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1 Return to competitive gymnastics training in the UK following the first COVID-19  
2 national lockdown

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4

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23

## 24 Abstract

25 Following the outbreak of COVID-19 (coronavirus), the UK entered a national lockdown, and all sport  
26 was suspended. The study aimed to explore the process of returning to gymnastics training after several  
27 months away from the gym, with particular interest towards training load and injury. Twenty-six,  
28 national programmed gymnasts from Men's artistic, Women's artistic and Trampoline gymnastics  
29 recorded training load and injury whilst returning to training. At the end of data collection, 3 coaches  
30 were interviewed to further explore the experiences and practices of returning to training. Home-based  
31 training during lockdown was seen as beneficial in maintaining a level of fitness. Coaches described a  
32 gradual increase in training to reduce the risk of injury and this partly explains a non-significant  
33 association between training load and a substantial injury ( $P=0.441$ ). However, week-to-week changes  
34 in training load following periods of additional restrictions (additional lockdown, periods of isolation or  
35 substantial restrictions), were not always gradual. There was a significant association between an injury  
36 in the preceding week (niggle or substantial injury to a different body part) and a substantial injury in  
37 the subsequent week (RR: 5.29,  $P=0.011$ ). Monitoring training was described to be a useful practice  
38 during the process of returning to training. Coaches believed that although the short-term  
39 development of their gymnasts were affected, the long-term development would not be impacted from  
40 COVID-19. It is anticipated that learnings from this study can be applied to future practices and  
41 situations, particularly when gymnasts are away from the gym for an extended period.

42

43 **Keywords:** COVID-19, Gymnastics, Trampoline, Return to Training, Training Load, Injury,  
44 Niggles

## 45 Introduction

46 In March 2020, following the outbreak of COVID-19 (coronavirus), the UK entered its first national  
47 lockdown as an attempt to reduce the spread of the virus. As a result, all organised sport was suspended  
48 and during this time young gymnasts, like many other athletes, were restricted to home-based exercise  
49 and training. Following the easing of restrictions, gymnasts in England, gradually followed by gymnasts  
50 in Northern Ireland, Wales and Scotland, were able to return to training within a gym environment.

51

52 One particular concern of returning to sport-specific training following lockdown is the increased risk  
53 for injury<sup>1-3</sup>. During the lockdown period, it was assumed athletes would experience a certain amount  
54 of detraining as a result of a reduction in training loads and sport-specific stimuli<sup>2</sup>. Consequently, these  
55 changes in training may influence tissue structures and mechanical properties resulting in an increased  
56 risk of injury if not considered or appropriately addressed when returning to sport-specific training<sup>2</sup>.  
57 From a training load perspective, previous research has associated sudden increases or 'spikes' in  
58 training load with an increased risk of sustaining an injury<sup>4-6</sup>. To avoid sudden increases in training load  
59 whilst returning to training following national lockdown, it was recommended by researchers and  
60 practitioners in professional and amateur sports contexts<sup>7,8</sup> that training should be increased gradually  
61 to minimise the risk of injury. Recent research has also suggested that athletes experiencing minor  
62 injuries or 'niggles' may be at an increased risk of injury in the following week<sup>9</sup>. As it is likely athletes  
63 will experience niggles when returning to training, flagging niggles may act as a tool for reducing the  
64 risk of more substantial injuries. Reducing the risk of injury in competitive, young gymnasts as they  
65 return to gym-based training was also important to minimise any further disruption to their  
66 development.

67

68 Typically, gymnasts train in the gym all year round for multiple hours each week, with minimal time  
69 spent out of the gym. The national lockdown has created a unique opportunity to explore the process  
70 of returning to gym-based training after several months away. Findings from this study may provide  
71 future guidance for returning to gym-based training following an extended period away from the gym  
72 (e.g., due to injury or illness). The primary aim of the study was to explore how competitive, young  
73 gymnasts returned to training in gyms following the UK's initial COVID-19 national lockdown, with  
74 particular interest towards training load and injury. The second aim of the study was to understand the  
75 perceptions and experiences of coaches during this time.

76

## 77 Materials and Methods

78 A mixed-method design was used develop a complete understanding of returning to gymnastics  
79 training <sup>10</sup>. Training load and injury were recorded between the 25<sup>th</sup> July and the 13<sup>th</sup> December 2020.  
80 At the end of data collection, three coaches were interviewed to further explore the experiences and  
81 practices of returning to training.

82 Gymnasts from Women’s artistic (WAG), Men’s artistic (MAG) and Trampoline (TRA) Great Britain  
83 Pathway Programmes were invited via email to take part in the study. Following data collection, a  
84 purposive sample of three coaches (**Table 1**) who’s gymnast(s) had participated in the study, were  
85 invited via email to participate in individual interviews. Consent and assent were provided via an online  
86 survey by parents and gymnasts, respectively. Consent was also obtained from the interviewed  
87 coaches. The study was approved by the University of Bath Research Ethics Approval Committee for  
88 Health.

89

90

**\*\*\*Insert Table 1 near here\*\*\***

91 Data collection for each gymnast began in line with their club reopening. Each gymnast received a  
92 training capture form via email and was asked to complete the form for each training session following  
93 their return to the gym. Gymnasts were asked to record separate duration (min) and rate of perceived  
94 exertion (RPE [0-10]) <sup>11,12</sup> scores for each apparatus or activity <sup>13</sup> to account for the long duration of  
95 training sessions (3-4 hours) and variance in demands of each apparatus/activity. An RPE scale with  
96 verbal anchors was provided for each gymnast <sup>11</sup>. Trampoline gymnasts were also asked to record the  
97 total difficulty of skills for each trampoline session as requested by National Trampoline Coaches.

