Weight regain

No link to success in a real-life multiday boxing tournament

Reale, Reid; Cox, Gregory R.; Slater, Gary; Burke, Louise M.

Published in: International Journal of Sports Physiology and Performance

DOI: 10.1123/ijspp.2016-0311

Published: 01/08/2017

Document Version: Peer reviewed version

Link to publication in Bond University research repository.

Recommended citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

For more information, or if you believe that this document breaches copyright, please contact the Bond University research repository coordinator.

Download date: 29 Aug 2020
Title page

Title: Weight re-gain is not linked to success in a real life multi-day boxing tournament

Submission Type: Original investigation

Authors: Reid Reale\textsuperscript{1,2}, Gregory R Cox\textsuperscript{1,2,3}, Gary Slater\textsuperscript{2}, Louise M Burke\textsuperscript{1,3},
1 Australian Institute of Sport, Canberra, Australian Capital Territory, Australia
2 University of Sunshine Coast, Sippy Downs, Queensland, Australia
3 Australian Catholic University, Melbourne, Victoria, Australia

Address for correspondence:
Reid Reale
Australian Institute of Sport
Telephone: +61 422 831 719
E-mail: reid.reale@ausport.gov.au

Running head: Weight re-gain in boxing not linked to success

Abstract word count: 249
Text-only word count: 3497
Number of figures and tables: 5 figure 5 tables
1. Abstract

**Purpose:** Combat sport athletes acutely reduce body mass (BM) prior to weigh-in in an attempt to gain a size/strength advantage over smaller opponents. Few studies have investigated these practices among boxers and none have explored the impact of this practice on competitive success. **Methods:** One hundred (30♀/70♂) elite boxers participating in the Australian National Championships were weighed at the official weigh-in and an hour before each competition bout. Re-gain in BM after weigh-in was compared between finalists and non-finalists, winners and losers of each fight, males and females and weight divisions. Boxers were surveyed on their pre and post weigh-in nutrition practices. **Results:** The lightest male weight category displayed significantly greater relative BM re-gain than all other divisions, with no difference between other divisions. BM pre-bout was higher than official weigh-in for males (2.12±1.62% (p < 0.001; ES=0.13)) and females (1.49±1.65% (p < 0.001; ES=0.11)). No differences in BM re-gain were found between finalists and non-finalists, winners and losers of individual bouts, or between preliminary or final bouts. BM re-gain was significantly greater (0.37% BM, p < 0.001; ES=0.25) prior to an afternoon bout compared to a morning bout. **Conclusions:** Boxers engage in acute BM loss practices before the official competition weigh-in but this does not appear to affect competition outcomes, at least when weight re-gain between weigh-in and fighting is used as a proxy for the magnitude of acute loss. While boxers recognise the importance of recovering after weigh-in, current practice is not aligned with best practice guidance.
2. Introduction

Weight divisions in combat sports exist in order to have athletes matched against those of similar size. An official weigh-in is held before the start of competition to ensure that competitors are within the weight requirements for their division. It is commonplace for athletes to utilise 'weight making strategies' to induce rapid weight loss (RWL) before the official weigh-in\(^1\text{–}^4\). These strategies, primarily decreasing body mass (BM) via losses of body water, are commonly utilised by athletes to qualify for a lighter weight division, gaining a potential size and/or leverage advantage\(^5\) over smaller opponents. Average weight losses equivalent to ~5% BM in the hours and days before the official weigh-in are reported, however ranges vary between and within different combat sports\(^1\text{–}^3,^5\).

Combat sport athletes induce RWL despite warnings by medical professionals\(^6\), as well as evidence that RWL impairs performance, at least when measured directly after the weight-making strategy\(^7\). Why athletes continue to engage in practices that induce RWL may in part be due to the long standing culture evident in combat sports\(^8\). Indeed, the majority of these athletes perceive RWL as a fundamental part of their sport\(^9\). Importantly, a competitor’s success is not dependent on absolute performance, rather on their performance relative to their opponents’ in an open environment. Thus it is not necessary to perform at one’s physiological best to win, but rather to outperform one’s opponent.

