Introduction

Olympic weightlifting (OWL) is one of seven weight-category sports in the Olympic Games, accommodating a wider range of categories than any other sport. In each weight category, an athlete's heaviest successful attempt in both the snatch and clean and jerk is combined, and the athlete with the highest combined weight wins the competition. OWL is unique amongst weight category sports, given the critical role velocity and force play in defining success (Fry et al., 2006).

Athletes in weight-category sports typically use a range of acute weight loss (AWL i.e., weight loss undertaken in the final days and hours prior to competition) and/or chronic weight loss (CWL i.e., weight loss in the weeks to months prior to competition) strategies. Athletes may use these strategies to compete in a category lighter than their habitual training weight, under the premise this provides a competitive advantage over smaller opponents (Burke et al., 2021). Concerns have been raised about the health and performance implications of the body mass (BM) management practices employed by these athletes (Artioli et al., 2010; Reale et al., 2018). AWL has been linked to adverse health outcomes (Barley et al., 2019; Barley et al., 2018; Berkovich et al., 2019; Kasper et al., 2019), and in some cases, death (Centers for Disease & Prevention, 1998). The majority of research exploring the BM management practices of athletes in weight category sports has remained focused on combat sports (Anyzewska et al., 2018; Barley et al., 2019; Brito et al., 2012; Connor & Egan, 2019; da Silva Santos et al., 2016; Franchini et al., 2012; Hillier et al., 2019; Matthews et al., 2019; Park et al., 2019; Reale et al., 2018). Less is known about the BM management practices of athletes in OWL, despite the former being a summer Olympic Games event for over 100 years.

OWL athletes physical traits are less impacted by acute compromises in hydration status (Barley et al., 2018) and muscle energy reserves (Barley et al., 2018; Pallarés et al., 2016; Reale et al., 2018; Schytz et al., 2023). This may leave OWL athletes curious about the use of common AWL strategies targeted at the manipulation of total body water (TBW). Indeed, the most commonly used methods reported by powerlifters include water loading (Campbell et al., 2023; Nolan et al., 2022) and fluid restriction

(Campbell et al., 2023; King et al., 2023; Kwan & Helms, 2022; Nolan et al., 2022). Although the physical demands of powerlifting and OWL are similar (Gee et al., 2023; Keogh et al., 2007; Serrano et al., 2019), OWL has a shorter time between weigh-in and competition, and a shorter competition duration (Burke et al., 2021), which may impact the athletes' ability to recover from any AWL strategies. These individual sport nuances, including time frame between weigh-in and competition, the requirement for repeat weigh-ins, and culture of weight loss, makes inferring athlete practices and outcomes between sports inappropriate (Burke et al., 2021; Reale et al., 2017). To our knowledge, only one other study has assessed the BM management practices of OWL athletes, undertaken on a small sample of athletes using a tool not validated for that population (Gee et al., 2023). Our research group has recently validated a rapid weight loss questionnaire in OWL athletes (Cox et al 2024), creating an opportunity to better explore the BM management practices of OWL athletes.

This study aimed to investigate the BM management practices of competitive male and female OWL athletes using a validated questionnaire (Cox et al 2024). It was hypothesised OWL athletes compete in a weight category lighter than their habitual training weight, achieved via a range of acute and/or chronic BM management practices. It was also hypothesised athletes of higher calibre would be more likely to use AWL practices and that there would be no impact of sex on BM management practices.

Methods:

Competitive male and female OWL athletes (>18 years) at Queensland state championships in Brisbane, Australia, were invited to complete an anonymous online questionnaire (voluntary response sampling). The survey was advertised for seven days prior to the competition on social media platforms, including Instagram and Facebook. Additionally, eight flyers were posted around the competition venue, featuring a QR code for easy access to the questionnaire. To facilitate survey completion, two iPads were made available for athletes. Announcers at the event also promoted the survey. A designated location was manned throughout competition hours where athletes were encouraged to fill out the survey. The survey was retrospective in nature, asking athletes to focus on competitions during the previous two years. This research project was approved by the Human Research Ethics Committee (University of the Sunshine

Coast, Australia); ethics approval number S221696, and participants provided informed consent after having the study explained either verbally and/or in writing.

The survey used in this investigation has previously been validated in OWL athletes (Cox et al, 2024). It was comprised of five different sections including demographics, training and competition history, weight history (maximum and usual weight loss), source of influence on BM management strategies and BM management practices i.e., retrospective exploration of usual practices. Athlete's responses were collected online via Qualtrics Core XM survey software (Qualtrics LLC, Provo, Utah).

