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WHITE, Tyler and KIRK, Christopher

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

Tyler White¹ and Christopher Kirk^{1,2}

Affiliations:

¹University of Derby, College of Science and Engineering, Kedleston Rd., Derby, United Kingdom, DE22 1GB

²Liverpool John Moores University, Research Institute for Sport and Exercise Sciences, Tom Reilly Building, Liverpool, United Kingdom, L3 3AF

Email address and contact details of corresponding author: Christopher Kirk, C.Kirk@Altius-Sports.co.uk, ORCID: 0000-0002-6207-027X

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Abstract

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

Introduction

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

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

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

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

Methods

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

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

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

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

Results

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

Table 1 – Participant descriptive data by group

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

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		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

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

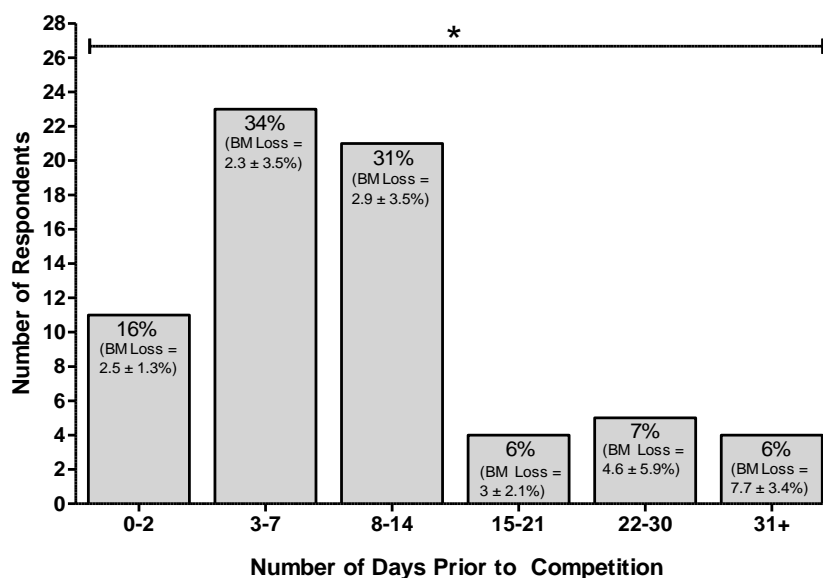
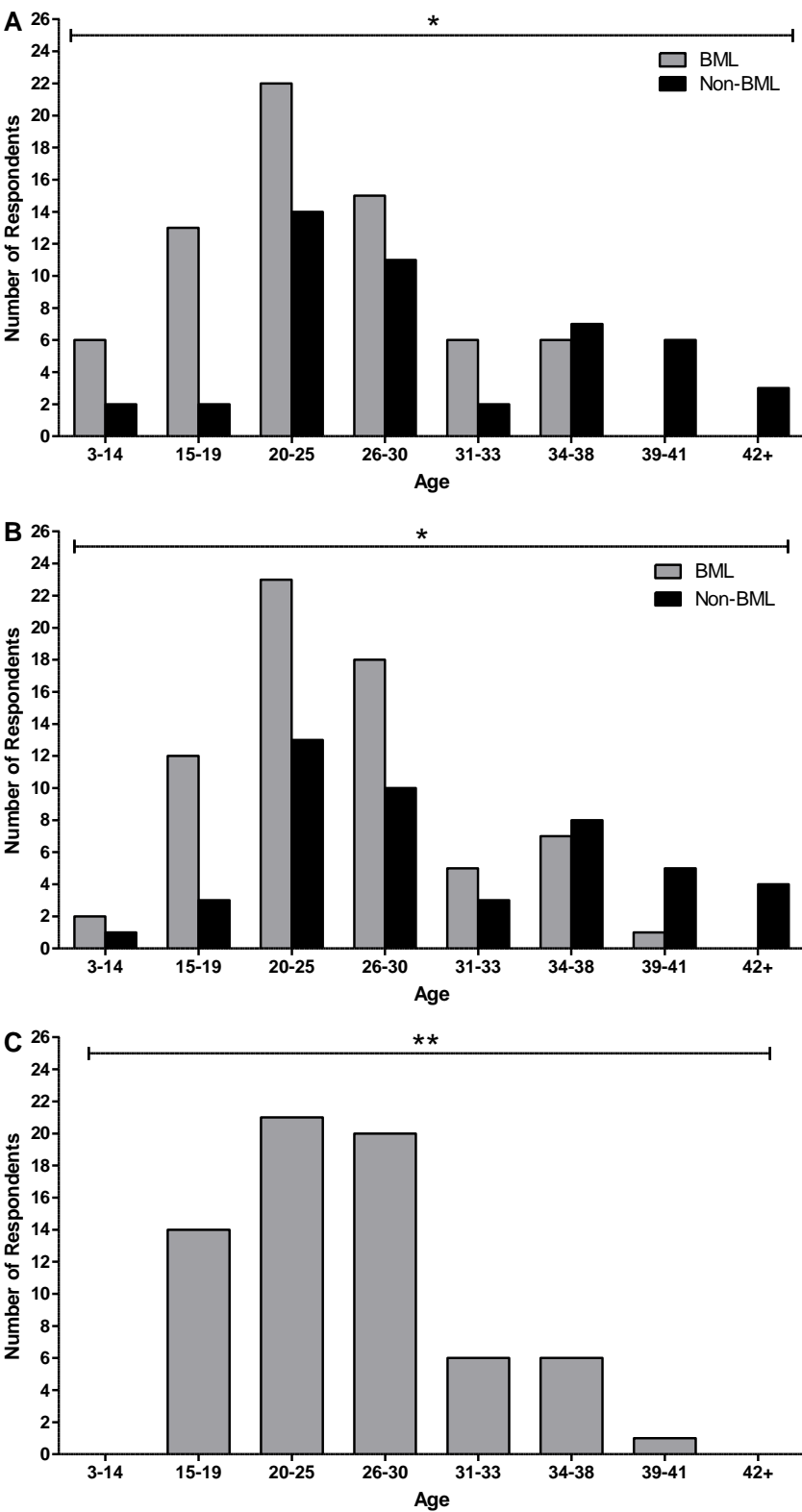


Figure 1 – Number of days prior to competition BJJ competitors began body mass loss and the magnitude of body mass loss of each group. * = Number of days prior to competition to commence AWL/RWL decisively skewed towards fewer days; % = proportion of participants commencing AWL/RWL in this time; (BM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



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

Discussion

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

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

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

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

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

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

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

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

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

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

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Authorship

TW and CK were responsible for project planning, design, data analysis and manuscript preparation. TW was responsible for data collection. Neither author has any conflict of interest to declare, and no funding was provided for completion of this work.

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