

**Pre-competition body mass loss characteristics of
Brazilian jiu-jitsu competitors in the United Kingdom**

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1 **Pre-competition body mass loss characteristics of Brazilian jiu-jitsu competitors in the UK**

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33 Pre-competition body mass loss characteristics of Brazilian jiu-jitsu competitors in the UK

34 Abstract

35 Background: Brazilian jiu-jitsu (BJJ) is a grappling based combat sport in which competitors engage in
36 pre-competition acute 'weight' loss (AWL) and rapid 'weight' loss (RWL) to achieve body mass (BM)
37 required for their desired division. AWL/RWL practices of UK BJJ competitors have not previously been
38 reported. Methods: In this study we used the rapid weight loss questionnaire (RWLQ) adapted for BJJ
39 to determine the prevalence and magnitude of AWL/RWL in UK BJJ, the prevalence of methods used
40 and the key stakeholder influences on these practices. As a secondary investigation we aimed to
41 determine whether there was any effect of age starting BJJ on AWL/RWL. Results: Of 115 completed
42 responses, 59% stated they performed AWL/RWL before competition. Mean BM loss for this
43 competition was 1.9 ± 3.8 kg ($2.3 \pm 4.6\%$), with 34% of participants starting BM loss 3-7 days prior and
44 16% starting 0-2 days prior. Methods used tend to be achieving calorie deficit via exercise and diet
45 rather than hypohydration, with little advice from formally qualified personnel. Participants who
46 perform AWL/RWL started training ($BF_{10} = 199$, $d = .72$) and competing ($BF_{10} = 107$, $d = .68$) in BJJ
47 younger than those who do not perform AWL/RWL. Conclusion: AWL/RWL is prevalent in UK BJJ, but
48 not at the magnitude of other combat sports or countries. Though negative effects of extreme
49 hypohydration are unlikely, there may be a higher chance of eating disorders in BJJ, particularly due
50 to the young age of AWL/RWL commencement.

51 Introduction

52 Brazilian jiu-jitsu (BJJ) is a grappling based combat sport in which the aim is to physically control the
53 opponent to gain a grounded, dominant position to achieve a 'submission' win, where the opponent
54 admits defeat due to joint locks or chokes. Bout duration can vary between belt levels, sex and age
55 division (Presley, 2018). Competitive bouts for non-International BJJ Federation (IBJJF) competitions
56 in the United Kingdom (UK) are generally 1 x 5 minute round for all categories with the exception of
57 black belts who compete in 1 x 10 minute round. Bout winners are determined through points scored
58 via successful manoeuvres in the incidence of no submissions occurring. Similar to other combat
59 sports, BJJ competitors are separated into body mass (BM) divisions that can differ between
60 competitions but tend to follow the delineations recommended by the IBJJF. Competitors official BM
61 recorded during weigh-in includes the gi which is to be worn in competition. Weigh-ins at UK based
62 non-IBJJF tournaments take place the morning of competition upon participant arrival at the venue.
63 This often differs in other countries, however, where tournament participants weigh-in together
64 immediately prior to their tournament bracket commencing (Presley, 2018).

65 Within BM regulated sports it is common for participants to reduce their BM prior to weigh-in to
66 ensure they qualify for the lightest category possible for their body size (Khodae, Olewinski, Shadgan,
67 & Kinningham, 2015). These methods range from increasing exercise and dieting to extreme
68 hypohydration via heat exposure and fluid restriction (Langan-Evans, Close, & Morton, 2011). These
69 processes can occur over several weeks/months, but often take place in the 7 days prior to
70 competition (termed acute 'weight' loss – AWL) with a more intensive period of BM reduction 0-48
71 hours prior to weigh-in (termed rapid 'weight' loss – RWL) (Reale, Slater, & Burke, 2017). The
72 prevalence and magnitude of this practice differs between combat sports (Barley, Chapman, & Abbiss,
73 2018; Brito et al., 2012; Matthews, Stanhope, Godwin, Holmes, & Artioli, 2018), with the dangers of
74 extreme AWL/RWL being highlighted (V. Coswig & Del Vecchio, 2016; V. S. Coswig, Fukuda, & Del
75 Vecchio, 2015; Crighton, Close, & Morton, 2016; Dolan et al., 2012, 2012; Murugappan et al., 2018)
76 and the effects on performance debated (Barley, Iredale, Chapman, Hopper, & Abbiss, 2017; Reljic,
77 Feist, Jost, Kieser, & Friedmann-Bette, 2016; Timpmann, Ööpik, Pääsuke, Medijainen, & Erelina, 2008).