While athletes were required to specify their usual competition weight category in the previous two years, these categories were subsequently consolidated by researchers into the following four weight category groups for both sexes. Light weight (≤73kg for male athletes, ≤55kg for female athletes), middle weight (>73kg to ≤96kg for male athletes, and >55kg to ≤71kg for female athletes), heavy weight (>96kg to ≤109kg for male athletes and >71kg to ≤87kg female athletes) and superheavy weight (+109kg for male athletes, and +87kg for female athletes). The calibre of each athlete was classified using a recognised tiering system, where 1 denotes recreational level and 5 indicates world-class standing (McKay et al., 2022).

Statistical analysis:

Descriptive statistics (i.e., mean, standard deviation (SD), range and frequency analysis) were used to represent subject characteristics and responses to survey questions providing ordinal and nominal data. Numeric values for the question 'how much weight do you usually lose in the 24 hours, week, month and two months prior to competition', were provided as a range. When analysed, the mean of the range was used, e.g., 0-1 = 0.5kg. The result for the question related to source of influence was consolidated by researchers into three groups, 'highly influential' (highly influential and very highly influential questionnaire responses), 'a little influential', and 'not influential'. The questionnaire response 'unsure' was removed for analysis. For analysis of calibre, tiers were consolidated into two groups, (tiers 1- 2, and tiers 3-5). A one-way ANOVA was used to compare influence against independent variables (sex, athlete calibre, weight category group). When a significant effect was identified (*P* = <0.05), post hoc testing was performed using Chi-Square test for independence. Frequency analysis for male and female BM practices were split into 'currently using' and 'not using' and compared against independent variables. When a significant effect was identified (*P* = <0.05), post hoc testing was performed using Spearman's Rho test.

Results:

Of the 174 athletes who initiated the survey, 25 incomplete data sets (*n* = 23 did not identify if they had made weight, *n* = 2 did not answer sources of influences/BM practices) were removed from all analysis. A descriptive analysis of the remaining athletes is presented in Table 1, while athlete calibre is presented in Table 2. Lower calibre athletes were more likely to use low fibre (*P* = .014; r = -.218), spitting (*P* = .003; r = -.290) and sauna (*P* = .010; r = -.245) to make weight. Of the 149 athletes, 76% of athletes have previously used CWL and/or AWL strategies to make weight. Three of these athletes acknowledged failing to make weight for a competition.

In the previous two years, 51% (*n* = 68) of athletes had competed at a BM outside of their usual category. The most common reasons for competing in another weight category are specified in Table 3. Sources of information influencing the BM management practices of OWL athletes are presented in Table 4. Female athletes identified dietitians/nutritionists as a highly influential source of information (*P* = 0.009; *r* = -.250), but there were no other differences identified according to athlete calibre, weight category or training age/competition age.

Table 5a and Table 5b present the self-reported BM management methods and timeframe of use amongst female and male athletes, respectively. The most prevalent practices used by females included gradual dieting (83%), fluid restriction (71%), a low carbohydrate diet (52%) and low food weight/high calorie options (51%). Males identified gradual dieting (74%), fluid restriction (71%) and low food/high calorie food options (55%) as their most commonly used practices. Female athletes were more likely to use gradual dieting ($P = .043$; $r = -.192$) and were less likely to increase their exercise ($P = .063$; $r = -.177$) and utilise fasting ($P = .035$; $r = .201$) in comparison to their male counterparts.

Discussion:

This is the first study to assess the BM management practices of both male and female OWL athletes prior to competition using a tool validated specifically for an OWL population. The majority of OWL athletes competed at a BM lighter than their habitual training weight, aligning with other preliminary findings in OWL athletes (Gee et al., 2023) and other weight category sports (Alderman et al., 2004; Anyzewska et al., 2018; Artioli et al., 2010; Brito et al., 2012; Campbell et al., 2023; Connor & Egan, 2019; Franchini et al., 2012; Hillier et al., 2019; King et al., 2023; Kwan & Helms, 2022; Matthews et al., 2019; Nolan et al., 2022; Park et al., 2019; Reale et al., 2018). Usual BM loss (2-3%) achieved in the week before competition is similar to that identified in other weight category sports with a shorter post weigh-in recovery period (<3 hours) (Campbell et al., 2023; Reale et al., 2018). Athletes used a combination of both CWL and AWL strategies, with gradual dieting, fluid restriction and low food weight/high calorie options being the most commonly used strategies. Sex differences were noted for gradual dieting, fasting and increase in exercise. Lower calibre athletes were more likely to use AWL practices (sauna, spitting, low fibre diets) to make weight. These practices did not vary by weight category.