98

99 Gymnasts were instructed to report details of any pain or injury (i.e., location) for each  
100 apparatus/activity. Additionally, gymnasts reporting any pain or injury were requested to complete the  
101 updated Oslo Sports Trauma Research Center Questionnaire on Health Problems (OSTRC-H2) <sup>14,15</sup> at  
102 the end of each week. Injury was defined in this study as any physical complaint reported by the  
103 gymnast using the OSTRC-H2 questionnaire as a consequence of rapid or repetitive transfer of kinetic  
104 energy. An injury was defined as substantial if it resulted in moderate or severe reductions in sports  
105 performance or training, or time loss <sup>15-17</sup>. An injury was described as a ‘niggle’ if it did not result in  
106 moderate or severe reductions in sports performance or training, or time loss. Blisters, skin tears, illness  
107 and any medical conditions were excluded from the study.

108

109

110 Three interviews took place between the 18<sup>th</sup> and 21<sup>st</sup> December 2020 using an online video platform.  
111 Audio was recorded using a sound recording application. A pilot interview was completed prior with a  
112 National Coach. Only the principal investigator (interviewer) and individual coach were present during  
113 the interview. Similar to the protocols employed by Cumming, Brown, Mitchell, Bunce, Hunt, Hedges,  
114 Crane, Gross, Scott, Franklin <sup>18</sup> and Patel, McGregor, Fawcett, Bekker, Williams, Williams, Cumming <sup>19</sup>,  
115 both written and verbal methods were used in the interviews. At the start of the interview, the coach  
116 was instructed to 'write three words to describe what coaching gymnastics has been like since returning  
117 to the gym from lockdown one'. The coach was then asked to elaborate on each word, where  
118 conversation from the activity led into the main interview. The interview itself was semi-structured in  
119 design to allow flexible questioning and was based on experience, practice, performance and injury  
120 since returning to a gym environment following the first national lockdown (**Appendix 1**). Additional  
121 field notes were made only to guide the flow of the interview.

122  
123 Descriptive statistics were calculated for gymnasts, training load and injury. Only gymnasts completing  
124 a minimum of 10 weeks of data were analysed. The final week of data was omitted for each gymnast if  
125 a full week was not recorded. Training load data was shortened if a substantial period of duration or  
126 RPE data were missing (15 weeks omitted). Session-RPE (sRPE) [duration x RPE] was calculated for all  
127 training sessions. Missing RPE data (1% of 7916 reported training sessions/activity), was estimated from  
128 RPE of similar and recent training sessions. Training load was analysed as week-to-week changes in total  
129 weekly load, expressed as a percentage value.

130  
131 The OSTRC-H2 questionnaire was used to calculate the prevalence and severity of an injury for each  
132 week. Missing OSTRC-H2 questionnaires (10% of 130 the questionnaires used in the study) were  
133 estimated from details of reported pain or injury. OSTRC-H2 questionnaires with inconsistent answers  
134 (24% of 130 questionnaires used in this study) were corrected in accordance with details of reported  
135 pain or injury (e.g., If an athlete selected '*full participation without health problems*' but also selected  
136 symptoms as '*to a mild extent*' or if the questionnaire reflected the day of the injury rather than the  
137 week). Prevalence of injury was calculated for each week by dividing the number of gymnasts reporting  
138 an injury using the OSTRC-H2 questionnaire by the total number of gymnasts who completed a training  
139 capture form for that week of training. The same calculation was applied to calculate the prevalence of  
140 a substantial injuries.

141  
142 Descriptive statistics and statistical tests were performed using R Studio (version 3.3.6, The R  
143 Foundation for Statistical Computing Platform, Vienna, Austria), using the '*lme4*' package for modelling

144 training load and injury<sup>20</sup>. To remove potential skewing of results, outlier week-to-week changes were  
145 omitted if greater than 3 SD away from the mean. Week-to-week change values were offset by one  
146 week, such that a given week-to-week change value was associated with injury risk in the *subsequent*  
147 week (due to the impact that an injury in a given week would have on the loads undertaken that week).  
148 Generalised linear mixed-effects models were used to model the associations between week-to-week  
149 changes in training load and a substantial injury and, the association between preceding injury (niggle  
150 or substantial injury to a different body part) and a substantial injury in the subsequent week using a  
151 binomial distribution and complementary log-log link function. Week-to-week changes and were  
152 modelled as a numeric fixed effect and gymnast ID was modelled as a random effect.

153

154 Interviews ranged between 23 and 64 minutes (average = 38 min). Interview audios were manually  
155 transcribed verbatim for analysis. All identifiable names were anonymised and replaced with  
156 pseudonyms. Transcribed interviews were analysed manually by the principal investigator in Microsoft  
157 Excel. Interviews were analysed using thematic analysis based on the method described by Braun,  
158 Clarke<sup>21</sup>. Coaches were given the opportunity to clarify initial interpretations and include additional  
159 comments if required to enhance the trustworthiness of interpreted data.

160

## 161 **Results**

162 Twenty-six (11 male; 15 female; age  $11.9 \pm 1.7$  years) gymnasts (**Table 2**) recorded training load and  
163 injury as they returned to training in the gym. No gymnasts tested positively for COVID-19. An  
164 additional 19 (10 male; 9 female) gymnasts were excluded from analysis. Of these 19 gymnasts, 17  
165 gymnasts recorded less than 10 weeks of data or provided inconsistent data, 1 gymnast formally  
166 withdrew from the study and 1 gymnast retired from gymnastics.

