MAKING WEIGHT IN WEIGHT CATEGORY SPORTS

BEST PRACTICE GUIDELINES FOR PERFORMANCE NUTRITION PRACTITIONERS

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OBJECTIVE

These Best Practice Guidelines on Making Weight in Weight Category Sports provide contemporary evidence-based information for performance nutrition practitioners to prioritise the health, safety and welfare of all individuals involved in making weight in sport.

SUMMARY

- Weight category sports make up a significant proportion of the events on the Olympic Games program and represent sports with growing participation rates at community and high-performance level.
- Within such sports, athletes routinely attempt to gain a competitive edge by manipulating their body mass to compete in a division that is lighter than their normal training 'weight'.
- Although strategies include long term changes in body composition, acute weight loss is typically undertaken in the period immediately before a competition weigh-in via dietary modification, increased exercise, and other strategies that achieve moderate to severe dehydration.
- Acute weight loss practices may impair performance and result in serious health and safety risks. Tragically, athletes have died while "making weight" for competition.
- Serious adverse implications from poorly considered chronic weight management practices are also possible, including the development of clinical conditions such as disordered eating, poor bone mineral density, hormonal imbalances and impaired growth.
- Many features of weight category sports make it unlikely that practices around making weight can be completely avoided. Weight categories are necessary for safety and fair competition in some sports and weight making enjoys a long history and culture in such environments. Furthermore, there is evidence that chronic and acute weight loss practices can be undertaken safely and in conjunction with competitive success.
- A pragmatic approach to making weight involves collaboration between the athlete, coach and performance support personnel to develop an individualised plan that targets the characteristics of the athlete and his or her event. Considerations within this plan, which integrates elements of chronic weight management, acute weight loss and post weigh-in recovery, include the individual's physiological and psychological traits, characteristics for success in their sport, the time available for recovery between weigh-in and competition, whether or not repeated weigh-ins are required for the competition in question, and previous weight loss experience.
- Sporting organisations should play a pro-active role in supporting the health, safety and performance of athletes who compete in weight category sports. This role includes the development of weight management policies, support for education activities, providing access to a Core Multidisciplinary Team (CMT) consisting of an accredited sports dietitian (ASD), sports doctor and psychologist, and contribution to an environment and culture that prioritises athlete welfare while supporting performance outcomes
- The ASD plays a key role in the CMT, by working with the athlete and coach to design, implement and refine weight management and weight making plans. Meanwhile, psychological support and assessment of health status contribute important services to athlete care and success. Professionals within this team should leverage each other's knowledge and expertise to provide education and counselling services that address the unique needs of weight category sports.

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BACKGROUND TO BEST PRACTICE GUIDELINES

Introduction

Rules and regulations in sport generally strive to ensure fair and exciting competition, mandating the behaviour of competitors, the use of equipment and the metrics of success. In sports in which increased height, body mass (BM), and strength provide a significant benefit, athletes may be separated into weight categories to 'create an even playing field' in terms of safety and competitive equality. Such events include combat sports, weightlifting events, lightweight rowing and "sprint" football. Indeed, weight category sports make up a significant proportion (~15%) of the medals available at the Summer Olympic Games. Furthermore, in Australia and worldwide, community participation in a range of amateur and professional sports with weight categories is increasing.

Given the importance of strength and power to performance outcomes, most athletes in weight category sports undertake chronic weight management strategies (over weeks and months) to achieve a lean physique that maximises muscle mass within their given weight limit. Additionally, they may attempt to take advantage of weight categories and their weigh-in procedures by "making" or "cutting" weight to qualify for a division that is lighter than their "normal" training BM. This involves the implementation of acute weight loss (AWL) strategies in the period immediately before the weigh-in (several hours to several days), followed by attempts to reverse the negative performance effects of AWL during the recovery period between weigh-in and the start of competition. In theory, this should provide the athlete with an advantage by allowing them to compete against smaller opponents. Indeed, there is indirect evidence that this strategy is associated with success in some weight category sports. Although the implementation of safe and sensible AWL strategies represents a pragmatic approach to optimise competitiveness in some weight category sports, it is important to acknowledge that severe health consequences (including death) have arisen from extreme use of AWL strategies. Therefore, the methods and magnitudes of AWL must be carefully managed to minimise the potential negative outcomes.

