners. They collectively agree prehab is important for reducing risk of injury, but barriers such as lack of time, resistance from runners, environment, and lack of knowledge need to be overcome. Evidence-based educational prehab resources involving practical applications are welcomed by Coaches/RGLs so they can have the confidence to incorporate prehab into training sessions for runners in the way research has firmly disseminated and effectively embedded active warm-up and cool-downs into a runners' routine.

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<b>Pre-and post-training routine (number of coaches/RGLs)</b>	<b>Specific strategy</b>	<b>Coaches/ RGL's (n)</b>
Warm-up (n=97)	Increase HR and dynamic warm-up	78
	Increase HR only	5
	Increase HR and static stretching	5
	Dynamic warm-up only	3
	Static stretching only	2
	Increase HR, dynamic warm-up, other warm-up	2
	Increase HR, static stretching, other warm-up	1
	No comment	1
Cool-down (n=94)	Decrease HR and static stretching	47
	Static stretching only	29
	Decrease HR only	10
	Decrease HR, static stretching, other cool-down	5
	Dynamic stretching	2
	Other cool-down	1
	No comment	0
Prehab exercises (n=67)	Supervised targeted exercises	36
	Education	12
	Advice to engage in unsupervised exercise	8
	Supervised and unsupervised exercise	2
	Unsupervised exercise, other prehab	1
	No comment	8

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*Table 1: Warm-up, cool-down, and rehabilitation (prehab) exercises used by coaches/RGL's pre-and post-training. Examples of specific strategies: Increase Heart Rate (HR) - jogging, running drills, brisk walk, game; Dynamic warm-up - lunges, high knees, jumping jacks; Other warm-up - core, balance; Decrease HR - jogging, walking; Other cool-down - yoga, deep breathing, strength exercises; Supervised targeted exercises – general / specific lower limb strengthening, stretching, balance; Education – importance of exercises, warm-up, breathing; Advice to engage in unsupervised exercise – strength and conditioning, yoga, swimming, cross-training; Other prehab – running form advice*

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Question	Themes	Example quotes
<b>What do runners ask about injury?</b>	Management	"Should they train through this injury/pain/problem? What specific loads should they be doing? What types of training can they continue with"
	Time scales	"How long will recovery be" "How long should I rest/recover for?"
	Diagnosis	"Usually is just why is a particular bit sore - sometimes easy to define - gone over on ankle etc., other times more complex and I advise to get physio etc." "C25K runners will ask about aches and pain and the problem is working out which aches are due to unaccustomed exercise (DOMS)"
	Prevention	"How can I prevent this from happening in the future"
<b>What do Coaches/RGL's believe cause injury?</b>	Training errors	"Inflexible approach to training plans...Strava obsession with kudos for min/mile speed of runs...too much obsession on 'straight to marathons'" "Overtraining - i.e. not getting sufficient recovery between sessions (particularly high intensity ones or competitions)" "Too high an intensity and not allowing the body adapt to the training stresses"
	Conditioning	"Inherent body weakness somewhere so can't cope with a level of running that their peers are able to do" "Lack of strength and conditioning"
	Terrain	"Track is too hard. Needs relayed"
	Environment	"Accident fall or twist ankle"
	Footwear	"High mileage on running shoes and wearing incorrect shoes for their running gait" "Not alternating shoes, however because shoes are very expensive many runners tend to stick with the same pair..." "Every runners is different, what works for one runner may not work for another, some runners run until their shoes are falling apart some get 300 miles and start to get pain"
	Ignoring injury	"Attitude to running 'I am a runner so I must run' sees a lot of runners run with injuries that could have been prevented from getting worse with rest" "Not listening to their bodies as soon as an injury comes on i.e. not going to physio straight away, and not listening to the physio"
	Lack or warm-up/cool down	"A lot of runners fail to warm-up properly then launch into a full-on sprint" "Not warming-up or cooling-down properly"
<b>What do Coaches/RGLs perceive as barriers to prehab?</b>	Time	"Finite time for session. To add something in, you need to take something out. But it can be inserted as a natural break between parts of the session and people can socialize while doing it ..." "People have limited time and want to get the distance covered. Not really counting exercises as proper running"
	Environment	"Appropriate area to do this, particularly in winter of there is a risk of runners getting cold etc" "Weather, as we meet in a car park so if weather bad no place to shelter"
	Coaches/RGL knowledge	"Being able to coach the techniques required. Understanding why and how it helps" "Understanding why and how it helps"
	Runners needs	"My experience is that many athletes/runners are not that compliant to doing prehab outside of the group session, so a price worth paying to get some prehab done" "None - as I am in charge of the session"
	Runners attitude	"People just wanting to run, rather than spend time on getting better at running through ensuring that they get stronger and can train consistently" "If forewarned I believe many would be turned off by a "boring" talk. Despite saving runners from injury" "Athletes just want to get on with the session. In a large group not everyone is paying attention or is interested"