78 Whilst there appears to be little effect of AWL/RWL on winning or losing in striking inclusive sports
79 (Daniele, Weinstein, Wallace, Palmieri, & Bianco, 2016; Kirk, Langan-Evans, & Morton, 2020; Reale,
80 Cox, Slater, & Burke, 2017), there is some support for this practice being predictive of success in
81 grappling only events (Reale, Cox, Slater, & Burke, 2016; Wroble & Moxley, 1998).

82 BM loss prior to competition in BJJ has been reported previously by Barley et al. (2018) using a mixed
83 group of practitioners mostly from USA, Australia and Canada via online remote survey. This study
84 found BJJ athletes engaged in AWL/RWL less often, reduced BM by less and regained less BM post
85 competition than those in other combat sports. Though this study shows that AWL/RWL in BJJ is not
86 as extreme as related sports (Brechney, Chia, & Moreland, 2019), the effects of different standards of
87 competition or time spent training or competing in BJJ were not discussed or analysed. Equally, due
88 to the multi-national cohort used, the specific AWL/RWL characteristics of BJJ competitors in the UK
89 cannot be directly inferred. Given the potential differences in bout length and weigh-in times of UK
90 BJJ tournaments in comparison to other regions, participants in this country may have unique
91 AWL/RWL characteristics. Therefore, our aim in this study was to determine the prevalence,
92 magnitude and stakeholder influences of AWL and RWL amongst BJJ participants in the UK. A
93 secondary aim was to explore whether there is any influence of time spent in the sport or competition
94 frequency on AWL/RWL practices. To achieve these aims we surveyed competitors at a regional BJJ
95 tournament regarding their use of pre-competition BM manipulation, how long they have been doing
96 this and who influences their decisions and choices during this process. Based on previous data from
97 other countries we hypothesised that BM manipulation would be highly prevalent in UK BJJ though at
98 a lower magnitude than seen in other combat sports, with the majority of influence coming from
99 coaches and training partners instead of qualified personnel.

100 **Methods**

101 Data were collected on one day at a regional adult (18 years old and above) BJJ tournament in the UK.
102 Data were collected using the pre-validated rapid weight loss questionnaire (RWLQ) (Artioli et al.,
103 2010) in English modified to refer to 'BJJ' in place of 'judo' where appropriate. The paper-based RWLQ
104 was distributed immediately after participants had registered to compete and completed their official
105 weigh-in procedures upon arrival at the venue. In total 125 RWLQ forms were distributed, with 10
106 being returned incomplete due to questions being missed out. This left 115 completed RWLQ forms,
107 7 from females and 108 from males. The full cohort had a mean age = 29.3 ± 7.5 years and reported
108 habitual mass = 80.5 ± 13.3 kg. Ethical approval was provided by the University of Derby research
109 ethics committee, with project descriptions and statements of implied consent being provided on the
110 RWLQ. Permission from tournament organisers as gatekeepers was confirmed four weeks prior to the
111 tournament.

112 All data were found to be normally distributed according to Shapiro-Wilk test ($p > .05$). Inferences in
113 each of the following tests were based on the calculation of Bayes factors (BF), to provide support for
114 either the hypothesis (BF_{10}) or the null hypothesis (BF_{01}) respectively. To determine whether body
115 mass loss (BML) participants were younger or began BJJ training and/or competition younger than
116 non-BML participants, one-sided Bayesian independent t tests were performed. A two-sided Bayesian
117 independent t test was used to determine if there was a difference in competition frequency between
118 BML and non-BML. Both tests were conducted using a default JZS Cauchy prior = .707. Cohen's d using
119 the standard deviation of the mean scores as the denominator was calculated as the effect size. To
120 examine if there was an effect of age range at which participants started training in BJJ or started
121 competing in BJJ, BML and non-BML were compared in terms of frequency in each reported age range
122 using Bayesian chi-squared (χ^2) multinomial tests. The age range frequencies of the non-BML group
123 were used as the expected count variable to test if BML participants differed from the rest of the
124 sample population. A χ^2 multinomial test was also used to determine whether or not BML

125 participants started engaging in AWL/RWL earlier or later in life. Finally, the frequency of the number
 126 of days prior to competition participants started BM manipulation was examined via χ^2 multinomial
 127 test.

