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Research paper

Quantifying frequency of use of methods of body mass loss in competing UK powerlifters☆

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ABSTRACT

Previous research in Powerlifting (PL) has qualitatively investigated rapid weight-loss (RWL) in PL athletes and body image, however limited research exists in quantifying such methods adopted in PL. This study aimed to assess the frequency of RWL methods are adopted by male and female PL athletes in the United Kingdom (UK) during competition preparation. A total of $n = 37$ ($n = 19$ female, $n = 18$ male) competitive powerlifters completed an anonymous online questionnaire assessing RWL methods. A Chi-square cross tabulation was utilised to identify any significant differences between independent and dependent variables. Multiple regression analyses were then conducted to assess the contribution of biological sex and PL category on RWL methods. Commonly reported methods of weight loss were gradual dieting (49%), fluid restriction (46%), and water loading (51%). Differences between PL category (Junior, Open, Masters One) and adopting RWL were observed ($X^2 = 4.220$, $p < 0.05$). PL category was a predictor of undertaking RWL ($R^2_{adj} = 0.160$, $F^{(2,\ 34)} = 4.429$, $p \leq 0.05$), whilst biological sex was a predictor of timeframe of undertaking RWL ($R^2_{adj} = 0.123$, $F^{(2,\ 34)} = 3.534$, $p \leq 0.05$). RWL strategies are adopted by PL athletes in order to make weight for competition. Despite known effects of RWL on strength performance, limited research currently exists on these strategies specifically within PL, therefore this may be a consideration for future research. Practitioners working with PL athletes may wish to consider appropriate nutrition and weight loss strategies in preparation for PL competitions.

1. Introduction

Powerlifting (PL) is a strength-based sport consisting of three fundamental barbell exercises: Squat, Bench Press and Deadlift (Grgic & Mikulic, 2017; Nolan, Lynch & Egan, 2020; Pritchard, Tod, Barnes, Keogh & McGuigan, 2016). PL requires competitors to 'make weight' at a pre-competition weigh-in event (Grgic & Mikulic, 2017; Nolan et al., 2020). During competition PL athletes are categorized into competitive groups based on age, sex, and weight category, with the Wilks formula calculating an aggregate score based on total load lifted, adjusting for an athlete's body mass and subsequently allowing for comparisons across athletes and weight categories (Nolan et al., 2020). During competition an athlete has three single-repetition attempts at each of the three lifts, with the aim of achieving the highest total of load lifted (Grgic & Mikulic, 2017; Nolan et al., 2020; Pritchard et al., 2016). Given the weight class demands of PL, many athletes attempt to weigh-in at competitions following a period of rapid weight loss (RWL) in order to achieve a desired weight-class (Vargas & Winter, 2021). PL athletes aim to gain a competitive edge over other lifters by achieving the highest possible power-to-weight ratio (i.e. obtaining a lower body mass whilst maximizing strength; measured using the Wilks coefficient within PL). Thus, competing at a lower weight-class may provide athletes relatively better results than if they competed at a heavier body mass (García--Manson et al., 2008; Vargas & Winter, 2021).

RWL refers to methods employed by an athlete to aggressively reduce body mass in preparation for a weigh-in and/or competition (Khodaee, Olewinski, Shadgan & Kiningham, 2015; Reale, Slater & Burke, 2018) with weight-making athletes potentially using single or multiple RWL techniques prior to weigh-ins in order to achieve losses of ~2% to 10% of body mass, depending on the sport (Artioli, Saunders, Iglesias & Franchini, 2016; Connor & Egan, 2019). Commonly reported RWL methods include (but are not limited to) manipulation of body water, glycogen depletion and fasting (Reale et al., 2018). Previous investigations into methods of RWL have typically focused on combat sports (Artioli et al., 2016, 2010; Barley, Chapman & Abbiss, 2018; Brito et al., 2012; Coswig, Fukuda & Del Vecchio, 2015; Kasper et al., 2019;

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Matthews & Nicholas, 2017; Reale, Slater & Burke, 2017). However, despite high prevalence of RWL in PL (Nolan et al., 2020), both the magnitude and severity of RWL in PL is lower when compared with combat sports (Connor & Egan, 2019). An important consideration for PL is that official weigh-in time for most drug-tested federations occur ≤2 h prior to competition (Ferland & Comtois, 2019), compared with 24 h to 36 h in combat sports (Artioli et al., 2016; Reale et al., 2017). With such discrepancies of weigh-in timing and their relationship to muscle recovery, nutrition and physiological adaptations, fluid and carbohydrate stores may be compromised in PL athletes (Nolan et al., 2020), particularly when considering hypohydration and low muscle glycogen can negatively impact strength outcomes (Leveritt & Abernethy, 1999; Schoffstall, Branch, Leutholtz & Swain, 2001; Slater et al., 2019). With this is mind, the aim of the study was to assess the frequency with which certain RWL methods are adopted by male and female PL athletes in the United Kingdom (UK) during competition preparation.