Many sporting bodies, academics and community members have called for the abolishment of weight cutting, hereafter termed weight making. However, unless regulations specifically and systematically disallow AWL, it is likely that athletes will continue to engage in the practice. As such, ASDs and other performance support practitioners who work with weight category sports need to balance the athlete's desire to achieve (real or perceived) advantages of weight making with real concerns for their physical, mental and emotional health. To this end, best practice guidelines are provided to assist performance nutrition practitioners to support athletes and coaches in weight category sports to make good decisions about weight making and to implement safe and sound practices when it is used. The information provided in this document will:

- Describe the risks associated with participation in weight category sports
- Describe the risks of inappropriate weight management practices
- Provide guidelines for ASDs and other professionals to assist an athlete to achieve safe and effective practices for weight loss
  - Describe principles for a safe and effective approach to chronic weight management
  - Detail safe and effective practices for acute weight loss
- Detail effective recovery (i.e., rehydration and refuelling) between weigh-in and competition
- Outline other useful resources that may assist with this area of practice
- Provide guidelines for sporting organisations to develop policies around weight management practices

HEALTH AND PERFORMANCE RISKS ASSOCIATED WITH WEIGHT MAKING

Participation in a making weight sport

Although it is possible to minimise many of the negative effects of the weight loss practices utilized by athletes, simply participating in a weight category sport poses potential problems. Athletes in weight category sports often experience pressure to obtain low BM and body fat levels for sports performance. Furthermore, the absence of adequate support and sound management practices is often not questioned, in part because weight making has become an integral part of the culture of many weight category sports. Typically, these athletes have an increased risk for poor body image, disordered eating (DE) and eating disorders (EDs).

A full discussion on the early identification, prevention and management of DE and EDs is beyond the scope of this document. Readers are directed to published reviews on the topic while the Position Statement on Disordered Eating in High Performance Sport Position Statement by the Australian Institute of Sport and the National Eating Disorders Collaboration provides a comprehensive guide to this issue.

Further reading

Bratland-Sanda, S., & Sundgot-Borgen, J. (2013). Eating disorders in athletes: Overview of prevalence, risk factors and recommendations for prevention and treatment. *European Journal of Sport Science, 13*(5), 499-508.

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Wells, K. R., Jeacocke, N. A., Appaneal, R., Smith, H. D., Vlahovich, N., Burke, L. M., & Hughes, D. (2020). The Australian Institute of Sport (AIS) and National Eating Disorders Collaboration (NEDC) position statement on disordered eating in high performance sport. *British Journal of Sports Medicine,* 54(21), 1247-1258.

High risk weight loss practices

An athlete's plans for BM management should consider the potential (physical and mental) health and performance concerns posed by both acute and chronic weight loss strategies. Some athletes attempt BM loss that involves use of extreme forms of previously identified practices and/or the involvement of practices that are inherently riskier. Some of these methods are banned under Anti-Doping codes (e.g., use of diuretics or prohibited stimulants) or pose a risk of causing an Anti-Doping Rule Violation (e.g., ingestion of banned substances present as contaminants or undeclared ingredients within untested sports/diet supplements). Others become dangerous due to their use, singly or in combinations, to achieve excessive BM losses while creating other physiological disturbances and/or exposure to thermal stress. Indeed, there have been numerous case histories in which athletes across a range of weight category sports have died in association with competition preparation practices. Because of these concerns, and the availability of alternative methods of AWL that are effective and less harmful, the use of the following practices or items is strongly discouraged:

- Vomiting
- Bowel preparation formulas
- Laxatives
- Diuretics
- Dietary supplements, "diet pills" and stimulants promoting either acute or chronic weight loss
- Supplements which have not undergone third party testing, or been authorised by the athlete's CMT
- Prolonged/extreme restriction of fluids and food in combination with sweat-inducing practices
- Prolonged exposure to thermally stressful environments like sauna or hot baths, especially when exercising in these environments. Similar adverse outcomes can occur as a consequence of wearing impenetrable clothing (plastic sweats) for extended periods of time. The cessation of a sweat response, altered cognition, or presence of nausea should be of particular concern and warrant immediate removal from the thermal challenge, introduction of cooling strategies and access to medical support.