128 The following thresholds were used for each BF: 1-2.9 = anecdotal; 3-9.9 = moderate; 10-29.9 = strong;
 129 30-99.9 = very strong; ≥ 100 = decisive. Due to default priors being used, BF robustness checks were
 130 performed. Where a result was found to cross a threshold, both thresholds are reported (Wetzels &
 131 Wagenmakers, 2012). Though not reported in the text, any result found to have $BF \geq 3$ was also found
 132 to have acceptably low probability of type 1 error ($p < .05$). Cohen's d thresholds were set at: small \geq
 133 .2; moderate $\geq .6$; large ≥ 1.2 ; very large ≥ 2 . Each of the named statistical tests were completed using
 134 JASP 0.14.0 (JASP Team, Amsterdam, Netherlands).

135 Results

136 Of the 115 completed RLWQ responses 68 (59%) stated they participated in AWL/RWL prior to
 137 competition, with 47 (41%) stating they did not. Participant descriptive data split by group are
 138 reported in Table 1. Table 2 displays the reported competition standards and achievements of BML
 139 and non-BML participants. Table 3 reports the methods used to perform AWL/RWL whilst Table 4
 140 displays the influences of different stakeholders on AWL/RWL practices. Respondents who did
 141 perform AWL/RWL reduced BM by 1.9 ± 3.8 kg ($2.3 \pm 4.6\%$) for this competition, based on their
 142 reported habitual mass and their official competition mass. Their estimated normal BM loss prior to
 143 competition was 2.7 ± 2 kg ($3.4 \pm 2.5\%$). BML participants estimated regaining 2.3 ± 1.6 kg in the week
 144 after each competition. They also reported their greatest BM loss = 5.1 ± 3.2 kg ($6.3 \pm 3.7\%$) and that
 145 they performed BM loss 1.6 ± 2.1 (range = 0 – 10) times in the previous calendar year. BML participants
 146 (range = 0 – 21) competed more often than non-BML participants (range = 0 - 12) in the previous
 147 calendar year ($BF_{10} = 6$, $d = .53$). An overall majority of BML participants began BM loss at some point
 148 in the 14 days prior to competition (Figure 1), with half of the cohort beginning in the 7 days
 149 immediately before competition, indicating a high prevalence of AWL. Though less prevalent, 16%
 150 reported engaging in RWL in the 48 hours before competition. Based on this pattern, BML participants
 151 were decisively more likely to commence AWL/RWL closer to the date of competition ($\chi^2 = 33.294$,
 152 $BF_{10} = 8,030$). As shown in Table 1 and Figure 2, BML participants started training in BJJ younger than
 153 non-BML participants ($BF_{10} = 199$, $d = .72$). BML participants also started competing younger than non-
 154 BML ($BF_{10} = 107$, $d = .68$). These results are also reflected in the frequency count of each range for the
 155 age of commencing BJJ training ($\chi^2 = 56.874$, $BF_{10} = 1.294^{e+6}$) (Figure 2a), and the age of first competing
 156 ($\chi^2 = 28.592$, $BF_{10} = 174$) (Figure 2b). BML participants were found to be more likely to first engage
 157 with AWL/RWL younger in life than later in life ($\chi^2 = 62.588$, $BF_{10} = 2.934^{e+10}$) (Figure 2c). Though BML
 158 participants tended to be younger than non-BML participants at the time of data collection, this result
 159 was anecdotal-moderate ($BF_{10} = 2.8 - 4$, $d = .44$).