2. Materials & methods

2.1. Experimental approach to the problem

A cross-sectional descriptive study design (via anonymous, online questionnaire) was utilised to quantify methods of weight loss adopted by UK-based male and female powerlifting athletes in preparation for a competition.

2.1. Subjects

Competitive powerlifters competing in the 'Junior' (18 - 23 years), 'Open' (24 – 39 years) or 'Masters One' (40 – 49 years) categories from UK-based Powerlifting clubs were invited to participate and complete an anonymous online questionnaire. The study was advertised through direct email communications to UK-based PL clubs, registered with British Powerlifting, and through invitations posted on social media sites. The study received institutional ethical approval and all participants provided informed consent prior to completing the survey.

2.2. Procedures

The RWL questionnaire (RWLQ) was uploaded manually to an online survey platform. The RWLQ required data on biological sex, participant category (i.e. Junior, Open, Masters One), and weight category. Participants were also required to quantify, from a pre-determined list, any previously adopted methods used to elicit RWL for competition. The RWLQ was developed based on the methods of Matthews and Nicholas (2017), which had been adapted from a similar model validated in combat sports (Artioli et al., 2010). Participants completed the questionnaire and gave responses based on all RWL strategies adopted previously in preparation for a competition. When listing relevant sources of information sought for body mass losses, participants were required to list as many options as were relevant to their circumstances.

2.3. Statistical analysis

Descriptive statistics were used to display responses to survey questions, referring to methods of RWL used by male and female PL athletes. Data were analysed via SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Normality was assessed via Shapiro-Wilks test. A Chi-square cross tabulation was utilised to identify any significant differences between independent variables (participant PL category and biological sex) against dependent variables (undertaking RWL, timeframe and advice sought). Following this, multiple regression analysis was carried out to determine the contribution of biological sex and PL category as factors to adopting RWL, timeframe of weight control and advice sought. The alpha level for significance was set at $p \leq 0.05$.

3. Results

A total of 37 ($n = 13$ Junior, $n = 24$ Open) competitive powerlifters completed the survey. Of these responses, $n = 18$ were male (48%) and $n = 19$ female (52%). Weight categories represented in the study were as follows; Male: <66 kg $n = 1$ (5.5%), <74 kg, $n = 3$ (16.7%), <83 kg $n = 5$ (27.8%), <93 kg $n = 4$ (22.2%), <105 kg $n = 5$ (27.8%) and Female: <47 kg $n = 1$ (5.3%), <57 kg $n = 8$ (42.1%), <63 kg $n = 4$ (21%), <72 kg $n = 4$ (21%), <84 kg $n = 2$ (10.6%).

3.1. Rapid weight loss

Of the total responses, $n = 17$ (43.6%) reported engaging in RWL. Methods of RWL adopted can be seen in Table A.1. Most commonly used methods of RWL were gradual dieting ($n = 18$; 48.7%), gradual fluid restriction ($n = 17$; 46.0%) and water loading ($n = 19$; 51.4%). A significant difference between PL category and whether RWL was adopted ($X^2 = 4.220$, $p<0.05$) was observed. Biological sex showed no significance on RWL ($X^2 = 1.303$, $p>0.05$). Multiple regression demonstrated that PL category is a modest predictor of RWL ($R^2_{adj} = 0.160$, $F^{(2,\ 34)} = 4.429$, $p \leq 0.05$; Table A.4)

3.2. Timeframe

Differences in timeframe of adopting weight loss for competition between biological sexes can be seen in Table A.2. No significant difference between biological sex and timeframe was observed ($X^2 = 5.801$, $p>0.05$) . PL category had no significant effect on timeframe ($X^2 = 4.340$, $p>0.05$). Multiple regression demonstrated that biological sex is a modest predictor of timeframe $R^2_{adj} = 0.123$, $F^{(2,\ 34)} = 3.534$, $p \leq 0.05$; Table A.4).