The recovery period between the official weigh-in and competition creates an opportunity for athletes to ingest foods and fluids to restore hydration and fuel status, attenuating the negative effects of RWL\(^3,^10\). The temptation for undertaking RWL increases when the recovery period is extended since it theoretically provides more opportunity to reverse the deleterious effects of RWL. Rules governing the timing of the official weigh-in and start of competition vary among combat sports. Olympic boxing competition is unique in that athletes are required to weigh-in the morning of the first day of competition and then each subsequent day they compete throughout the competition\(^11\). This leaves limited time to recover from RWL before the start of competition each day of the event. Reports of commonly used weight loss practices and their effects on various aspects of physiology appear in the literature which are derived from surveys and laboratory studies respectively\(^12\text{–}17\). Despite this, there is little data measuring actual weight loss in boxers, particularly those engaged in multi-day competitions.

Although it is of interest to monitor the real-life RWL practices of combat sport athletes and investigate their effect on performance or competitive success, there are inherent difficulties in undertaking such work (e.g. athletes typically arrive at the competition only hours before the official weigh-in). Additionally, chronic weight loss strategies (e.g. reducing fat mass) coincide with RWL making them impossible to separate. However, the re-gain in BM between the official weigh-in and the start of competition (the recovery period) can generally be monitored, and has been used as a surrogate measure of the magnitude of the RWL incurred to achieve a weigh-in target\(^18,^19\) at least when the recovery period is sufficiently lengthy to allow eating/drinking practices to be freely chosen.
Aside from gaining an understanding of RWL incurred before competition, examining BM re-gain post official weigh-in during competition affords an exploration of its association with competitive success\textsuperscript{18-21}. Several studies have examined the relationship between competition success and BM re-gain in grapplers suggesting a potential benefit for those gaining more weight post weigh-in, although this may be affected by the competition level of the athlete\textsuperscript{18, 20, 21}. One study investigated this relationship in striking athletes (taekwondo competitors) and found no correlation\textsuperscript{19}. It is important not to simply infer that what is true in judo, wrestling and taekwondo holds true for boxing, as these sports are truly unique and require different physiological and anthropometric attributes from athletes\textsuperscript{11, 22, 23}. To-date, no investigations have examined this relationship in boxing. In addition to vastly different physical requirements, amateur boxing offers another unique characteristic; requiring weight making over successive days with a more limited timeframe for recovery than other combat sports.

Accordingly, the primary aim of the present study was to measure boxers’ BM re-gain between the official weigh-in and each bout (“Post weigh-in BM re-gain”) in a multi-day competition, and examine its relationship to competitive success. Additionally, we investigated whether the need to repeatedly make weight affects the degree of BM re-gain; and whether an extended recovery time affects BM re-gain. Lastly, we collected information on boxers’ RWL and post weigh-in recovery practices.
3. Methods

Males and females in the elite categories of the 2015 Australian National Amateur Boxing Championship (Boxing Australia) volunteered for this project. We implemented an observational approach to examine weight fluctuations throughout a tournament and its relationship to competition success. The study was approved by the higher research ethics committee at the University of Sunshine Coast, Queensland, Australia and participants provided informed consent.

The event took place over six days (Day 1: Initial weigh in and Days 2-6: competition) with official weigh-ins being held every morning. The initial weigh-in took place 0730-0900 in the morning of Day 1 for all competitors. Subsequent weigh-ins took place each morning at 0630-0700 only for boxers competing that day. Two competition sessions were undertaken each day; a morning session, 1000-1500; and an afternoon session, 1600-2100.

In addition to the official weigh-in BM; we recorded BM of boxers within an hour of their bout. Hence a minimum of three hours and a maximum of approximately 12 hours elapsed between the official weigh-in and the pre-bout weigh-in. Elapsed time depended on whether a boxer fought in the morning or afternoon session, and the fight schedule. Body mass measurement was conducted using the same set of scales used during the official weigh-in (Tanita, Japan, BWB800S). Where possible, boxers were weighed in the same clothing as the official weigh-in. In situations where this was not possible, details of clothing were noted and weighed separately to account for differences.