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Table 1 – Participant descriptive data by group

	BML	Non-BML
Age (years)	27.9 \pm 6.3	31.2 \pm 8.6
Habitual body mass (kg)	78.9 \pm 9.3	83 \pm 17.4
Age started BJJ training (years) *	23.6 \pm 7.1	29.1 \pm 8.5
Age started BJJ competition (years) *	24.6 \pm 6.7	29.7 \pm 8.5
Number of times competed in 12 months prior (n) **	3.6 \pm 4.2	1.7 \pm 2.3

*Nb. BML = Body mass loss group; Non-BML = Non-body mass loss group; BJJ = Brazilian jiu-jitsu; * = decisive differences between groups; ** = moderate differences between groups*

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Table 2 – Participant reported competition standards

	Regional Achievement		National Achievement		International Achievement	
	BML	Non-BML	BML	Non-BML	BML	Non-BML
Never participated	6 (9.5%)	9 (20%)	25 (39%)	32 (72%)	45 (70%)	40 (90%)
Participated without winning medal	13 (20.5%)	6 (14%)	8 (13%)	2 (5%)	10 (16%)	2 (5%)
Won medal	45 (70%)	29 (66%)	31 (48%)	10 (23%)	9 (14%)	2 (5%)

Nb. BML = Body mass loss group; Non-BML = Non-body mass loss group

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Table 3 – Reported methods of acute and rapid body mass loss

	Always	Sometimes	Almost never	Never used	Don't use anymore	Total
Gradual dieting	35 (51.5%)	19 (28%)	5 (7.5%)	8 (11.5%)	1 (1.5%)	68
Skipping 1 or 2 meals	17 (25%)	24 (35.5%)	12 (17.5%)	13 (19%)	2 (3%)	68
Fasting	10 (14.5%)	19 (28%)	16 (23.5%)	19 (28%)	4 (6%)	68
Restricting fluid intake	11 (16%)	22 (32.5%)	10 (14.5%)	23 (34%)	2 (3%)	68
Increased exercise (more than usual)	27 (40%)	21 (31%)	9 (13%)	11 (16%)	0 (0%)	68
Training intentionally in heated rooms	9 (13%)	12 (17.5%)	13 (19%)	33 (49%)	1 (1.5%)	68
Saunas	10 (14.5%)	18 (26.5%)	15 (22%)	23 (34%)	2 (3%)	68
Training with rubber/plastic suits	4 (6%)	5 (7.5%)	8 (11.5%)	44 (65%)	7 (10%)	68
Use winter or plastic suits during the whole day and/or night (without exercising)	3 (4.5%)	4 (6%)	9 (13%)	49 (72%)	3 (4.5%)	68
Spitting	4 (6%)	5 (7.5%)	7 (10%)	49 (72%)	3 (4.5%)	68
Laxatives	3 (5%)	6 (8%)	6 (9%)	47 (69%)	6 (9%)	68
Diuretics	0 (0%)	3 (4.5%)	7 (10%)	53 (78%)	5 (7.5%)	68
Diet pills	1 (1.5%)	5 (7.5%)	5 (7.5%)	54 (79%)	3 (4.5%)	68
Vomiting	3 (4.5%)	3 (4.5%)	4 (6%)	54 (79%)	4 (6%)	68

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Table 4 – Influences on acute and rapid body mass loss methods and prevalence