3.3. Advice sought

Of the total responses, $n = 27$ (73.0%) reported seeking advice regarding weight loss for competition. Descriptive statistics for sources

Table A.1
Frequency analysis of rapid weight loss methods adopted by powerlifting athletes in the United Kingdom ($n = 37$).

Method	Always (%)	Sometimes (%)	Almost Never (%)	Never (%)	Do not use anymore (%)
Gradual Dieting	49	32	0	16	3
Skipping Meals	11	27	27	35	0
Fasting	8	43	16	32	0
Restricting Fluid Intake	46	30	5	16	3
Increased Exercise	16	27	14	43	0
Training in Heated Room	0	14	5	78	3
Saunas	3	27	8	57	5
Hot Bath	16	41	11	30	3
Hot Salt Bath	16	22	11	46	5
Training with Plastic Suits	0	3	0	97	0
Spitting	0	27	11	62	0
Laxatives	14	5	5	73	3
Diuretics	0	11	3	84	3
Diet Pills	0	3	0	97	0
Fat Burners	0	8	0	92	0
Vomiting	0	0	0	97	3
Water Loading	51	32	3	11	3

Table A.2
Descriptive statistics relating to the timeframes adopted when undertaking rapid weight loss practices reported by male and female powerlifting athletes in the United Kingdom ($n = 37$).

Timeframe	Total *n*= (%)	Male *n*= (%)	Female *n*= (%)
6 - 8 weeks prior to competition	19 (51)	6 (32)	13 (68)
3 - 5 weeks prior to competition	9 (24)	4 (44)	5 (56)
1 - 2 weeks prior to competition	5 (14)	4 (80)	1 (20)
Less than 1 week	1 (3)	1 (100)	0 (0)
I do not weight control for competition	3(8)	2 (67)	1 (33)

of information of body mass losses for competition between biological sexes can be seen in Table A.3. Common sources of advice of body mass losses for competition included: PL coach ($n = 23$; 29.9%), internet research ($n = 15$; 19.5%) and athletes' own nutritional knowledge ($n = 12$; 15.6%). Neither PL category nor biological sex showed any significance on whether advice was sought (PL category: ($X^2 = 0.142$, $p > 0.05$); Biological Sex: ($X^2 = 0.010$, $p > 0.05$). Similarly, multiple regression demonstrated that neither PL category nor biological sex are predictors of advice sought ($R^2_{adj} = -0.055$, $F^{(2,\ 34)} = 0.066$, $p \geq 0.05$; Table A.4).

4. Discussion

The aim of this study was to quantify the frequency of weight loss methods adopted during competition preparation of both male and female PL athletes from the UK, with reported prevalence of RWL among UK-based powerlifters at 43.6%. Gradual dieting along with body fluid manipulation via fluid restriction and water loading are the most commonly used methods of body mass losses by PL athletes (49%, 46% and 51% respectively). Coaches (30%) and internet research (19%) were cited as popular sources of information on the RWL practices adopted by these athletes.

Prevalence of RWL in our findings was lower than reported by Nolan et al. (2020) (43.6% versus 85.8% respectively). The findings within the present study indicate that category (i.e. Junior or Open PL) is a contributing factor to whether RWL is undertaken. Such findings are further supported by the multiple regression analysis that view PL category as a modest predictor (16% contribution) to undertaking RWL. The exact reasons for these findings are unclear, however Nolan et al. (2020) identified that when analysed by weight class, and biological sex, no effects within their RWL scores were observed in PL athletes. Interestingly, within their findings, athlete calibre (categorised by Low/-Mid/High Wilks scores) had a significant effect on RWL score, therefore it could be hypothesized that competing within a particular category adds to a pressure to achieve a desired Wilks score and subsequent RWL techniques are adopted. Such pressures have been proposed in female PL athletes by Vargas and Winter (2021), however further qualitative research into Junior and Open PL athletes (of both sexes) and their motivations regarding RWL is needed to confirm this hypothesis, and

Table A.3
Descriptive statistics for the sources of information consulted when undertaking body mass loss practices reported by male and female powerlifting athletes in the United Kingdom ($n = 37$).

Source of Information	Total *n*= (%)	Male *n*= (%)	Female *n*= (%)
Medical Professional	3 (4)	3 (100)	0 (0)
Coach	23 (30)	11 (48)	12 (52)
Nutritionist or Dietician	11 (14)	5 (45)	6 (55)
Parents	0 (0)	0 (0)	0 (0)
Books/Magazines	2 (3)	2 (100)	0 (0)
Friends	5 (6)	2 (40)	3 (60)
Internet Research	15 (19)	8 (53)	7 (47)
Sport Scientist	5 (6)	3 (60)	2 (40)
My own knowledge	12 (16)	6 (50)	6 (50)
Other (please specify)	1 (1)	0 (0)	1 (100)

Table A.4
Results from regression analysis of independent predictors on dependent variables, adopting rapid weight loss (RWL), timeframe and advice sought.