Further reading

Burke, L.M., LaBella, C.R., Matthews, J., Slater, G., & Horswill C.A. (2021). ACSM Expert Consensus Statement on Weight Loss in Weight-Category Sports. *Current Sports Medicine Reports*, 20(4), 199-217.

Kasper, A. M., Crighton, B., Langan-Evans, C., Riley, P., Sharma, A., Close, G. L., & Morton, J. P. (2019). Case Study: Extreme Weight Making Causes Relative Energy Deficiency, Dehydration, and Acute Kidney Injury in a Male Mixed Martial Arts Athlete. *International Journal of Sport Nutrition and Exercise Metabolism,* 29(3),331-338

Matthews, J. J., Stanhope, E. N., Godwin, M. S., Holmes, M., & Artioli, G. G. (2019). The Magnitude of Rapid Weight Loss and Rapid Weight Gain in Combat Sport Athletes Preparing for Competition: A Systematic Review. *International Journal of Sport Nutrition and Exercise Metabolism, 29(4), 441–452.*

Reale, R., Slater, G., & Burke, L. M. (2018). Weight Management Practices of Australian Olympic Combat Sport Athletes. *International Journal of Sports Physiology and Performance,* 13(4), 459-466.

Junior athletes

In view of the negative consequences of the inappropriate weight management practices previously identified, these best practice guidelines promote the general principle that junior athletes (<18 years of age) should not engage in AWL in order to qualify for competition. Instead, young athletes are encouraged to adopt sound nutrition practices that promote good health, support their growth and overall development, and exclude a preoccupation with weight control. Given normal growth patterns, it is natural for a junior athlete to transition through several weight categories until they fully mature. It is recognised, in rare situations, a compelling case in which a junior athlete might need to engage in weight management practices could occur. For example, a talented young athlete who is undergoing a growth phase may exceed the weight category of the Olympic Games for which they have previously qualified several months earlier, rendering them unable to compete in the absence of BM manipulation. Such scenarios should be assessed, managed and closely monitored on a case-by-case basis. Furthermore, support should be provided to the athlete and their parents/guardians by the CMT of ASD, sports doctor and psychologist.

Further reading

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Brown, K. A., Dewoolkar, A. V., Baker, N., & Dodich, C. (2017). The female athlete triad: special considerations for adolescent female athletes. *Translational Pediatrics*, 6(3), 144.

Female athletes

Hormonal variations throughout the menstrual cycle can influence several physiological systems relevant to weight management in females, inclusive of body composition, substrate utilization, fluid balance and thermoregulation. Given this, gender should be considered when exploring both chronic and acute weight loss strategies, plus recovery following weigh-in. For example, recommended body fat cut off limits are higher for females and they appear to be more vulnerable to adverse health and performance implications of sustained periods of dietary restriction and/ or training excesses. As such, a periodises approach to FM loss may be warranted, with smaller energy deficits applied over longer time frames, inclusive of recovery periods where energy balance is restored. Energy intake should not be prescribed at a level below resting energy needs or resting metabolic rate (RMR), with associated macronutrient ranges approximating 3 g·kg BM^{-1} carbohydrate, 2 g·kg BM^{-1} protein and 1 g·kg BM^{-1} fat, depending of course on daily training loads and thus exercise energy expenditure. Prescription could then be adjusted to achieve rates of weight loss within the range of 0.5 - 1.0 kg·wk^{-1} or approximately 1% weekly. Females also have proportionally less fat free mass (FFM), and as a consequence, ~10% less TBW. Coupled with lower body size and surface area, females have lower sweat production, resulting in less body mass loss for a given period of exercise and/ or thermal exposure. As a consequence, caution must be considered in the AWL strategies implemented by females. Lower absolute rates of fluid absorption may also adversely impact on the ability to recover from implemented AWL strategies following weigh-in. Finally, some evidence suggests phase of menstrual cycle may influence TBW and core temperature, at least amongst athletes not using the oral contraceptive pill. The late follicular phase results in an increase in TBW interstitial fluid, in response to the elevation of arginine vasopressin that follows the increase in oestrogen levels. However, debate remains if there is an associated increase in body mass. It may be fluctuations in sex hormones throughout the menstrual cycle are not large or long enough to result in changes in body mass. However, there is evidence to confirm the elevation in progesterone levels during the luteal phase are associated with an increase in core temperature of 0.3-0.7°C, potentially further increasing the risk of heat stress if female athletes are exposed to thermal challenges to support weight loss during this phase of their menstrual cycle. As such, it is pertinent to examine either the use of contraception or menstrual cycle status, in conjunction with any potential underlying health issues related to energy availability when working with female athletes.