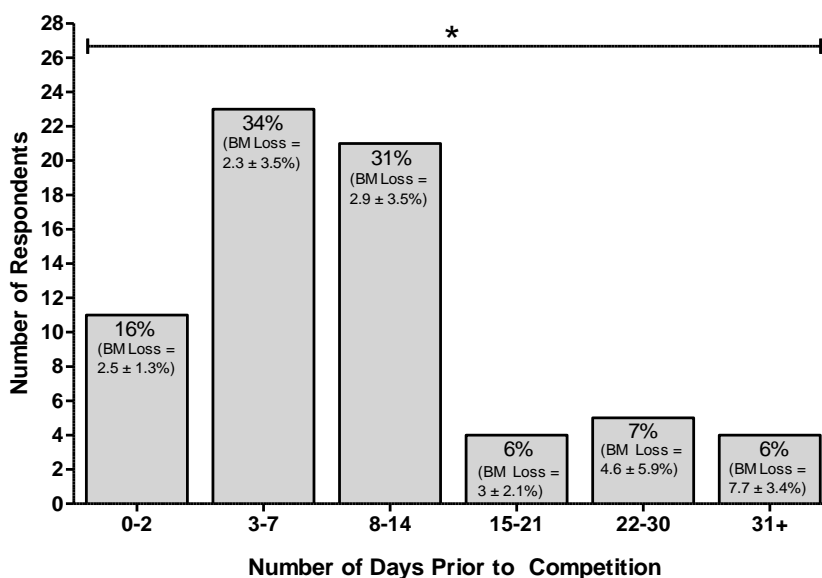
Training partner	Fellow BJJ competitor	BJJ coach	Personal trainer	Physician/Doctor	Dietician	Parents	Other
18 (26.5%)	15 (22%)	14 (20.5%)	3 (4.5%)	1 (1.5%)	3 (4.5%)	2 (3%)	12 (17.5%)

Nb. BJJ = Brazilian jiu-jitsu

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Figure 1 – Number of days prior to competition BJJ competitors began body mass loss and the magnitude of body mass loss of each group. * *= Number of days prior to competition to commence AWL/RWL decisively skewed towards fewer days; % = proportion of participants commencing AWL/RWL in this time; (BM Loss %) = mean±SD BM% reduced by participants commencing AWL/RWL in this time period; BJJ = Brazilian jiu-jitsu*

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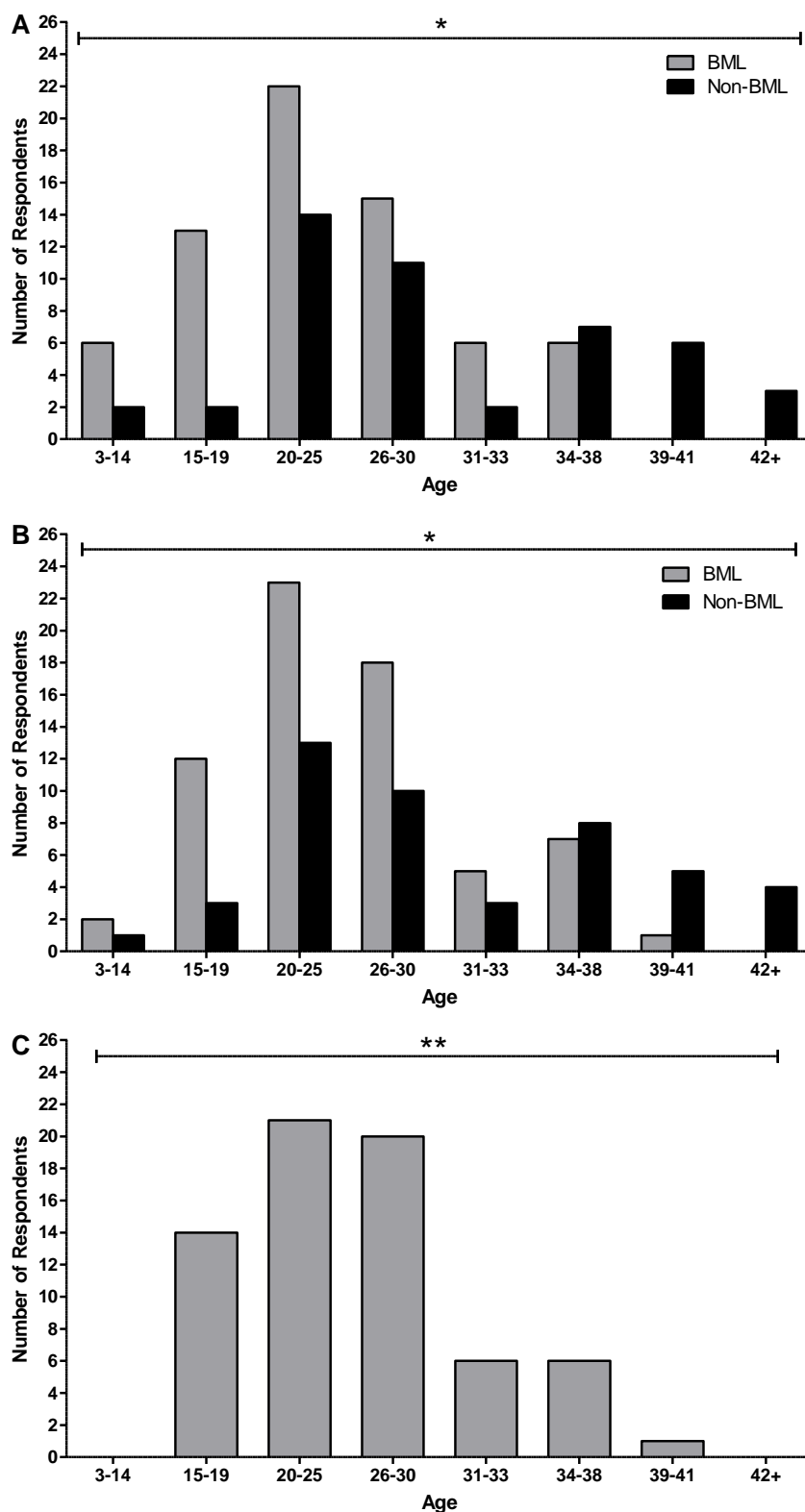
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210 **Figure 2 – A) Age ranges BML and non-BML participants began BJJ training; B) Age ranges BML and**
 211 **non-BML participants began competing in BJJ; C) Age ranges BML participants began engaging in**
 212 **AWL/RWL prior to competition. * = Age range frequencies of BML are decisively different to non-BML; ** = Age**
 213 **range frequencies are decisively skewed towards younger ages; BML = Body mass loss group; Non-BML = non-body mass**
 214 **loss group; BJJ = Brazilian jiu-jitsu**
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216 **Discussion**