	B	SE (*B*)	*β*
Predictor – Adopting RWL			
Sex	.318	.160	.319
Category	−0.454*	.167*	−0.435*
Predictor – Timeframe			
Sex	−1.000*	.399*	−0.411*
Category	.667	.417	.262
Predictor – Advice sought			
Sex	.002	.160	.003
Category	−0.058	.167	−0.063

* indicates statistical differences at $p \leq 0.05$ level.

further support the findings of the present study regarding category being a predictor of RWL.

The most commonly reported methods of RWL within the present study (gradual dieting, fluid restriction and water loading) are similar to findings conducted in PL athletes (Nolan et al., 2020) with similar popularity in such strategies in competitive PL athletes adopting methods of RWL (gradual dieting: 39.5%; fluid restriction: 54% and water loading: 49%; Nolan et al., 2020). Given the associated negative implications of RWL documented in combat sports (Artioli et al., 2016, 2010; Barley et al., 2018; Brito et al., 2012; Connor & Egan, 2019; Coswig et al., 2015; Kasper et al., 2019; Khodaee et al., 2015; Matthews & Nicholas, 2017; Reale et al., 2018, 2017), it would be pertinent to examine this in other weight sensitive sports such as PL. Further research specifically within PL and additional strength-specific sports and training methods would be needed to confirm this.

Additional methods adopted by UK-based PL athletes (registered response as 'always' in competition preparation) included hot bath (16%), salt bath (16%) and laxative (14%). The prevalence of these methodologies is higher than observed by Nolan et al. (2020) in PL, with hot/salt baths lower than, and laxative use higher than reported in mixed martial arts (MMA) athletes (Matthews & Nicholas, 2017). When compared to MMA, the present study reported higher laxative use, however it has been reported that Judo and Taekwondo coaches recommendations to take laxatives are greater (~21%; Berkovich, Stark, Eliakim, Nemet & Sinai, 2019). The reasons for the frequency of laxative use within PL remain unclear, however coaches perceptions and/or recommendations on the use of such strategies with their athletes may be an area of future investigation. Interestingly, additional strategies (registered response as 'sometimes' in competition preparation) adopted by UK-based PL athletes include dietary manipulations such as skipping meals and fasting (27% and 43%, respectively; Table A.1). A well-established relationship exists with respect to muscle mass, lifting performance and energy intakes within resistance trained individuals (Slater et al., 2019; Vargas & Winter, 2021), however it could be hypothesized that the adopted techniques of skipping meals and/or fasting may be counter-productive to a PL athlete's objectives. It has been proposed that acute adoption of a low carbohydrate diet may not be detrimental to resistance exercise performance, or associated cell-signaling activities responsible for muscular adaptation (Escobar, VanDusseldorp & Kerksick, 2016), with evidence suggesting that signaling of protein synthesis remains unaffected by carbohydrate restriction or low muscle glycogen concentrations (Cholewa, Newmire & Zanchi, 2019; Escobar et al., 2016), however carbohydrate hypercaloric dietary intake appears optimal for enhancing muscle hypertrophy (Cholewa et al., 2019). Given the associated strength demands of PL, coupled with the findings in the present study, this poses an interesting area of future research within PL athletes in relation to optimal dietary intakes for competition preparation.

The timeframes reported in the present study contradict the findings of Pritchard et al. (2016), who reported tapering practices occur (including nutrition and/or weight loss) ~2.5 weeks prior to