167

**\*\*\*Insert Table 2 near here\*\*\***

168 An average of  $16.3 \pm 3.8$  ( $\pm$  SD) weeks of training load and injury data were analysed for each gymnast.  
169 Weekly changes in training load varied between each week and each gymnast (**Figure 1**). Overall, the  
170 average change of weekly training load throughout the data collection period (weeks 2 to 20) was  $18.7\%$   
171  $\pm 26.8\%$  ( $\pm$  SD). During the data collection period, a total of 430 (average  $\pm$  SD;  $15.9 \pm 15.7$  per gymnast)  
172 days were recorded in an additional lockdown, isolation or when a gymnast had substantially restricted  
173 access to the gym (less than half of weekly sessions). Weekly changes in training load following  
174 additional lockdown, isolation or substantial restriction differed between gymnasts (**Figure 1**). On

175 average, weekly training load changed by  $109.8\% \pm 140.7\%$  ( $\pm$  SD) following an aforementioned  
176 restriction.

177

178 **\*\*\*Insert Figure 1 near here\*\*\***

179 The average weekly prevalence of an injury and the average weekly prevalence of a substantial injury  
180 was 28% (95% CI 23 to 34) and 11% (95% CI 8 to 13), respectively. The prevalence of a substantial injury  
181 was highest in week 3 (**Figure 2**) The most commonly described area for an injury to occur (weekly  
182 prevalence through the OSTRC-H2 questionnaires) was the lower extremities (59.1% [knee (20.1%),  
183 ankle/foot (19.5%), shin (7.9%), heel (6.7%), calf (1.8%), groin (1.2%), hamstring (1.2%), hip flexor  
184 (0.6%)], followed by the elbow (11.6%), shoulder (11.0%), wrist (6.7%) and chest/rib (6.1%). Other injury  
185 locations included back (3.0%), neck (1.2%), arm (0.6%) and thumb (0.6%). Discipline specific averages  
186 of training load and injury characteristics can be found in **Appendix 2**.

187

188 **\*\*\*Insert Figure 2 near here\*\*\***

189 There was no significant association between week-to-week changes in training load and the risk of a  
190 substantial injury in the subsequent week ( $P=0.441$ ) (**Figure 3**). However, there was a significant  
191 association between a preceding injury (niggle or substantial injury to a different body part) and a  
192 substantial injury (RR: 5.29,  $P=0.011$ ) (**Figure 4**).

193

194 **\*\*\*Insert Figure 3 & 4 near here\*\*\***

195 Six core themes and three sub-themes were identified through inductive thematic analysis using the  
196 interview guide as guidance. Definitions of the core themes can be found in **Table 3** and supporting  
197 quotes can be found in **Appendix 3**.

198

199 **\*\*\*Insert Table 3 near here\*\*\***

## 200 **Lockdown**

201 Home training during lockdown was discussed by all three coaches. This included individual training  
202 and group sessions on zoom . All three coaches expressed the benefits of training during lockdown from  
203 both a physical and mental perspective. In particular, coaches highlighted the positive impact that  
204 home training had on their gymnasts when they returned to training in the gym. Additionally, the MAG



205 coach articulated the benefit of lockdown itself on his older gymnast in terms of rest and recovery.  
206 Specifically, this gymnast was deemed to be in a period of rapid growth prior to lockdown.

207

### 208 **Challenges of returning to training in the gym**

209 Several challenges were articulated by coaches when they were able to return to training in a gym  
210 environment. One of the common challenges was knowing how quick to progress training alongside  
211 managing the speed of which the gymnast wanted to progress. Both the WAG and TRA coach also  
212 highlighted the growth of some gymnasts as a challenge when returning to training in the gym. Other  
213 challenges included gymnasts coming back at different abilities both physically and mentally, and  
214 challenges faced with unknown time frames, particularly regarding competitions getting cancelled.

215

### 216 *Rules & Restrictions*

217 Rules and restrictions were a specific challenge faced by all three coaches as they returned to training  
218 in the gym. These included late and/ or limited access to training venues, the banned use of foam pits  
219 and inability to support gymnasts from both a safety and confidence point of view. These rules &  
220 restrictions became a challenge when planning a safe return to gymnastics training.

221

### 222 **Return to training – Practice**

223 All three coaches described their return to training process as gradual, taking onboard the advice given  
224 from National Governing Bodies and experts in the field. Across the board, coaches started with basics  
225 and/or conditioning for the first few weeks before building up skills. In particular, the TRA coach  
226 emphasised breaking down skills further than normal. Although training was gradual, the MAG coach  
227 did add *'if the gymnast said can I try this, I feel good, I would let them if they felt they were ready to do*  
228 *go further, quicker than my plan erm because in my mind I've never been through this before and I was*  
229 *maybe too cautious and maybe holding back a bit too much.'*

230

### 231 *Monitoring training load*

232 During the data collection period, coaches were asked to monitor internal training load using sRPE. All  
233 three coaches commented on the benefit of using RPE and how it was used to influence training. This  
234 included stimulating conversation with their gymnasts and modifying training. Additionally, the WAG  
235 coach discussed monitoring elements of external load such as *'vault impacts so every time they hit the*  
236 *vault and that went up by 15% each week. Long swing actions on bars. On floor it was landing hard*  
237 *landings and onto soft they could do more but we strict on how many hard landings they did and impacts*  
238 *on the beam.'* The WAG coach also collected wellness measurements at the start of each training

239 session and an RPE at the end. None of these variables of load were previously monitored prior to  
240 lockdown. All three coaches expressed that they would like to continue monitoring internal training  
241 load variables in the future.