217 In this study we aimed to characterise the pre-competition BM loss prevalence of UK based BJJ
218 competitors and the most common practices employed by this group of athletes. As a secondary aim,
219 we also attempted to highlight any possible influence of time in the sport on BM loss. We found that
220 over half of the surveyed cohort engaged in BM manipulation in the build up to competition, with 50%
221 of these performing AWL in the 7 days prior. RWL in the 48 hours before was present in 16% of BML
222 participants. Participants who started training and/or competing in BJJ younger in their lives appear
223 more likely to take part in AWL/RWL than those who take up BJJ later in life. As seen in other combat
224 sports, these athletes rely on mostly unqualified personnel for advice and guidance during the
225 AWL/RWL process.

226 Our data indicates that there is a lower prevalence and magnitude of BM manipulation in UK based
227 BJJ practitioners than seen in other countries (Barley et al., 2018; Franchini, Brito, & Artioli, 2012). The
228 reasons behind this are unclear, but given that 60% of the Barley et al. sample was based in North
229 America, the comparative lack of cultural influence of wrestling in the UK may be a factor, based on
230 how embedded AWL/RWL practices are in this sport from a young age (Lambert & Jones, 2010;
231 Sansone & Sawyer, 2005). It may be the case that BJJ participants based in North America have also
232 taken part in wrestling during their lives and have continued the associated AWL/RWL practices whilst
233 in BJJ. This lack of cultural crossover in the UK may reduce the likelihood for UK BJJ competitors to
234 view BM manipulation as necessary or even an option, especially amongst those who begin BJJ later
235 in life. Only four of the non-BML group took up BJJ before the age of 20, in comparison to twenty-one
236 in the BML group. That fourteen of the BML athletes also started engaging in pre-competition BM loss
237 in this time suggests that participants are more likely to perform AWL and/or RWL if they have been
238 'brought up' in the sport. This pattern continues in the 20-33 age ranges, with the majority of
239 participants starting BJJ competition in this time also performing AWL/RWL. This demonstrates that
240 the older a person starts BJJ, the less likely they are to start 'cutting weight'. The reasons for this
241 cannot be determined from these data as the RWLQ does not inquire about reasons for AWL/RWL.