Before leaving the competition, boxers were asked to complete a survey assessing their post weigh-in nutrition behaviours as well as their weight loss practices in the seven days before competition. The survey was based on previous work from our group examining post weigh-in recovery practices in light weight rowers, tested for content validity and screened for readability and comprehension by relevant experts (Australian Institute of Sport (AIS) dietitians) and comparable athletes to those who completed the survey in present study (combat sport athletes training at the AIS). The survey included both closed and open ended questions relating to fluid and food choices, as well as factors influencing their nutrition practices. Questions examining pre weigh-in RWL focused on strategies which affect muscle glycogen content, total body water status and gut contents as these are the BM compartments that can be acutely manipulated. Boxers were asked to indicate (yes/no) to a range of factors that influenced their post-weigh in nutrition practices and then rate the importance of that factor using a 1-5 Likert scale.

In this study we report descriptive statistics of the survey data. Chi square tests were performed to determine if survey responses differed from chance and to report on differences between responses where appropriate. Descriptive statistics were used to report mean change in BM from weigh-in to competition in absolute values (kg) and percentage of BM with further analyses completed according to sex, weight division group (multiple weight divisions were grouped together in order to provide sufficient sample sizes for ANOVA analysis) and competition success. A repeated measures two-way ANOVA with Bonferroni post-hoc tests.
was used to compare official weigh-in BM and pre-fight BM between males and females. For within-subject single comparison questions paired t-tests were conducted. For between-subject comparisons, Levene’s tests of homogeneity were conducted followed by unpaired t-tests when single comparisons were made and by ANOVA with a Bonferroni post-hoc test when multiple comparisons were made. Boxers were separated into finalists and non-finalists to determine the relationship between BM re-gain and success. The two boxers who qualified for the final bout were considered finalists, except in the case of divisions with only two competitors where only the winner was counted as a finalist. In recognition of the multiple sampling of this data set, a Bonferroni correction was applied to all findings, by reducing the level of significance to $P<0.0125$. Additionally, 95% confidence intervals (CI95%) and Cohen d effect sizes (ES) are reported when appropriate. The magnitudes of these ES were classified as trivial (0–0.19), small (0.20–0.49), medium (0.50–0.79) and large (0.80 and greater) using the scale advocated by Cohen (4). All data is expressed as mean ±SD. No male super heavyweights (>91kg division) were included in the analysis as they are not required to make weight.

4. Results

One hundred of the 101 boxers who competed in the tournament participated in the study, including all winners. One boxer failed to make weight which occurred on the morning of the first competition day. In total, 85 bouts were included in the analysis.

Table 1 presents BM data measured at weigh-in and pre-bout. There was a significant effect for sex, $F(1, 98) = 16.91$, $p < 0.001$, and time $F(1, 98) = 110.1$, $p < 0.001$; as well as for the interaction between time and sex, $F(1, 98) = 6.532$, $p = 0.0121$. Across all bouts, pre-fight BM was significantly greater than official weigh-in BM for both males ($p < 0.001$; ES= 0.13; CI95% [1.10, 1.62]) and females ($p < 0.001$; ES=0.11; CI95% [0.43, 1.22]) (Table 1).

**INSERT TABLE 1.**

Percent changes in BM re-gain by weight division group are presented in Figure 1. No significant differences were found between weight division groups for females ($F(3, 26) = 2.154$, $p = 0.948$), however significant differences existed between male weight division groups ($F(3, 66) = 3.22$, $p = 0.028$). Weight re-gain was significantly greater in the lightest weight division group (<49kg, <51kg, <56kg) than in the heaviest weight division group (<81kg, <91kg).