242

#### 243 *Full training*

244 The time period to return to full training (volume and ability) differed between coaches. The WAG coach  
245 suggested her gymnasts were at a similar ability of gymnastics before the second lockdown (~15 weeks)  
246 but was not able to reach the same volume (in reps per session) on all the pieces before the second  
247 lockdown. The MAG coach described his gymnasts to reach full training volume (in hours) to be  
248 between 6-8 weeks and 12 weeks to return to a similar ability prior to lockdown. The TRA coach  
249 described his gymnast to return to a similar amount of volume (measured in contacts) and ability within  
250 9-10 weeks.

251

#### 252 **Niggles and injuries**

253 All three coaches described their gymnasts to experience niggles with only one WAG gymnast  
254 experiencing both an ongoing and acute injury, whilst returning to training in the gym. Coaches  
255 expressed their caution towards niggles and injuries when returning to training in the gym and  
256 explained the purpose for increasing training gradually was a means of reducing the risk of any injuries.  
257 This gradual approach was reflected on by the TRA coach when his gymnast experienced niggles  
258 following a sudden increase in training.

259

#### 260 **Additional lockdowns or isolation**

261 The experience of additional lockdowns or isolation during the data collection period varied between  
262 all three coaches. This was attributed to the differing motivational levels of individual gymnasts,  
263 whether their gymnasts had to isolate and the home nation of the club. The WAG coach interviewed in  
264 this study was based in England. Although none of her gymnasts had to isolate, England went into a  
265 second, 4-week lockdown. Motivational levels during and following the second lockdown differed  
266 between gymnasts.

267

268 The MAG coach interviewed in this study was based in Wales and during the data collection period  
269 experienced local lockdowns and a 2-week lockdown ('circuit breaker'). In addition, some of his  
270 gymnasts had to isolate. Overall, motivation was perceived as constant but the varying level of  
271 gymnastics between individuals became challenging. The coach described a continuation of home

272 training during any lockdown or isolation and would then spend '*probably at least a week of building*  
273 *back up*' when returning to a gym environment.

274

275 Conversely, the TRA coach interviewed in this study was based in Scotland, which did not implement  
276 any additional lockdowns during the data collection period. The gymnast also did not have to isolate  
277 during this time. The coach described his gymnast as '*very self-motivated in himself*' and believed that  
278 his gymnast would be able to cope in the future if he was no longer able to train through Scottish and  
279 Great Britain elite athlete exemption.

280

### 281 **Influence on development**

282 Similar views were shared by all three coaches regarding the influence of lockdowns on their gymnasts'  
283 short and long-term development. Coaches explained that although lockdowns had influenced the  
284 gymnasts short term development, overall, their gymnast's long-term development (i.e., development  
285 to becoming an elite gymnast) would not be affected.

286

### 287 **Discussion**

288 The overall aim of this study was to observe and explore how competitive, young gymnasts returned to  
289 training in the gym following the UK's first national lockdown in light of the COVID-19 pandemic.  
290 Training at home during lockdown was seen as particularly beneficial on maintaining a level of fitness  
291 and proving advantageous when returning to training in the gym. Home training included, but was not  
292 limited to, strength and conditioning, flexibility, plyometrics, high intensity interval training (HIIT), and  
293 cardiovascular exercises (cycling, running). Artistic gymnasts also incorporated ballet and gymnastics  
294 specific conditioning (e.g. handstands, shaping etc) into their training during lockdown. The benefits of  
295 home training is aligned with previous research, where HIIT has been found to help maintain fitness  
296 during an offseason<sup>22,23</sup>. Lockdown was also described by one coach as a period of rest and recovery  
297 for a gymnast experiencing rapid growth prior to lockdown. Typically, gymnastics training is comprised  
298 of year long, intense training, however, additional periods of rest or less intense training could benefit  
299 gymnasts experiencing periods of rapid growth. During the growth spurt, youth athletes are found to  
300 be at a greater risk of injury and often experience awkwardness during this time<sup>24-26</sup>. In comparison,  
301 coaches found gymnasts who had experienced rapid growth throughout lockdown as a challenge when  
302 returning to the gym. Gymnastics coaches have previously described a temporary loss of skill associated  
303 with periods of rapid growth as challenging<sup>19</sup>. In addition, the rules and restrictions imposed to  
304 maintain a COVID secure environment was expressed as challenging whilst returning to gymnastics in

305 the gym. Restrictions included late and or limited access to facilities, banned use of foam pits and the  
306 inability to support gymnasts.

307

308 In general, coaches started with basics and conditioning before building up skills, it is, however, unclear  
309 as to whether coaches assessed their gymnasts at the start and during the return to training. Assessing  
310 the returning levels of fitness (i.e. flexibility, strength etc) provides a baseline for coaches, which  
311 therefore will aid the return to training process. A similar battery of testing is often conducted following  
312 an offseason to understand an athlete's current level of fitness<sup>27</sup>. The observed week-to-week changes  
313 in training load was found to vary amongst gymnasts. Previous research has found inconsistencies  
314 between coaches and athletes' perception of training load in other youth sports <sup>28,29</sup>. Similarly, the  
315 discrepancies between perceived gradual increases in training load and actual training load could be  
316 partly due to differences in prescribed external load and the observed internal load of gymnasts (sRPE)  
317 collected in this study <sup>30</sup>. Internal load was collected as it represents the individual response to external  
318 load and determines training outcome <sup>30,31</sup>. Coaches interviewed in the study did articulated the  
319 benefits of using RPE to monitor and manage training, alongside other variables of training load. Prior  
320 to this study, RPE was not commonly used to monitor training load. It was, however, something that  
321 these coaches would consider using as a tool to help manage training in the future, along with other  
322 methods of monitoring training. Currently, the understanding and process of monitoring training load  
323 in gymnastics varies between disciplines (MAG,WAG &TRA) <sup>19</sup>, therefore further research and coach  
324 education is required in this area.