242 There is a trend for BML participants to compete and win medals at a higher standard than non-BML.
243 This association between AWL/RWL and competition standard does, however, require the following
244 caveat. The RWLQ was designed for use in judo (Artioli et al., 2010), a sport that has clear distinctions
245 between regional, national and international performance standards. These distinctions are not as
246 clear in BJJ and are made more ambiguous by the existence of national and international tournaments
247 for lower belts including white belt and blue belt. Though a BJJ competitor may have competed
248 'internationally' as a white belt, this should not infer that they compete at a higher standard than
249 someone who competes 'regionally' but as a brown or black belt. What can be stated though, is that
250 BML participants compete almost twice as often as non-BML. The interpretation that may be drawn
251 here is that the younger a person starts BJJ, the more likely they may be to view competition as a
252 motivating factor and that BM manipulation is required for success. This could be evidence that this
253 practice has become part of the culture of BJJ, but only for those who view competition and winning
254 as important, a group people appear more likely to be a part of the younger they join the sport. This
255 is of concern given the chronic negative physical and psychological effects related to starting such
256 practices before biological maturity is reached (Werner et al., 2013). Research into BJJ coach's and
257 athlete's motivations for, and understanding of, AWL/RWL within the sport's culture may be required
258 to fully understand the reasons for this finding.

259 There is a current lack of agreed definitions for either AWL or RWL. The delineations used here are in
260 keeping with the aforementioned general practice of BM being reduced acutely via diet and exercise
261 in the 7-30 days prior to competition with 1-6 days of hypohydration to reduce BM in a more 'rapid'
262 fashion leading to weigh-in (Reale, Slater, et al., 2017). The acute and chronic effects of such
263 hypohydration methods are an area of key research (V. Coswig & Del Vecchio, 2016; V. S. Coswig et
264 al., 2015; Crighton et al., 2016; Dolan et al., 2012, 2012), with the magnitude of BM loss via

265 hypohydration being of most concern (Kasper et al., 2018; Murugappan et al., 2018). Within our
266 sample, however, though slightly more than 1/6 of BML participants engaged in RWL, the amount of
267 BM being lost is relatively low (Barley et al., 2018; Barley, Chapman, & Abbiss, 2019; Matthews et al.,
268 2018). Additionally, the most prevalent reported methods tend to avoid hypohydration, with most
269 participants stating they 'sometimes' or 'never' use these methods. This implies that BJJ competitors
270 in the UK are attempting to 'make weight' whilst avoiding the negative health or performance effects
271 caused by extreme hypohydration. There is, however, a relatively high use of attempting calorie deficit
272 to achieve BM reduction via increased exercise and reduced food intake. Calorie restriction may cause
273 negative changes in electrolyte balance, in turn leading to hypohydration due to decreased osmolality.
274 This may be further exacerbated by combining calorie and water restriction over as short a time period
275 as 24 hours (James & Shirreffs, 2013). Subsequently, participant hydration may still be negatively
276 affected dependent on the ratios and combinations of AWL/RWL methods used. Unfortunately, a
277 shortfall of the RWLQ is that it does not provide information on timescales of methods used, or how
278 much each was used relative to others. This prevents any firm statements being made on the efficacy
279 of AWL/RWL methods used in BJJ based on RWLQ data alone. To understand which specific practices,
280 if any, have potential to be of risk to this population, real time examinations of BJJ athlete BM
281 manipulation using direct measurements of energy and fluid intake should be prioritised.