**INSERT FIGURE 1.**
Differences in BM re-gain for boxers who competed in the morning and afternoon sessions and for those who competed in preliminary and final bouts are displayed in Figure 2. BM re-gain was greater (0.37% BM, p < 0.001; ES=0.25; CI95% [0.12, 0.61]) for afternoon bouts compared to morning bouts. Body mass re-gain was not different between preliminary and final bouts (0.25% BM, p = 0.129; ES=0.18; CI95% [-0.08, 0.59]).

INSERT FIGURE 2.

In forty-one of the eighty-five bouts analysed the winner was heavier than the loser. In forty bouts, the loser was heavier than the winner; on three occasions both boxers were the same weight and one bout was not analysed due to incomplete data. Percentage BM re-gain for finalists and non-finalists are presented in Figure 3. No significant differences in BM re-gain were found between finalists and non-finalists among males 0.13% BM (p = 0.771; ES=0.08; CI95% [-0.77, 1.03]); females 0.68% BM (p = 0.266; ES=0.41; CI95% [-1.91, 0.54]); or males and females combined, 0.02% BM (p = 0.948; ES=0.01; CI95% [-0.67, 0.71]).

INSERT FIGURE 3.

BM fluctuations throughout competition for females, males, and females and males combined; and, for those who competed in the maximum four bouts possible (males only) are displayed in Figure 4. These results mirrored the general findings that BM measurements for bouts were greater than weigh-in measurements and that males displayed greater BM re-gain than females. There were no significant differences in fluctuations across the course of the tournament.

INSERT FIGURE 4.

Seventy-three of 101 athletes completed the survey on pre and post weigh-in weight loss and nutrition practices. Respondent’s weight loss strategies used in the week before the current competition are displayed in Table 2. Respondents self-reported losing 3.6% BM in the week before competition (3.5% BM for females and 3.7% BM for males). The most popular methods of weight loss were active dehydration and a reduction in food portion sizes.

INSERT TABLE 2.
A majority (81%) of respondents reported following a plan during the post weigh-in recovery period with the remainder indicating the absence of a plan. Factors influencing post-weigh-in nutrient intake are presented in Figure 5, together with mean ratings of how important they were to the survey respondents. Significant differences existed between influencing factors ($F(6, 497) = 75.53, p < 0.001$).

**INSERT FIGURE 5.**

Post weigh in food and fluid intake are presented in tables 3 and 4 respectively. Only one respondent indicated not consuming any foods or snacks other than fluids.

**INSERT TABLE 3.**

**INSERT TABLE 4.**

Factors influencing boxers’ food and fluid intake practices are displayed in Table 5. Thirst and hunger, as well as weight loss in the past 48 hours were key factors influencing dietary choices and volumes consumed post weigh-in.

**INSERT TABLE 5.**
5. Discussion

This is the first study to measure BM re-gain during a multi-day boxing tournament and examine the relationship to competitive success. As expected, boxers' BM increased significantly after official weigh-in. Males re-gained more BM than females and the lightest male weight division group displayed significantly greater BM re-gain than the heaviest weight division group. Longer recovery time after weigh-in, as found in bouts scheduled for the afternoon, were associated with greater BM re-gain. However, no differences in BM re-gain were found between finalists and non-finalists, between winners and losers of individual bouts, or between preliminary or final bouts. One interpretation of this finding is that under conditions in which there is a limited time for post weigh-in recovery, BM re-gain may no longer provide a surrogate measure of RWL in the days preceding the official weigh-in; indeed, the capacity for restoration of BM losses may be relatively clamped and therefore unable to address and differentiate small and large BM losses. Alternatively, since no differences existed between successful and less successful boxers with regard to BM re-gain, it could be argued that greater RWL and re-gain is not associated with competitive outcomes in boxing.