While the majority of OWL athletes acknowledged the use of AWL strategies, especially those promoting loss of TBW, the BM reductions were similar to that potentially achieved during a normal training session (Gee et al., 2023; Keogh et al., 2007; Serrano et al., 2019). Typical BM loss observed in the week prior to competition aligns with current American College of Sports Medicine guidelines (<3% of total BM) (Burke et al., 2021). However, outliers were evident, with a small number of athletes reporting typical losses of up to 8% of BM in the week prior to competition, similar to typical losses identified in combat athletes (Morton et al., 2010; Reale et al., 2018). Adverse health outcomes have been identified in combat sports athletes undertaking similar amounts of AWL (Franchini et al., 2012; Kasper et al., 2019). Athletes with a short post weigh-in recovery period (≤3 hours) have been advised against AWL of greater than 5% of total BM (Burke et al., 2021), presumably due to potential adverse effects on health and performance. However, without an understanding of an athletes' post-weigh-in recovery practices, it is difficult to pass comment on the potential performance implications, warranting further investigation in OWL athletes.

Manipulation of TBW is common amongst weight category sport athletes, given it has the capacity for large and rapid fluctuations that directly impact BM (Sawka et al., 2005). The reliance on fluid restriction observed in OWL athletes (Durguerian et al., 2016; Gee et al., 2023) is similar to reports in other weight category sports (Anyzewska et al., 2018; Brito et al., 2012; Connor & Egan, 2019; Gee et al., 2023; Matthews et al., 2019; Park et al., 2019; Reale et al., 2018). While the majority of combat sport athletes (Reale et al., 2018) undertake additional exercise to facilitate AWL, a minority of OWL athletes engaged in additional exercise (Table 5a and 5b), similar to reports in powerlifting (Campbell et al., 2023; Kwan & Helms, 2022; Nolan et al., 2022). Interestingly, a similar proportion of OWL athletes used passive sweating (saunas and hot baths) to reduce TBW. The limited use of aerobic training in OWL (King et al., 2023) may likely influence the preference for passive techniques. Passive sweat loss may have greater deleterious impact on physiological and psychological function (altered mood states) (Barley et al., 2018; Benton, 2011; Durguerian et al., 2016), and performance, posing a more serious recovery challenge (Barley et al., 2018). Indeed, passive sweating techniques have been shown to increase the risk of heat-related illnesses, especially in athletes, who have a brief recovery period (less than 3 hours), and lose more than 3% of total BM (Barley et al., 2019).

Manipulation of gastrointestinal (GI) content is another common AWL strategy used amongst athletes in weight category sports (Brito et al., 2012; da Silva Santos et al., 2016; Nolan et al., 2022; Reale et al., 2017). Approximately one-third of OWL athletes manipulated their GI contents to promote BM loss, a practice which is more prevalent among combat (Reale et al., 2018) and powerlifting athletes (Nolan et al., 2022). A small proportion (10%) of OWL athletes resorted to laxatives to alter GI contents in the day prior to competition, similar to previous reports in combat sports (Artioli et al., 2010; Filaire et al., 2007), and recent OWL literature (Gee et al., 2023). While laxatives can efficiently clear faecal matter, they can adversely influence exercise capacity (Holte et al., 2004). A low-fibre diet (<10g of fibre over 5-7 days) can also be effective in clearing GI contents and has been linked to an estimated 0.7% decrease in total BM (Foo et al., 2022). Given its ability for repeatable use, with no apparent adverse performance implications, and only minimal physiological disturbances (decreased satiety) (Foo et al., 2022), a low-fibre diet is potentially a BM management strategy that could be considered by more OWL athletes.