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Table 2. Themes, subthemes and quotes on what runners ask coaches/RGLs about injury, what coaches/RGLs believe leads to injury, and barriers to prehabilitation (prehab)/ injury prevention during training sessions.

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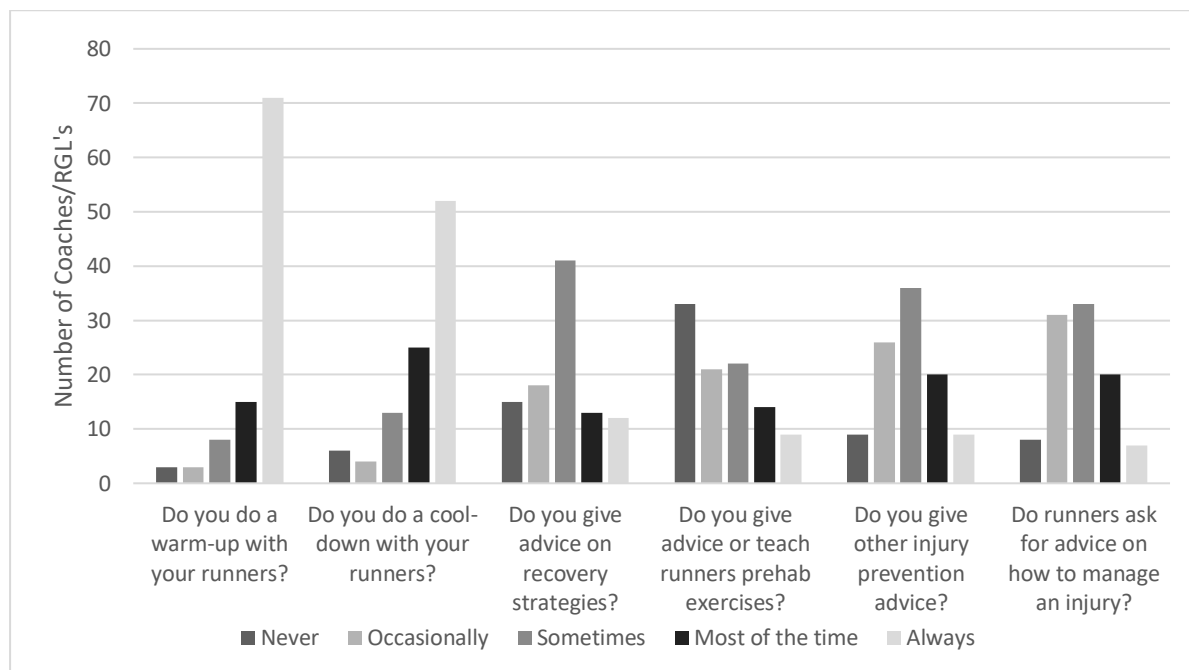
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Figure 1. Coaches and Running Group Leaders' (Coaches/RGL) participation in injury prevention strategies with their runners (n=100): warm-ups, cool-downs, recovery strategies, prehabilitation (prehab), other injury prevention, and runners asking advice on injury management.