competition in New Zealand-based PL athletes. The exact differences observed between the male and female PL athletes within these respective studies is unclear, however individual athlete preparation may be a likely reason, with research indicating that PL athletes use 'trial and error' and/or previous experiences to adjust their tapering strategies accordingly (Pritchard et al., 2016), however further research to substantiate the reliability and validity of such practices within PL athletes is warranted. Similarly, observed timeframes for undertaking RWL are greater than those observed in professional MMA (~1 week prior to weigh-in; Hillier et al., 2019), which indicate that such strategies are not adopted in such drastic a manner as in MMA. It could be hypothesized that such practices are not adopted due to the lack of re-feeding opportunities (i.e. PL: <2 h versus MMA: 24 – 36 h post weigh-in; Artioli et al., 2016; Ferland & Comtois, 2019; Reale et al., 2017), however this warrants further investigation. Interestingly, within the findings of the present study, biological sex was a contributing factor, and a modest predictor (12%) of the timeframe adopted for RWL in PL athletes. Female respondents in the present study employ a longer timeframe of any associated body mass losses compared to male PL athletes (Table A.2). Weight-class athletes have been shown to be at risk of disordered eating and it has been documented that there is a weight-cutting culture within PL. This may lead to the adoption of disordered eating practices (Vargas & Winter, 2021), with such practices potentially impacting upon physiological and psychological function (Melin et al., 2014) with negative effects on exercise and sporting performance, and an increased risk of overuse injuries, bone fractures and physiological processes (El Ghoch, Soave, Calugi & Dalle Grave, 2013; Logue et al., 2018; Mountjoy et al., 2014).

Nolan et al. (2020) reported both online resources and PL coaches as 'very influential' sources of advice for RWL (35% and 37.5%, respectively). These findings are comparable with the findings of the present study, with both PL coaches (30%) and internet research (19%) as popular sources of RWL information. As reported by Nolan et al. (2020), this highlights the importance of educating PL athletes and coaches regarding RWL, as unregulated advice from online resources or PL coaches could potentially pose a significant and dangerous threat to athlete health and performance (Nolan et al. (2020). Practitioners should ensure athletes are provided with appropriate resources to assist with safe weight loss practices in competition preparation. Doctors, and nutritionists/dieticians were rated as "not influential" on RWL practices with PL athletes (Nolan et al. (2020), findings which are replicated in the present study, with only 4% of respondents seeking medical advice and 14% from a nutritionist/dietician regarding appropriate nutrition strategies. In both cases, these findings are concerning given the potential negative health outcomes of aggressive, unregulated methods of RWL (Nolan et al. (2020), therefore both RWL practices in PL athletes and reasons why they do not seek advice from such professionals require further investigation from both a physiological and psychological perspective.

Despite offering novel findings regarding the RWL practices of PL athletes within the UK, the present study is not without limitations. Firstly, due to the COVID-19 pandemic, cancelation and closure of UK-based PL competitions and gymnasiums meant that data collection was limited to online, RWL questionnaire-format only. As such, it was not possible to record specific changes in body mass from the onset of RWL adoption until weigh-in. It could be hypothesized that any resulting implications of RWL (e.g. dehydration, muscle glycogen depletion etc.) may hinder PL athletes' performance during a competition period, a statement that may be particularly pertinent given the relationship between muscle mass, lifting performance and energy surplus in resistance trained individuals (Slater et al., 2019; Vargas & Winter, 2021). Secondly, despite attempts to recruit within the Masters One category, no responses were received as part of the present study. Incorporating data from additional age categories may help provide further insight and prevalence to any additional RWL techniques in PL athletes across differing competitive categories and allow for the potential of more representative data of PL athletes. Further investigation into RWL practices, either prior to, or at the time of weigh-in and/or competition and the influence these have on strength outcomes, has yet to be investigated and may be a direction of future research. Similarly, the addition data relating to rapid weight gain following weigh-in would provide further insight into any physiological adaptations that occur within PL athletes following a period of RWL and would potentially allow for further sub-categorical analyses (e.g. differing weight classes, biological sex differences etc.).

In conclusion, this study indicates a high prevalence of RWL in both male and female PL athletes from the UK. Because of the specific demands of PL, RWL strategies are adopted by both male and female athletes in order to make weight for competition. Fluid manipulation – either through water loading or gradual restriction and gradual dieting appear to be the most common methods adopted, however despite known effects of RWL on strength performance, limited research currently exists on these strategies specifically within PL. Internet-based materials, personal knowledge and PL coaches appear to provide the main source of information of RWL strategies for these athletes. With this in mind, associated practitioners, coaches and PL governing bodies may wish to consider developing appropriate learning and educational materials for those involved with PL athlete preparation and/or development. Similarly, increasing access to qualified nutrition practitioners to enhance PL athlete knowledge of suitable nutrition and/or weight loss strategies in preparation for PL competitions may be beneficial.

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CRediT authorship contribution statement

T.J. Wood: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft. **L.J. Wilson:** Methodology, Visualization, Data curation, Writing – review & editing. **C. Curtis:** Conceptualization, Methodology, Investigation, Data curation, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors have no conflicts of interest, financial or otherwise, to declare.

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