282 Our lack of knowledge regarding the relative contributions of energy and fluid restriction also inhibits
283 our understanding of how the time between weigh-in and competition may affect glycogen
284 resynthesis and/or rehydration. Due to UK BJJ competitors weighing-in upon arrival at the venue, they
285 may either have up to 1-2 hours to recover from AWL/RWL, or only a few minutes. This contrasts to
286 professional boxing and MMA where competitors weigh-in 24-30 hours prior to competition (Kirk et
287 al., 2020; Langan-Evans et al., 2011). Post weigh-in recovery of muscle glycogen may potentially occur
288 during the time provided in boxing and MMA, but little glycogen is likely to be recovered in the
289 minutes/hours BJJ competitors are afforded (L. M. Burke, van Loon, & Hawley, 2017). Conversely,
290 sufficient rehydration may be achieved within the short post weigh-in timeframes typical of BJJ if
291 guided strategies are used (Evans, James, Shirreffs, & Maughan, 2017). Therefore, it may be that
292 calorie restriction has greater impact on performance in BJJ than hypohydration (L. M. Burke et al.,
293 2017). Notably, however, combat sport athlete's ad libitum rehydration methods do not appear to be
294 effective (Alves et al., 2018; Moghaddami, Gerek, Karimiasl, & Nozohouri, 2016), suggesting that
295 specific interventions may still be required for BJJ athletes who do perform dehydration.

296 Prolonged energy restriction during periods of increased training has been linked to incidences of low
297 energy availability (LEA) particularly for participants engaged in regular competition (L. M. Burke et
298 al., 2018). BML participants in this study reported competing twice as often as non-BML, but with
299 relatively low BM loss prior to competition (Barley et al., 2018). Further to this, there is a general trend
300 within our data of BML participants who reduced their BM by a greater amount doing so over a longer
301 period of time. The reported BM loss is also below the previously suggested upper threshold of 5%
302 (Franchini et al., 2012), with only participants beginning BML 22+ days prior being consistently above
303 this. Based on such moderate BM reduction practices, LEA may be unlikely in UK based BJJ athletes.
304 Greater concern may be caused by the reported young age of first engaging in AWL/RWL. This may be
305 indicative of potential eating disorders becoming present in BJJ (Glazer, 2008). Given the lack of
306 qualified support used by BJJ competitors during BM manipulation, this risk is likely increased. With
307 this support being similar between most combat sports (Barley et al., 2018) it is possible that such
308 disorders may be common amongst athletes in these events. This would be an area of research focus
309 to ensure the chronic health of these participants moving forward, with club, coach and governing
310 body engagement being highly recommended.

311 Our findings in relation to BM manipulation methods used should be examined within the contexts of
312 the terms presented to the participants. For example, 'fasting' is defined as the abstention from eating
313 or drinking (Maughan et al., 2012). Under this description fasting is performed between meals
314 regardless of their frequency. Participant's colloquial understanding of the term may differ, however,

315 with people possibly relating it to prolonged food restriction (>12 hours) such as practiced for religious
316 purposes (L. Burke, 2010). This inconsistency likely confounds the data provided by this section of the
317 RWLQ. Redefining and repurposing the terms on the RWLQ may be required to allow future data to
318 be more robust while maintaining comparisons between studies. Additionally, as previously
319 mentioned, the terms AWL and RWL are currently poorly defined, predominantly being based on the
320 time scales BM reduction takes place over (Reale, Slater, et al., 2017). As seen in our data, however,
321 the methods used and the rate at which BM is reduced is of more concern than how long this process
322 takes. Determining clear delineations of AWL and RWL based on methods, BM reduction rate and
323 magnitude alongside timescale should be an immediate aim for researchers to better inform and assist
324 practitioners.

325 In conclusion, our data demonstrates for the first time that over half of UK based BJJ competitors take
326 part in BM manipulation prior to competition, though at a lower magnitude than seen in other combat
327 sports. Participants who start training and competing in BJJ at a younger age are more likely to perform
328 AWL/RWL than those who start later in life. Methods used tend to focus on achieving calorie deficit
329 rather than hypohydration, but in keeping with practices in combat sports in general, very little advice
330 is sought from qualified personnel. Though BJJ participants appear unlikely to suffer the effects of
331 extreme hypohydration or LEA, there may be the possibility of eating disorders being prevalent
332 amongst this population due to the young age of first engaging in BM reduction. Future studies should
333 focus on the specific ratios of methods used by BJJ competitors during BM manipulation to determine
334 the effects of their practices on energy availability, hydration, post weigh-in recovery and the influence
335 of AWL/RWL on performance and success.

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338 involvement in their competition, and also to thank each of the competitors who took part in our
339 research.

340 **Authorship**

341 TW and CK were responsible for project planning, design, data analysis and manuscript preparation.
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