OWL athletes utilise gradual dieting as a means of making weight, similar to results observed in athletes in combat (Reale et al., 2018) and strength-based sports (Campbell et al., 2023; King et al., 2023; Kwan & Helms, 2022; Nolan et al., 2022). Gradual dieting involves a systematic reduction in energy intake over an extended time period, and is often complemented by an increase in exercise to promote steady weight loss, while preserving muscle mass and avoiding metabolic disruptions (Mountjoy et al., 2023). Energy expenditure inherent to OWL training is similar to that in powerlifting, but likely less intensive than endurance and combat sports (King et al., 2023). While these strategies may reduce the immediate physiological stressors of AWL, if not managed appropriately could result in low energy availability, and associated adverse health (Mountjoy et al., 2018) and performance implications related to relative energy deficiency in sport (REDs) (Benton, 2011; Kasper et al., 2019; Mountjoy et al., 2023). The majority of research addresses the prevalence, magnitude and performance implications of AWL strategies amongst athletes (da Silva Santos et al., 2016; Kasper et al., 2019), but few address the impacts of CWL in weight category sports (Langan-Evans, Germaine, et al., 2021; Mountjoy et al., 2023). Further research into the methods and impact of gradual dieting amongst OWL athletes is warranted, including the risk of low energy availability and subsequent REDs.

Male OWL athletes did not identify preference for any one source of influence over their BM management practices which contrasts with combat athletes, where coaches and training partners have been consistently identified as influential (Campbell et al., 2023; Connor & Egan, 2019; Kwan & Helms, 2022; Nolan et al., 2022; Reale et al., 2018). This may stem from former athletes transitioning into coaching roles, perpetuating pre-existing cultural attitudes within weight category sports (Brown et al., 2012; Filaire et al., 2007; Purcell et al., 2022; Reale et al., 2018). Interestingly, female OWL athletes highlighted dietitians/nutritionists as very influential, indicating that evidence-based advice regarding BM management practices is deemed as impactful. Female OWL athletes were more likely to focus on CWL, utilising gradual dieting, with less reliance on AWL strategies, including fasting and increased exercise. This variation in preference could be indicative of wider sex-based differences in dietary habits and approaches (Brown et al., 2012; Grzymislawska et al., 2020). Indeed, females often place a greater emphasis on nutrition and actively managing their BM, likely influenced by societal expectations that prioritise appearance and body image (Brown et al., 2012; Grzymislawska et al., 2020). The existing body of research is yet to feature sex-based interventions within weight category sports (Langan-Evans, Reale, et al., 2021).

Limitations

This study used a BM management questionnaire for which construct validity was recommended during data capture (Cox et al., 2024), possibly by capturing biochemical measures to confirm the athlete's hydration and energy status. Unfortunately, this was deemed too intrusive and costly to implement directly prior to competition. In hindsight, incorporating a rapid weight loss score (Artioli et al., 2010) to measure the 'intensity of application' for each AWL and CWL strategy may have been beneficial. Such a scale would offer a means of facilitating a more straightforward comparison with other studies (Artioli et al., 2010; Berkovich et al., 2019; Nolan et al., 2022; Reale et al., 2017). It is recognised that self-reported data can be susceptible to recall bias (Althubaiti, 2016). Measures were taken to mitigate this by validating the questionnaire specifically for OWL athletes, specifying timeframes, avoiding leading questions, and utilising the imminent OWL competition to enhance recall (Althubaiti, 2016). It should be noted that only a third of the OWL athletes surveyed in this study compete at a national or international level. This underrepresentation could potentially skew the observed relationships between athlete calibre and weight loss methods. Thus, the impact of athlete calibre on BM management practices in OWL warrants further exploration, especially in international competitions.

Conclusion

This research offers new insights into the BM management practices of OWL athletes, identifying that the majority (76%) of athletes compete at a BM lighter than their habitual training weight. The prevalence and magnitude of weight loss (2-3%) achieved in the week before competition are trends consistent across sex, athlete calibre and weight category. Athletes use a combination of both CWL and AWL strategies, with gradual dieting, fluid restriction and low food weight/high calorie options being the most commonly used strategies. Lower calibre athletes were more likely to use AWL practices (sauna, spitting, low fibre diets) to make weight. While male athletes acknowledged a wide-ranging impact from various influences on their BM management practices, females sought guidance from dietitians/nutritionists, which may reflect sex differences in dietary habits and approaches. This may be important to consider in any subsequent interventions used to influence an athlete's BM management practices. Further research into the recovery practices of athletes following weigh-in is warranted and should be complemented by an exploration of the performance implications of OWL athletes BM management practices.

Table 1: Olympic weightlifting (OWL) athletes characteristics according to weight categories.