The AIS has partnered with specialist medical practitioners, high performance athletes and high-performance coaches to deliver a broad suite of online learning modules relating to key female athlete performance and health considerations.

Further reading

Langan-Evans, C., Reale. R., Sullivan, J., & Martin, D. (2022). Nutritional Considerations for Female Athletes in Weight Category Sports. *European Journal of Sport Science, 22:5, 720-732.*

Rodriguez-Giustiniani, P., Rodriguez-Sanchez, N., & Galloway, S. (2022). Fluid and electrolyte balance considerations for female athletes. *European Journal of Sport Science, 22:5, 697-708.*

Baker, F. C., Sibozo, F., & Fuller, A. (2020). Temperature regulation in women: Effects of the menstrual cycle. *Temperature, 7(3), 226-262.*

Giersch, G., Charkoudian, N., Stearns, R., & Casa, D. (2020). Fluid Balance and Hydration Considerations for Women: Review and Future Directions. *Sports Medicine, 50, 253-261.*

BEST PRACTICE GUIDELINES FOR WEIGHT MANAGEMENT IN WEIGHT CATEGORY SPORTS

Core Multidisciplinary Team (CMT)

Ideally, all athletes who compete in weight category sports should have access to a CMT of an ASD, psychologist and a sports doctor, all of whom should have special expertise in issues relating to BM management, and specific knowledge of weight category sports. As per the Olympic Movement Medical Code, all activities of the CMT should be based on the premise that the health and welfare of athlete are pre-eminent and prevail over competitive, economic, legal or political considerations.

Although there are many aspects to their roles within the environment of weight category sports including education and the development of a weight management policy, special attention needs to be given to scenarios in which athletes should be supported or mandated to receive individual attention from members of the CMT. Recommendations are provided in the table below:

Professional	Scenarios which require Professional expertise
Sports Dietitian	Any athlete who needs to reduce their body mass to make weight, but particularly: > An athlete who is known to have difficulties with making weight or has expressed interest to qualify for a lower weight category > An athlete, identified by another health professional, whose weight making practices are affecting their performance, physical or mental health, or lifestyle > A junior athlete (< 18 y) who is in the exceptional circumstances where weight making might be considered; e.g. an athlete who has qualified for high level open competition, but due to subsequent growth is no longer able to make their competitive weight category without engaging in AWL strategies for that specific competition. Thereafter, a review of the most appropriate weight class should be undertaken
Psychologist	Any athlete who is identified as having mental or psychological health problems related to weight making or their general involvement in a weight category sport, including > An athlete who is not making progress despite a structured plan for weight management > An athlete who demonstrates concerning eating behaviours > An athlete who demonstrates body image concerns > An athlete who experiences large weight gains between competitions > An athlete who expresses interest in competing in a lower weight category where this has been deemed a "borderline" decision following assessment of body composition and discussions with an ASD In addition: > A junior athlete (<18 y) who is in the exceptional circumstances where weight making might be considered
Sports Doctor	Any athlete who is identified as having medical or health issues related to weight making or their general involvement in a weight category sport, including: > A youth athlete (<18 y) who is in the exceptional circumstances where weight making might be considered > An athlete who expresses interest in competing in a lower weight category where this has been deemed a "borderline" decision following assessment of body composition and discussions with an ASD > An athlete who is identified by an ASD as needing diagnosis (blood testing) of suspected sub-optimal nutrient status > Any athlete who is identified as having mental or psychological health problems related to weight making or their general involvement in a weight category sport, including — An athlete who has reoccurring injury and/or illness — An athlete who has suffered complications during the weight making process such as episodes of dizziness/ fainting, stomach pains or nausea, full body cramps, changes in blood pressure, cessation of sweat response or altered cognition