The boxers in our study re-gained significant amounts of BM after weigh-in, as has been shown in other Olympic combat sports of taekwondo\(^1\), wrestling\(^{18, 20}\) and judo\(^{21}\), as well as in previous research examining boxers\(^4\). The magnitude of BM re-gain was considerably less for the boxers in the current study than reported in this latter study in which boxers participated in a tournament where the official weigh-in was held the day-before competition (1.93±1.64\% BM vs 4.4±3.3\% BM)\(^4\). Larger BM re-gain has been also been shown in other combat sports in which weigh-in is conducted on the previous day\(^{18, 21}\); this suggests that fighters exploit the increased potential to acutely reduce and re-gain BM provided by larger recovery times.

Although our observation of greater BM re-gain in male athletes is not a universal finding of similar studies in other sports\(^{19, 21}\), this finding may reflect the greater muscle and water mass of men than women at a given weight. Assuming body water manipulation is the dominant contributor to acute BM fluctuations, males would have greater capacity to acutely reduce and re-gain BM. Alternatively the greater magnitudes of BM re-gain displayed by the males in this study may be related to their greater experience and higher calibre, factors that are also known to correlate with more extreme RWL\(^{1-3}\) practices. Indeed, there were a larger number of males than females in the present competition, suggesting greater ‘depth in competition’; this mirrors the general finding within the sport of boxing in Australia.

The difference in BM re-gain between the lightest and heaviest male weight division groups in the present study indicates that the RWL of these athletes are more extreme than others. Results of this study support earlier findings of more extreme RWL of combat sport athletes in lighter weight divisions\(^{18, 20}\). A possible reason for this difference is that athletes attempt to compete in weight divisions with fewer competitors (which was the case in the present study). Furthermore, the smaller absolute weight intervals between the lighter weight divisions relative to the heavier weight divisions may increase the temptation for athletes to...
undertake more extreme RWL. Alternatively, there may be an absolute threshold for RWL that boxers aim to achieve which leads to a greater BM re-gain in lighter boxers when expressed as a percentage.

The protocols of competition in this boxing tournament permitted observations of potential differences in behaviour over successive bouts across a competition as well as changes according to the scheduled timing of the bout in the day. We observed greater BM re-gain when bouts were scheduled later in the day (thus providing increased recovery time) which we attributed to recognition of the greater opportunities for, and benefits of, restoration of RWL. However, we failed to find differences in practices across successive bouts in the competition (i.e. preliminary and final bouts). This suggests several factors combine to influence behaviour. First, it appears from both the survey responses and our observations of BM changes that boxers attempt to rehydrate and refuel as must as possible within their allotted (limited) recovery time, presumably considering this important for immediate performance, despite the implication that further RWL will be needed to achieve the subsequent weigh-in. Whether this finding would persist when competition rules allowed a longer recovery time (and more opportunity for greater fluid restoration and food intake) is unknown and may involve some individual calculation of the “cost” of re-losing the additional BM re-gain before the next weigh-in. A greater sample size in the current study would have allowed comparison between some boxers who fought (and weighed in) daily and those who fought less frequently in their progression to the final bout on the last day, due to a smaller number of competitors in their division.