	Weight Category							
	Male				Female			
	Light Weight (*n* = 5)	Middle-Weight (*n* = 38)	Heavy-Weight (*n* = 9)	Super heavy Weight (*n* = 3)	Light Weight (*n* = 18)	Middle-Weight (*n* = 49)	Heavy-Weight (*n* = 23)	Super Heavy weight (*n* = 4)
Age (y)	34±8	29±11	38±16	31±3	33±14	32±11	32±10	24±5
Weight (kg)	81.4±6.6	84.1±10.1	101.8±7.7	110±28	55.7±3.9	67.2±5.4	81.7±6.4	117.3±24
Height (cm)	172.6±2	174.9±5.9	185.4±9.1	182±9.5	155.3±4.6	163.5±6.8	170.2±6.4	171±3
Age began practicing OWL	21±6	23±8	25±8	17±6	29±12	27±9	28±8	18±9
Age began competing in OWL	22±5	24±9	28±9	17±6	30±12	28±10	29±9	18.9
Competitions in the past 12 months?	5±3	3±2	2±1	2±2	3±1	3±2	3±3	2±1
Athletes that have made weight before. n (%)	5 (100)	28 (74)	6 (67)	3 (100)	18 (100)	34 (69)	16 (70)	1 (25)
What is the most weight you have ever lost to compete (kg)?								
Mean ± SD	4±1.3	4.3±1.9	4.5±2.3	9±2.6	2.2±0.9	3.4±1.7	3.7±2.7	2
Range	2-5	2-8	2-8	7-12	1-5	1-9	1-11	
What is the most weight you have ever lost in the week before competition (kg)?								
Mean ± SD %	1.8±0.4	3±1.4	4.5±2.6	4.7±1.5	1.7±0.8	2±1.7	2.2±1.2	1
Range %	1-2	1-7	2-8	3-6	1-3	1-5	1.5	
How much do you usually lose in the last 24 hours before competitions (kg)?								
Mean ± SD %	1.5±1.1	1±0.8	2.8±2.7	2.2±1.2	0.9±0.5	0.6±0.4	0.7±0.4	0.5
Range %	0.5-3.5	0.5-3.5	0.5-7.5	1.5-3.5	0.5-1.5	0.5-1.5	0.5-1.5	
How much do you usually lose in the last week before competitions (kg)?								
Mean ± SD %	1.1±0.5	2±1.3	3±2.5	2.2±1.2	1.1±0.8	1.3±0.8	1.4±0.7	1.5
Range %	0.5-1.5	0.5-5.5	0.5-7.5	1.5-5.5	0.5-3.5	0.5-3.5	0.5-3.5	
How much do you usually lose in the last month before competitions (kg)?								
Mean ± SD %	3.5±1.3	2.1±1.6	2.7±0.5	3.5±2	1.9±1.4	1.9±1.4	2.1±1	1.5
Range %	1.5-5.5	0.5-5.5	0.5-7.5	1.5-5.5	0.5-5.5	0.5-5.5	0.5-3.5	
How much do you usually cut in the last 2 months before competitions (kg)?								
Mean ± SD %	3.1±2.2	2.3±2	2.5±0.5	2.2±2.9	1.8±1.5	1.9±1.6	2.4±1.7	3.5
Range %	0.5-5.5	0.5-7.5	0.5-7.5	0.5-5.5	0.5-5.5	0.5-5.5	0.5-5.5	
How much do you usually regain in the week after competition (kg)?								
Mean ± SD %	1.5±0.3	2.4±1.2	2.5±1.4	4.2±2.9	1.4±0.7	1.7±1	2±1	1
Range %	1-2	0-5	1.5-5	2-7.5	0-2.5	0-4	1-4	

Table 2. Calibre of Olympic Weightlifting athletes who completed the questionnaire.*

Calibre**	Male *n* = 55 (%)	Female *n* = 94 (%)
Tier 5	0 (0)	3 (3)
Tier 4	8 (15)	4 (3)
Tier 3	13 (24)	24 (26)
Tier 2	28 (51)	38 (40)
Tier 1	6 (11)	25(27)

*(McKay et al., 2022) Tier 5: World Class; Tier 4: Elite/International level; Tier 3: National Level; Tier 2: Trained/developmental; Tier 1: Recreational active.
** All P = >0.05

Table 3. Rationale for Olympic weightlifting athletes competing in a different weight category than their usual weight category (*n* = 68).