325

326 The location of injuries was reported most commonly in the lower extremities, which is similar to  
327 previous research in youth gymnastics <sup>32,33</sup>, however, in this study, injuries were most prevalent in the  
328 knee. This differs from preceding literature, where injuries are most frequently reported to occur in the  
329 ankle<sup>32,33</sup>. The prevalence of a substantial injury appeared to be highest during the first few weeks of  
330 returning to training in the gym, with the highest prevalence of injury on week 3. This finding was similar  
331 to the high incidence of Achilles tendon ruptures immediately following the National Football League  
332 lockdown <sup>34</sup>. The return to training process was described as gradual but proved challenging on knowing  
333 how quick to progress and managing gymnasts' expectations of progression. On reflection, one coach  
334 believed they were over cautious on the progression and perhaps could have progressed slightly faster.  
335 Increasing training gradually was emphasised as a means of reducing the risk of injury. This could partly  
336 account for no significant association between week-to-week changes and the risk of a substantial  
337 injury amongst gymnasts. In comparison, large increases in absolute week-to-week changes in load  
338 have also been found to increase the risk of injury in professional rugby players and adolescent Gaelic

339 football players<sup>35,36</sup>. A similar concept was reflected on by one coach, where the gymnast experienced  
340 niggles following a sudden increase in training load and was therefore something they would have  
341 avoided in hindsight. The differences in findings may also be related to the small number of substantial  
342 injuries recorded in this data collection, at least 20 to 50 injury cases are required to detect a moderate  
343 to strong associations<sup>37</sup>. Coaches from all disciplines did experience niggles amongst their gymnasts.  
344 Some of these niggles may be a result of gymnasts experiencing rapid growth<sup>33</sup>. Interestingly, there  
345 was a significant association between an injury in the preceding week (niggle or substantial injury of a  
346 different body part) and a substantial injury. From an applied perspective, taking into consideration any  
347 injury (including niggles) whilst training may reduce the risk of a more substantial injury developing in  
348 the following week<sup>9</sup>. Research in this area is limited and requires further exploration.

349  
350 Additional lockdown, periods of isolation or substantial restrictions to the gym varied between  
351 gymnasts. Variations in these additional restrictions were a result of location, elite athlete exception  
352 (where athletes at a certain level have been given permission to continue training), facility access and  
353 self-isolation. Although one coach explained how he spent at least a week building training back up  
354 following an aforementioned restriction, the observed week-to-week changes in training load were  
355 varied. A possible explanation for this variation may be the ability of gymnasts to maintain similar modes  
356 and load when training during these restrictions compared to gym training. In addition, following  
357 restrictions or anticipated restrictions, coaches also articulated differing motivational levels of their  
358 gymnasts.

359  
360 Gymnasts were described as returning to their pre-lockdown abilities within approximately 9-15 weeks.  
361 The variation in time is likely to be due to additional restrictions, individual isolations as well as  
362 individual variations. Coaches shared similar views on the impact of COVID-19 on their gymnast's long  
363 and short-term development. Although their gymnast's short-term development had been affected by  
364 COVID-19, overall coaches believed that their gymnast's long-term development of becoming an elite  
365 level gymnast would not be affected.

366  
367 Due to the nature of the study, only a small number of high-level, pathway gymnasts training load and  
368 injury data was captured, therefore interpretations should be taken with caution. Similarly, only three  
369 coaches were interviewed and therefore experiences, and opinions may not be representative of all  
370 gymnastics coaches. Nevertheless, the mixed methods employed in this study provides a well-rounded  
371 appraisal of returning to training in the gym. In addition, there are a few limitations in relation to data  
372 collection. As the capture forms were self-reported by gymnasts (with coach or parent assistance), it is

373 unknown whether any training session or activities were not reported, whether gymnasts took part in  
374 other sports or physical activities outside of gymnastics and at what time point the training load forms  
375 were completed in respect to training. With regards to the Oslo Sports Trauma Research Center  
376 Questionnaire on Health Problems, the understanding and interpretation of the forms may have  
377 influenced the finding in this study. In terms of RPE collection, there is limited and mixed research  
378 regarding the use of RPE in youth athletes and therefore should be considered when interpreting  
379 results<sup>38</sup>. In addition, to overcome the long duration and different demands of gymnastics training, it  
380 was recommended that gymnasts provided a separate RPE rating for each activity. However, it is  
381 unclear whether sRPE captured in this way or in general is a valid method of collecting training load in  
382 gymnastics.

383

## 384 **Conclusion**

385 This study aimed to observe and explore competitive, young gymnasts returning to the gym following  
386 the first national lockdown in the UK. Training during lockdown was seen as beneficial in maintaining a  
387 level of fitness. Additionally, lockdown was also perceived as a possible time for rest and recovery.  
388 Coaches interviewed in this study experienced some challenges whilst returning to the gym including  
389 rules and restrictions to maintain a COVID secure environment. Coaches described a gradual increase  
390 in training to reduce the risk of injury and this could partly explain a non-significant association between  
391 week-to-week changes and the risk of injury. Additionally, there was a significant association between  
392 a substantial injury and an injury (niggle or substantial injury of a different body part) in the preceding  
393 week. Monitoring training load was seen as useful throughout the return to training process. At the  
394 time of interview, coaches believed that these gymnasts' long-term development would not be  
395 impacted from COVID-19.