Information collected in this study on recovery nutrition practices suggest that the boxers relied on their own experiences as well as internal perceptions (hunger, thirst, energy levels, taste preferences etc.) rather than expert advice, external influences or objective cues. This is in contrast to other reports in the literature on RWL practices of combat athletes in which the respondents identified coaches and other athletes as their primary influences. Current sports nutrition guidelines for effective rehydration while minimising gut discomfort promote the slow consumption of fluids in volumes equivalent to ~ 150% of BM loss, supported by the replacement of sodium via electrolyte-containing beverages or sodium-rich foods. By contrast, in the current study, water was the preferred rehydration beverage, with ~ half of the boxers failing to follow practices to consciously replace electrolyte losses. In addition, although boxers indicated that they reduced portion sizes of food while making weight, few purposely reduced fibre intake and many consumed fibre-rich/low energy foods in the post weigh-in recovery period. Therefore, they appeared unaware of the potential use of a low-fibre diet to decrease the weight of gut contents, and thus promote weight loss without compromising fluid or nutrient intake for the first or subsequent bouts. Overall, this study suggests that further education is needed to assist boxers to improve their RWL and recovery practices. Whilst the present survey was constructed by relevant experts, it is acknowledged that it was not externally validated thus this must be considered when interpreting our findings and highlights the need for consolidation in this space in future research.
In contrast to the findings of studies in combat sports\textsuperscript{20, 21}, we failed to find a correlation between the BM re-gain and competitive success, either in terms of the outcomes of individual bouts or success in reaching the finals. As previously stated, this may be due to the circumstances of this boxing tournament in which BM re-gain is limited by opportunity and may not provide a true surrogate for the magnitude of RWL. However, another interpretation of the overall literature on this theme is that RWL and BM re-gain has no effect on competitive success in striking sports\textsuperscript{19} (boxing and taekwondo) whereas an effect is seen in grappling sports\textsuperscript{20} (judo and wrestling). These differences may be due to the technical nature of the sports; grappling involves the manipulation of an opponent’s BM whereas success in striking sports is more dependent on the tactical implementation of movements of one’s own BM thus small differences in BM and strength are less important. It has even been suggested that height is more important than BM in striking sports and that athletes should be separated by height rather than weight\textsuperscript{32}.

A final explanation for our findings is that in competitions where combat sport athletes are all of an elite or roughly equal standard, all competitors within a weight class engage in similar patterns of RWL and re-gain and any further benefit derived from qualifying for a lower weight class is negated by the universality of these practices. Indeed, the present study examined a national championship in which boxers had to be selected by their respective state organisations to attend, thus achieving a more homogenous level of competition. Similarly, there was no benefit observed for greater BM re-gain in a study undertaken at a national wrestling competition in the USA in which athletes had qualified to attend\textsuperscript{18}. However, in competitions without qualification requirements, where there is a greater disparity in athlete experience and calibre, greater post weigh-in BM re-gain has been shown to correlate with improved chances of success\textsuperscript{20, 21}. Of course, this correlation does not show the direction of the cause and effect, since it is possible that the more successful athletes have endured in their sport because of their ability to tolerate more extreme weight making practices just as it is possible that greater RWL and BM re-gain are directly beneficial to competitive success.
6. **Practical applications**

While the degree of BM re-gain post official weigh-in did not influence success in this study, most boxers still engaged in RWL practices. Boxers understand the importance of recovering from RWL however their understanding of optimal BM loss and recovery strategies is not ideal. Sports nutrition professionals should deliver targeted education to combat sport athletes and coaches to improve RWL practices and subsequent recovery to optimise performance while ensuring the health and well-being of the athlete. Unlike other combat sports, the magnitude of BM re-gain during (limited) recovery periods and the necessity to weigh-in for successive bouts may not reflect the severity of weight making practices.
7. Conclusion

The majority of boxers practice RWL and BM re-gain pre and post official weigh-in, respectively. Despite the requirement to repeatedly make weight throughout a multi-day competition, boxers focus on restoring BM losses as much as possible before a bout, with extended recovery times resulting in greater BM re-gain. In this study, the requirement to make weight for a following bout had no influence on BM re-gain. RWL and BM re-gain appear to have no effect on competitive success (at least in the present investigation). While boxers recognise the importance of adequate hydration, fuelling and recovery; many do not appear to understand optimal methods to achieve this, thus further education is warranted.
8. Acknowledgments

The authors would like to acknowledge the support and cooperation of Boxing Australia and the individual athletes in conducting this study.

This study did not receive any funding.