An ASD should be the first practitioner within the CMT an athlete engages to identify an appropriate weight category and then subsequently design, implement and refine weight making plans. Having access to psychological support will enable greater provision of services to athletes at risk of DE or EDs, and a doctor will be best positioned to assess changes in general health/physiological status, as well as enable any necessary diagnostic tests (blood chemistry, bone mineral density scans etc.). Good communication within the CMT is critical for optimal outcomes to be achieved for the athlete. For example, prescription of non-steroidal anti-inflammatory drugs by the athlete's doctor may confound a well-constructed weight management/loss program as a result of fluid retention caused by the medication. Together the CMT can leverage each other's expertise to identify "at risk" athletes earlier in their progression to detrimental states.

GUIDELINES FOR SPORTS DIETITIANS

It is strongly recommended that an ASD lead the CMT in providing support for athletes in weight category sports. A number of different nutritional goals and themes should be periodised into the annual training and competition plan of weight category athletes. These include

> Identifying an appropriate weight category for individual athletes, based primarily on their presenting body composition at the start of pre-season but also taking into consideration individual physique nuances, prior weight loss practices, DE risk etc.

> Achieving acute and chronic management of body mass and composition

> Meeting day-to-day fuelling and recovery needs

> Reducing the risk of illness and injury, managing hydration, and

> Optimising competition outcomes via available performance nutrition strategies as well as management of weight making activities, inclusive of recovery after weigh-in

Although most ASDs are experienced in the knowledge and practice of these themes, including chronic management of BM and body composition, the implementation/supervision of AWL strategies is a specialised area of work almost uniquely associated with weight category sports. Therefore, specific commentary around these strategies is warranted and is aided by the inclusion of case studies of AWL practices.

Chronic weight loss

An athlete's plans for BM management should consider the potential health and performance concerns posed by both acute and chronic weight loss strategies. Given the potential concerns associated with large energy deficits and extreme reductions in energy availability, including emerging awareness about the RED-S syndrome, athletes should achieve chronic management of BM in a way that avoids sustained periods of extreme low energy availability (LEA). While the rate of chronic BM loss can be used as an indication of the severity of an energy deficit, this alone may not be adequate, give the potential for metabolic adaptation. As such, a review of EA and risk of RED-S is warranted.

According to present knowledge, a weekly rate of BM loss of no greater than 0.5-1 kg or ~1% BM is advocated since evidence suggests that this is associated with limited adverse implications on the athlete's training capacity and health. Nevertheless, given the magnitude of the BM changes often reported in weight category athletes, and anecdotal observations that some athletes seem to tolerate such changes with minimal effect on health, there is a need for further investigation of optimal or safe methods of BM loss in athletes. This includes assessment of the duration of periods of energy restriction and its subsequent impact on body mass and composition, the interaction between the duration and magnitude of energy restriction, the value of intermittent energy restriction, and optimal macronutrient balance during energy restriction.

In addition to the rate and duration of chronic weight loss, consideration should be given to the 'end point' goals: the individual athlete's BM relative to their weight category (prior to engaging in AWL) and their absolute BM and body composition targets. In terms of body fat, several position statements and existing guidelines identify a body fat equivalent to 5% BM in males and 12% BM in females as the lowest levels consistent with the support of athlete health. In reality, many individuals may not be able to achieve such low body fat levels due to a range of factors including genetics, their hormonal, metabolic and psychological makeup, the social environment, and the possession of the tools, skills and commitment to planning/managing a nutrition program. Furthermore, many elite performers compete at the highest levels in weight category sports with body fat levels ranging from 8-12% in males and 15-22% in females. Therefore, a "one size fits all" target for chronic management of body composition is not recommended. The setting of targets should include the input of the ASD and other members of the CMT who are familiar with the sport plus the athlete's coach.