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## 397 **Perspectives**

398 Learnings from this study can be applied to future situations, particularly when young, competitive  
399 gymnasts are away from the gym for an extended period of time. It is also likely that a number of these  
400 learnings could be applied to other high-performance, youth athletes who are unable to access facilities  
401 for a prolonged period of time. Young athletes should be encouraged to continue training from home  
402 (where applicable) during periods where the gym cannot be accessed, to help maintain a level of fitness.  
403 This could include strength, sport-specific conditioning, and cardiovascular training such as HIIT<sup>22</sup>. It is  
404 still recommended that any return to training is gradual, avoiding any large changes in week-to-week  
405 load, to reduce the risk of injury. Moreover, coaches should be encouraged to monitor internal loads

406 (e.g., RPE), alongside external measures of training load, to help guide and manage the return to  
407 training process. In general, injuries, including niggles, should also be taken into consideration to reduce  
408 the risk of a more substantial injury developing. For instance, training load modifications <sup>39</sup> and/or  
409 prehabilitation exercises could be used to prevent 'niggles' developing into substantial time-loss  
410 injuries. This study also raises the question as to whether youth gymnastics training is required to be  
411 intense all year round, particularly for gymnast's experiencing growths spurts. From a development  
412 point of few, reduced periods of training and scheduled periods of recovery may contribute to  
413 gymnast's longevity <sup>25</sup>.

414

415

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419

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421

422

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426

427 **Data availability:** Due to the nature of this research supporting data is not available.

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545

546 **Tables**

547 **Table 1** Coach characteristics

	Gender	Discipline	Qualification	Gymnast Programme	Home Nation
Coach 1	Female	WAG	Level 5	Foundation/Development	England
Coach 2	Male	TRA	Level 4	Junior	Scotland
Coach 3	Male	MAG	Level 3	Foundation	Wales

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552 **Table 2** Gymnast characteristics

Discipline	Age (yrs.)	Programme	Home Nation
WAG (n=9)	9 - 12 10.5 ± 1.1	Foundation (n=8) Development (n=1)	England (n=7) Wales (n=2)
MAG (n=5)	10 - 14 11.8 ± 1.5	Foundation (n=3) Development (n=2)	England (n=4) Wales (n=1)
TRA (Male=6; Female=6)	10 - 15 12.8 ± 1.5	Foundation (n=2) Development (n=7) Junior (n=3)	England (n=10) Scotland (n=2)

553 WAG – Women’s artistic gymnastics; MAG – Men’s artistic gymnastics; TRA – Trampoline gymnastics. Age: Min-Max; Mean ±  
 554 SD (Age at start of individual data collection). Programme: GBR performance pathway programme as of March 2020.

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558 **Table 3** Definitions of core themes

Theme	Definition
Lockdown	Experience and practice during the first initial lockdown
Challenges of returning to training in the gym SUB THEMES: Rules & restrictions	Challenges faced by coaches and gymnasts when returning to training in a gym environment
Return to training – Practice SUB THEMES: Monitoring training, Full training	The practice of returning to full training in a gym environment
Niggles and injuries	Niggles and injuries experienced whilst returning to training in a gym
Additional lockdowns or isolation	The influence and experience of additional lockdowns or isolation
Influence on development	Coaches perspective on gymnastics short and long-term development

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561 Figures

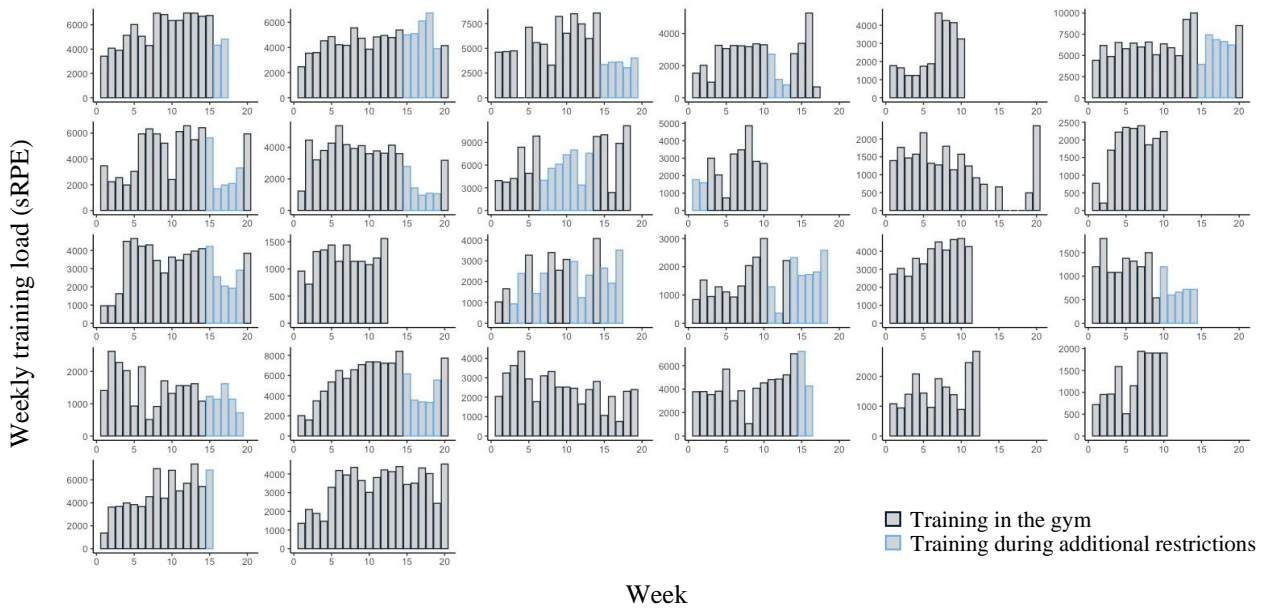
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564 Figure 1.