All the authors declare that they have no conflict of interest derived from the outcomes of this study.
9. References


10. Figures and tables

Figure 1 - BM re-gain between weight division groups for males (A) and females (B). Analysis of variance revealed no significant differences between weight divisions for females. A significant difference between the lightest and heaviest weight division groups in males was revealed (*).
Figure 2 - BM re-gain comparisons for boxers who competed in both; (A) morning and afternoon bouts (n=25) and (B) preliminary and final bouts (n=26). Paired t-tests revealed significant differences in BM re-gain between morning and afternoon bouts (** p = 0.0051) but not for preliminary and final bouts.
Figure 3 - BM re-gain comparisons between finalists and non-finalists for; males (A), females (B) and combined males and females (C). Unpaired t-tests revealed no significant differences in BM re-gain between finalist and non-finalists.
Figure 4 - BM re-gain between weigh-ins and bouts throughout tournament for; females (A), males (B), males and females combined (C) and males who competed in bouts in all four rounds (D). No significant differences in BM re-gain between bouts were found.
Figure 5 - Boxers' ratings of the importance of various factors when considering food and fluid intake practices post weigh-in/ prior to a bout. ANOVA revealed significant differences exist between factors (p < 0.001).
Table 1. Mean weigh-in and pre-bout body mass (BM) of boxers

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>70 (70%)</td>
<td>30 (30%)</td>
<td>100</td>
</tr>
<tr>
<td>Weigh-in BM</td>
<td>66.99±10.4kg</td>
<td>58.66±7.6kg*</td>
<td>64.49±10.35kg</td>
</tr>
<tr>
<td>Pre-bout BM</td>
<td>68.35±10.28kg</td>
<td>59.49±7.4kg*</td>
<td>65.70±10.32kg</td>
</tr>
<tr>
<td>BM re-gain (Kg)</td>
<td>1.36±0.97kg</td>
<td>0.82±0.9kg*</td>
<td>1.2±0.98kg</td>
</tr>
<tr>
<td>BM re-gain (%)</td>
<td>2.1±1.6%</td>
<td>1.59±1.6%*</td>
<td>1.9±1.6%</td>
</tr>
</tbody>
</table>

* Donates significant difference from males
Table 2. Self-reported acute weight loss methods prior to weigh-in

<table>
<thead>
<tr>
<th></th>
<th>Active dehydration</th>
<th>Passive dehydration</th>
<th>Both</th>
<th>Neither</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluid manipulation</strong></td>
<td>30%</td>
<td>9%</td>
<td>41%</td>
<td>20%</td>
</tr>
<tr>
<td>Reduce portion sizes/ skip meals</td>
<td>36%</td>
<td>5%</td>
<td>Both</td>
<td>None</td>
</tr>
<tr>
<td><strong>Gut content manipulation</strong></td>
<td>59%</td>
<td>3%</td>
<td>11%</td>
<td>27%</td>
</tr>
<tr>
<td>Reduce carbohydrate intake</td>
<td>23%</td>
<td>8%</td>
<td>10%</td>
<td>59%</td>
</tr>
<tr>
<td>Reduce energy intake</td>
<td>17%</td>
<td>9%</td>
<td>Both</td>
<td>None</td>
</tr>
</tbody>
</table>

Chi square analysis determined reported frequencies to responses for each question were significantly different to chance (p < 0.01)
Table 3. Athlete post weigh-in food intake practices

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumes foods or snacks other than fluid</td>
<td>83%</td>
<td>16%</td>
<td>1%</td>
</tr>
<tr>
<td>Prepares own meals and snacks</td>
<td>42%</td>
<td>50%</td>
<td>8%</td>
</tr>
<tr>
<td>Utilises pre-packaged meals or snacks</td>
<td>8%</td>
<td>73%</td>
<td>19%</td>
</tr>
<tr>
<td>Purposely consumes high salt foods or adds salt to food</td>
<td>6%</td>
<td>40%</td>
<td>54%</td>
</tr>
<tr>
<td>Consumes vegetables, legumes or beans post weigh-in</td>
<td>34%</td>
<td>44%</td>
<td>22%</td>
</tr>
<tr>
<td>Consumes fruit post weigh-in</td>
<td>55%</td>
<td>37%</td>
<td>8%</td>
</tr>
<tr>
<td>Consumes grains/cereals/pasta/breads etc. post weigh-in</td>
<td>44%</td>
<td>50%</td>
<td>6%</td>
</tr>
<tr>
<td>Consumes meat or fish post weigh-in</td>
<td>37%</td>
<td>48%</td>
<td>15%</td>
</tr>
<tr>
<td>Consumes dairy post weigh-in</td>
<td>8%</td>
<td>55%</td>
<td>37%</td>
</tr>
<tr>
<td>Consumes fats/oils post weigh-in</td>
<td>8%</td>
<td>52%</td>
<td>40%</td>
</tr>
<tr>
<td>Consumes sports foods (bars, gels, drinks) post weigh-in</td>
<td>12%</td>
<td>62%</td>
<td>26%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>&lt;1 hr</th>
<th>1-2 hrs</th>
<th>&gt;2 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>How close to your fight do you consume solid foods</td>
<td>12%</td>
<td>58%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Chi square analysis determined reported frequencies to responses for each question were significantly different to chance (p < 0.01), except for “Consumes vegetables, legumes or beans post weigh-in” (p = 0.15).