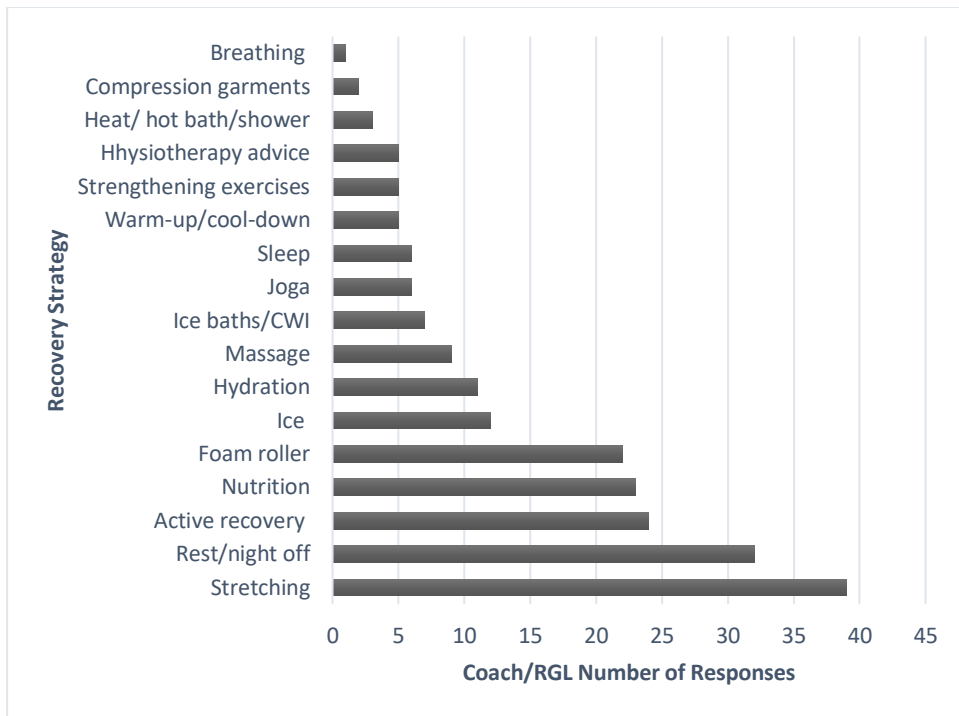
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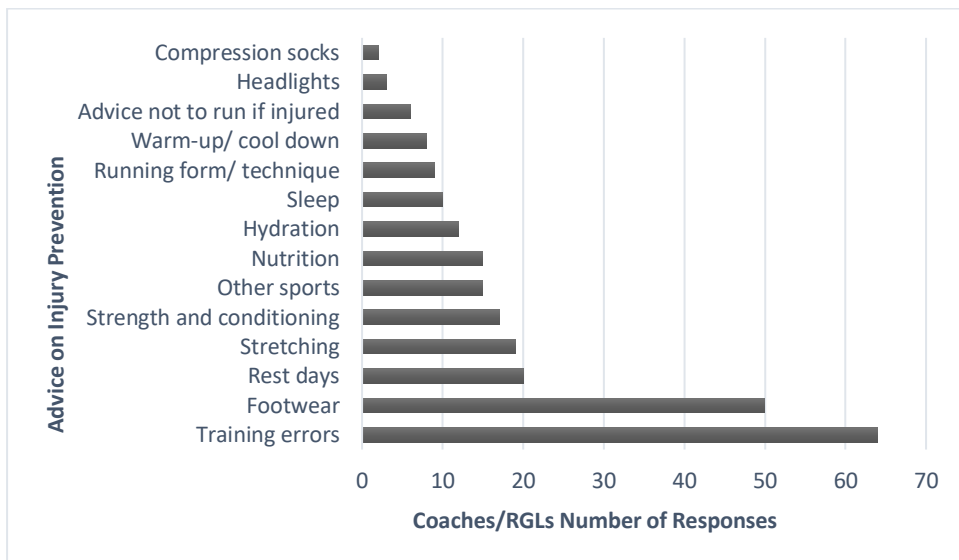
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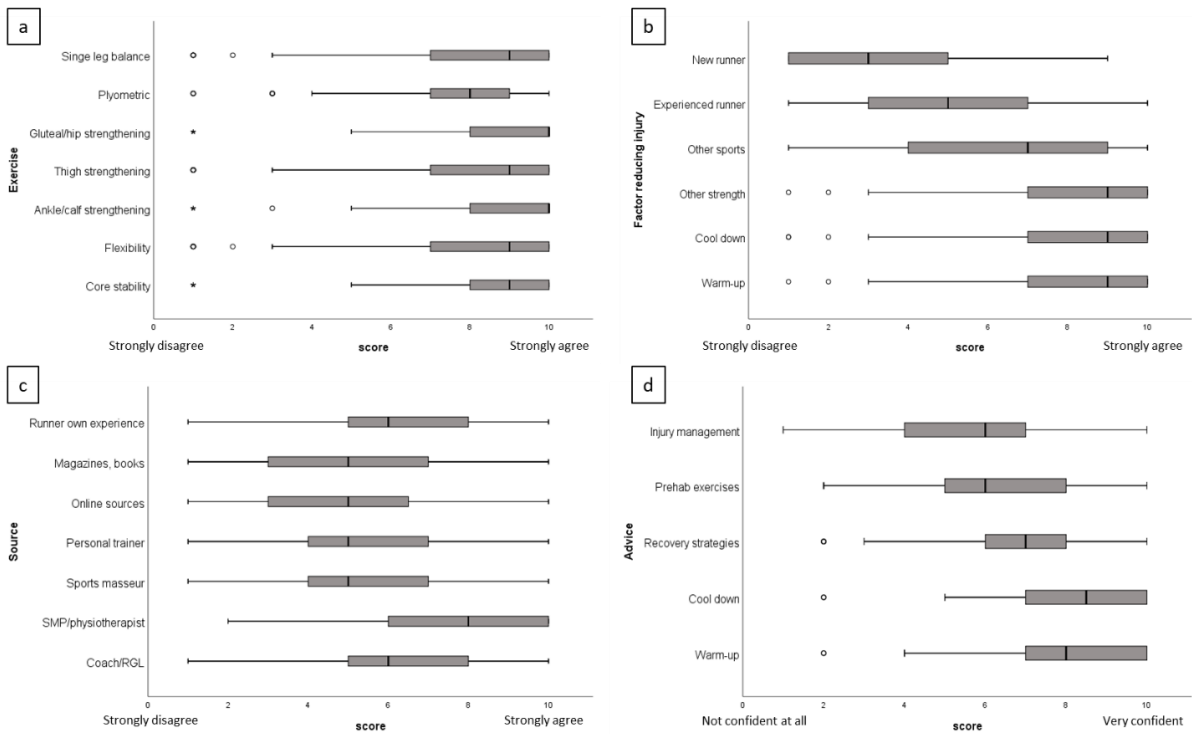


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Figure 2. (a) Range and their number of reports of recovery strategies Coaches and Running Group leaders (RGLs) incorporated in their sessions (CWI = cold-water immersion) (n=84) (b) Range and their number of reports of advice given to runners by Coaches/RGLs on factors that reduce risk of injury (n=91).

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*Figure 3. Ratings from Likert Scale questions are displayed as boxplots with first and third quartiles denoting the box, the whiskers representing smallest and largest values, and the median the vertical line within the box (a) How much Coaches and Running Group Leaders (Coaches/RGL) agree different types of exercises are important for injury prevention (b) How much Coaches/RGLs agree the following factors reduce the likelihood of injury: warm-up, cool-downs, other strength exercises, other sports, being an experienced runner, being a new runner (c) How much Coaches/RGLs agree where runners should acquire their knowledge of injury risk reduction from (SMP = Sports Medicine Practitioner) (d) How confident Coaches/RGLs are about giving advice on injury prevention strategies.*