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**Figure 1.** Individual gymnast's weekly training load (sRPE). Blue bars represent training during additional lockdown, isolation or when a gymnast had substantially restricted access to the gym (less than half of weekly sessions).

567 Figure 2  
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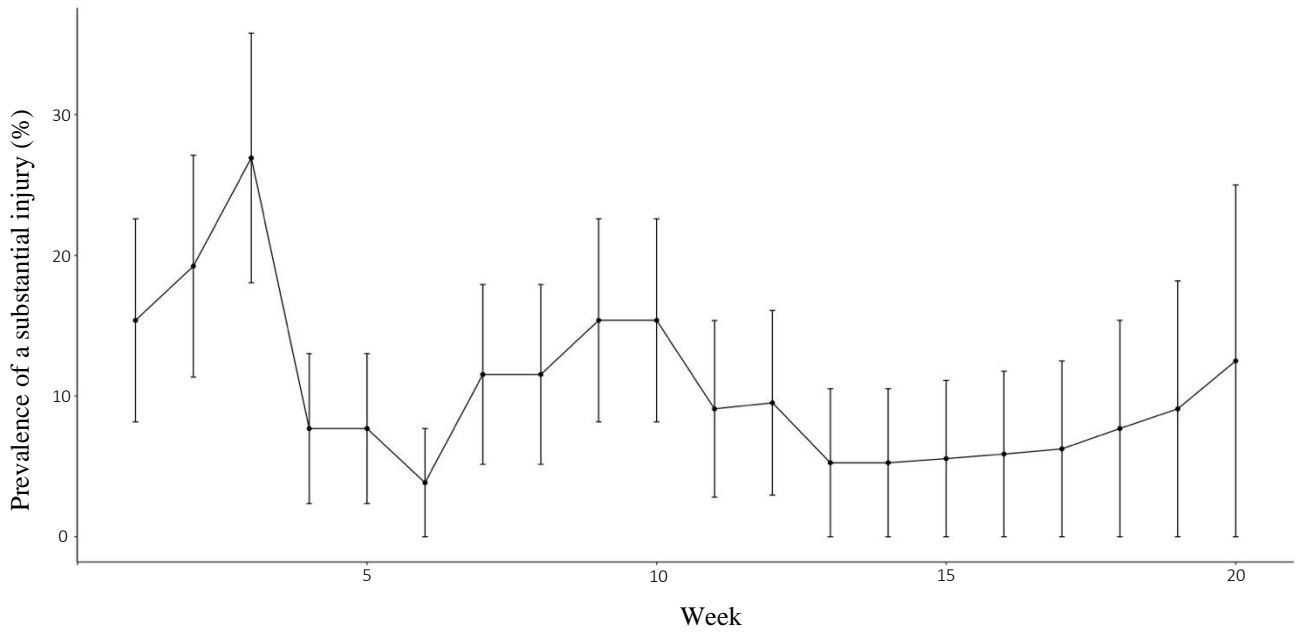


Figure 2. Weekly prevalence of a substantial injury. Prevalence  $\pm$  SE

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572 Figure 3

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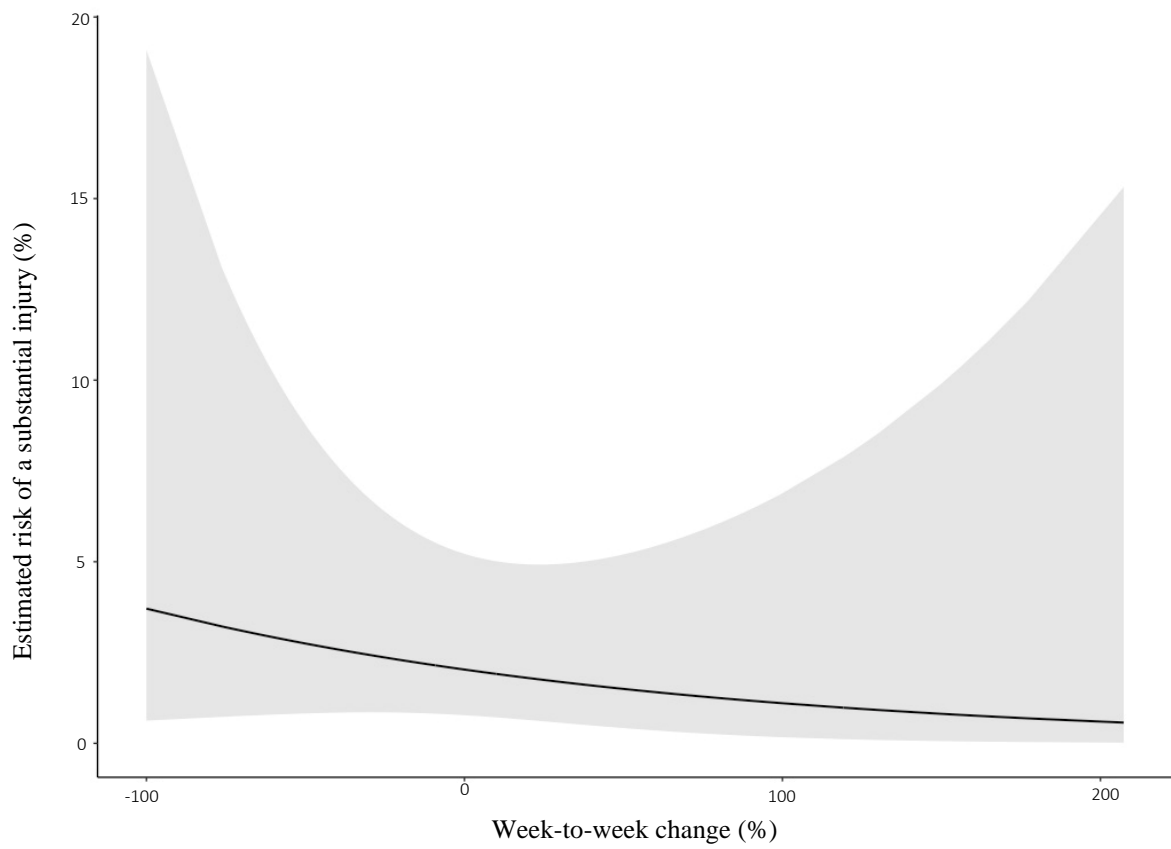
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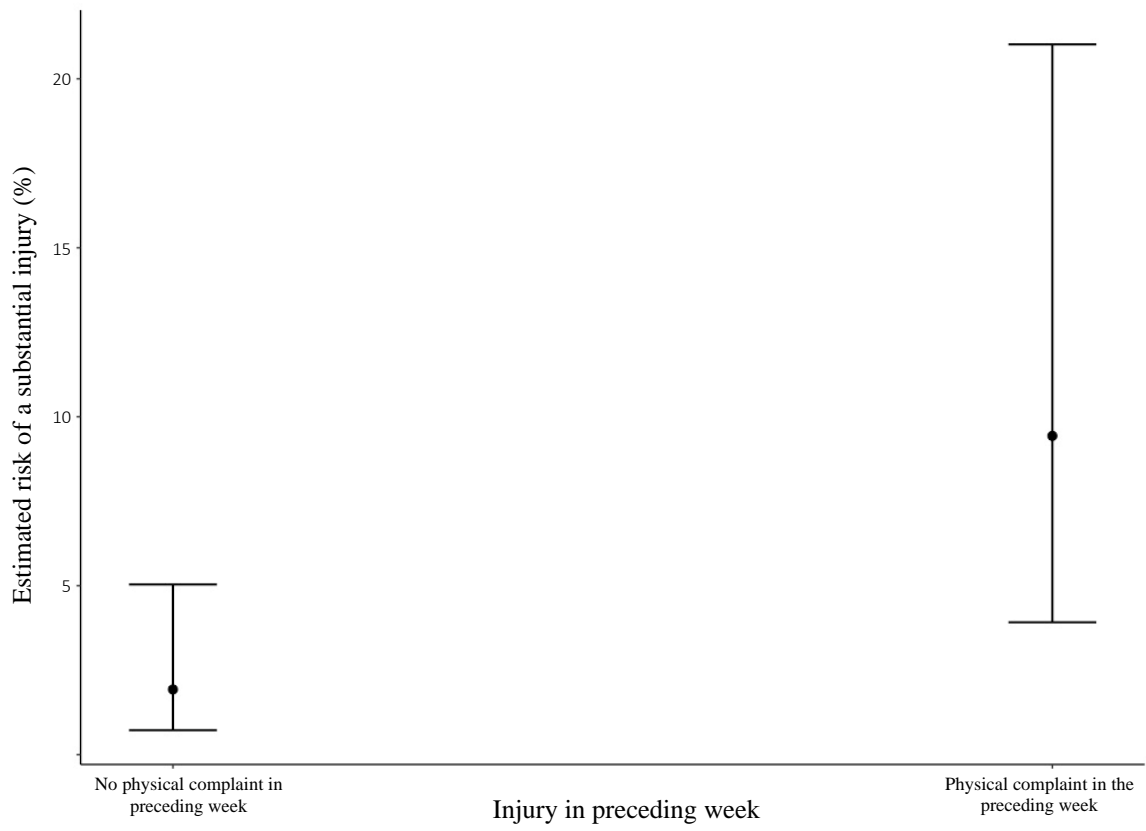
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**Figure 3.** Interaction between week-to-week changes in training load and the estimated risk of a substantial injury. Shaded areas represent 95% CI.

601 Figure 4  
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**Figure 4.** Interaction between any physical complaint in the preceding week and the estimated risk of a substantial injury. Estimated risk  $\pm$  95% CI.

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606 **Figure Legends**

607 **Figure 1** Individual gymnast's weekly training load (sRPE). Blue bars represent training during additional  
608 lockdown, isolation or when a gymnast had substantially restricted access to the gym (less than half of  
609 weekly sessions).

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613 **Figure 2** Weekly prevalence of a substantial injury. Prevalence  $\pm$  Standard Error

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617 **Figure 3** Interaction between week-to-week changes in training load and the estimated risk of a  
618 substantial injury.

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622 **Figure 4** Interaction between an injury (any physical complaint including substantial injury to a different  
623 body part) in the preceding week and the estimated risk of a substantial injury.

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