Differences between reported frequencies to food group responses (Q5-11) were significant also ($\chi^2$ (12, N=73) = 132.4, $p < 0.001$).
Table 4. Athlete post weigh-in fluid intake choices

<table>
<thead>
<tr>
<th>Fluid Intake</th>
<th>Mostly</th>
<th>Often</th>
<th>Infrequently</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consume water post weigh-in</td>
<td>77%</td>
<td>22%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Consume soft drinks post weigh-in</td>
<td>0%</td>
<td>5%</td>
<td>18%</td>
<td>77%</td>
</tr>
<tr>
<td>Consume fruit juice post weigh-in</td>
<td>0%</td>
<td>18%</td>
<td>26%</td>
<td>56%</td>
</tr>
<tr>
<td>Consume milk post weigh-in</td>
<td>0%</td>
<td>15%</td>
<td>22%</td>
<td>63%</td>
</tr>
<tr>
<td>Consume meal replacement drinks post weigh-in</td>
<td>3%</td>
<td>16%</td>
<td>25%</td>
<td>56%</td>
</tr>
<tr>
<td>Consume protein supplements post weigh-in</td>
<td>3%</td>
<td>25%</td>
<td>25%</td>
<td>47%</td>
</tr>
<tr>
<td>Consume sports drinks post weigh-in</td>
<td>27%</td>
<td>47%</td>
<td>16%</td>
<td>10%</td>
</tr>
<tr>
<td>Consume electrolyte replacement drinks post weigh-in</td>
<td>29%</td>
<td>29%</td>
<td>16%</td>
<td>26%</td>
</tr>
</tbody>
</table>

Chi square analysis determined reported frequencies to responses for each question were significantly different to chance (p < 0.01), except for “Consume electrolyte replacement drinks post weigh-in” (p = 0.46).

Differences between reported frequencies to responses were significant also ($\chi^2 (21, N=73) = 489.9, p < 0.001$).
### Table 5. Influences on boxers post weigh-in food and fluid choices and volumes consumed

<table>
<thead>
<tr>
<th>Percentage of respondents indicating being influenced by this factor</th>
<th>Thirst/hunger</th>
<th>Taste</th>
<th>Coaches advice</th>
<th>Dietitian/doctors’ advice</th>
<th>Other boxers’ advice</th>
<th>Weight lost in the last 48 hours</th>
<th>Weight lost in the past week</th>
<th>Weight of the food</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluid</strong></td>
<td>70%</td>
<td>11%</td>
<td>21%</td>
<td>14%</td>
<td>1%</td>
<td>52%</td>
<td>23%</td>
<td>-</td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td>53%</td>
<td>27%</td>
<td>26%</td>
<td>10%</td>
<td>4%</td>
<td>40%</td>
<td>29%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Chi square analysis determined reported frequencies to responses for fluid and food were significantly different to chance ($p < 0.001$).

Differences between reported frequencies to responses between fluid and food were significant also ($\chi^2 (7, N=73) = 27.09, p = 0.0003$).