Reasons:	**Female (%)**	**Male (%)**
Did not need to make weight for that competition	24	19
It was too difficult to make weight for that competition	28	5
Wanted to be more competitive in a different weight category	12	9
Wanted to increase/decrease lean mass/fat mass into the next body weight category	7	10
To qualify for states/nationals/international competitions	7	6
Returning to sport from injury	6	4
No longer competitive in the weight category	3	2
Lack of understanding on how to make weight into a different category	2	0
Other*	16	9

*Health reasons, increase in height

Table 4. Frequency analysis of the persons/sources who are influential on the weight management behaviours reported by participants in Olympic weightlifting.

	Male *n* = 42			Female *n* = 69		
Person/Source	**Not Influential**	**A little Influential**	**Highly Influential**	**Not Influential**	**A little Influential**	**Highly Influential**
Dietitian/Nutritionist	23	4	14	20	10	40*
OWL Coach	19	11	12	22	26	20
PT/Other coach	30	10	2	43	15	7
Internet	29	8	3	48	16	3
Journal articles/Textbooks	28	8	5	45	18	6
Social Media	31	7	1	55	10	3
OWL/Training partner	28	8	4	44	16	8
Doctor	37	1	1	64	3	1
Parents/partner	37	2	2	64	3	2
Other: Self-trial and error			3			4

For analysis, nutritionist (*n* = 2) was collapsed into dietitian; partner (n = 1) was collapsed into parents. * *P* = .006; *r* = .019.

Table 5a. Frequency analysis of self-reported methods of body mass loss and timeframe of use amongst female athletes (*n* = 69).

Weight loss methods	**Never used**	**I don't use anymore**	**<1 day**	**<2 days**	**<3 days**	**<4 days**	**<1 week**	**<2 week**	**<3 weeks**	**<4 weeks**	**>4 weeks**
Chronic weight loss											
Gradual Dieting	4	8	1			4	5	10	5	14	18
Increase exercise	31	6		1	1	2	12	2	3	6	5
Acute gut content manipulation											
Skipping 1-2 meals	39	10	8	6	2			3			1
Low fibre	42	4	5	6	5	4	3				
Low wt/high calorie*	32	1	15	6	3	2	7	2			1
Laxatives	57	6	1	2			3				
Acute total body water manipulation											
Restrict fluid	12	8	40	7		1	1				
Hot baths	38	5	15	5	1	1	3				
Saunas	33	5	14	7	2		6	1		1	
Heated rooms	62	3	1	1		1	1				
Water loading	33	12	2	2	2	8	9			1	
Low carbohydrate diet	27	7	4	5	4	6	13	1		1	1
Low salt	33	4	3	6	4	3	16				1
Wearing rubber suits	67	1	1								
Spitting	55	4	10								
Other											
Fasting	43	11	7	4		1	1	2			
Diuretics	66	2		1							
Diet pills	69										
Fat burners	63	5									1
Vomiting	67	2									

***Low weight/high calorie option**

Table 5b. Frequency analysis of self-reported methods of body mass loss and timeframe of use amongst male athletes (*n* = 42).

Weight Loss Methods	Never used	I don't use anymore	<1 day	<2 days	<3 days	<4 days	<1 week	<2 week	<3 weeks	<4 weeks	>4 weeks
Chronic Weight Loss											
Gradual Dieting	9	3			1		3	7	5	7	7
Increase exercise	27	3	1				1	3	2	3	2
Acute gut content manipulation											
Skipping 1-2 meals	19	5	6	2	2	1	3	1		1	2
Low fibre	30		2	4	3	1	2				
Low wt/high calorie	19		11	3	4		2	1		1	1
Laxatives	36	1	4		1						
Acute total body water manipulation											
Restrict fluid	8	3	24	6			1				
Hot baths	20	9	8				1			1	3
Saunas	19	8	8	1		2				1	3
Heated rooms	34	5	2	1							
Water loading	20	7	2	4	3	1	5				
Low carbohydrate	19	3	2	4	3	2	6	1		1	1
Low salt	23		4	5	2	2	3	3			
Wearing rubber suits	36	4	1					1			
Spitting	34	4	4								
Other											
Fasting	19	6	10	1	1		2			1	2
Diuretics	37	3	1	1							
Diet pills	41	1									
Fat burners	41	1									
Vomiting	41	1									

***Low food weight/high calorie food option**

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Conflict of interest: The results of this investigation are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation. The main author AC business does sponsor Queensland Weightlifting events otherwise there are no conflicts of interest to declare.

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