Although individualised targets and programs are required, some guiding principles for chronic BM management can be summarised:

> An ASD should always be consulted when an athlete is devising a long-term weight management plan

> Athletes should manage chronic BM manipulation with strategies that prevent the need for excessive or extended periods of dietary energy restriction. Allocating sufficient time to accommodate weight loss at a rate of no greater than 0.5-1 kg or ~1% BM per week

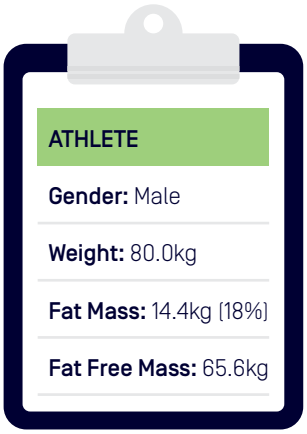
- Athletes should not set goals to achieve body fat levels lower than what is considered the "minimal healthy" body fat level (i.e. 5% BM for men or 12% BM for women). Furthermore, it should be noted that:
  - "Minimal" levels of body fat do not necessarily translate to optimal performance and could affect long-term health of individuals, even if they are achievable
  - Many individuals will not be able to achieve these "minimal healthy" levels of body fat, even with expert support
- Athletes who practice weight loss strategies for lengthy periods should be assessed and monitored for the impact on their mental health and risk of DE

Identifying an appropriate weight category

A valid and reliable assessment of body composition should be conducted on all athletes who wish to review their weight category, and those who have struggled/failed in the past to make weight despite the involvement of an ASD. In many situations, dual energy x-ray absorptiometry (DEXA) represents a valid, practical and commonly accessible method of quantifying body composition. This should be undertaken in accordance with current best practice guidance. Given that stature (and related variables like arm length) may play a more pivotal role than body mass in striking sports (tae kwon do and boxing), capture of this data is likely warranted, with results used to further assist the decision making process in identifying a preferred weight category. This is especially the case if normative data specific to weight categories is available.

The potential for further manipulation of BM via AWL should model a ≤5% BM reduction in the majority of scenarios, where shorter recovery times between weigh-in (<12 hrs) and the event limit the potential for full recovery from AWL. In the small number of sports in which recovery times between weigh-in and competition are longer (>12 hrs), slightly larger degrees of AWL may be considered but this needs to be balanced against the potential for exacerbated health and performance implications. It is noted that these estimates of achievable AWL assume a starting point where the athlete is glycogen replete, euhydrated and eating a nutrient rich, fibre-rich diet. An athlete who is already dehydrated, glycogen depleted, and/or with reduced intestinal contents due to prior dietary restriction will have significantly less capacity to further reduce BM. An example of these calculations is provided below:

Male athlete is currently 80 kg presented for a DXA scan overnight fasted and well hydrated (Usg = 1.010) prior to the initiation of any dietary restriction and thus presumably glycogen replete.



Results show below:

Assuming constant FFM during the weight loss process (which can be challenging to achieve), a chronic weight management strategy to achieve 10% body fat would require a reduction of body fat to 7.3kg i.e.

(65.6/90) x 10 = 7.3kg

This equates to a **7.1kg reduction in fat mass**, equating to a body mass of **72.9kg**

If the athlete competes in a sport with a shorter recovery time (<12 hrs), he could target a further AWL of up to 5% BM or 3.6kg **= 69.3kg**.

Therefore, this athlete could compete in a weight division of 69.3kg or higher.

While guidance on the identification of an appropriate weight category for an athlete is important, so too are the specific strategies to facilitate chronic weight loss, and where appropriate or necessary, acute weight loss. The time frame necessary to facilitate these losses is also critically important. These issues are addressing in the following sections.

Suggested weight (BM) targets throughout the season/year

> The athlete can be assisted with weight management goals by being provided with a series of BM targets for different times of the season which relate to both acute and chronic weight loss

> Targets for BM pre and post the 7 day period of AWL prior to the weigh-in have been discussed above

> In addition to the pre AWL BM target, the need for specific BM targets will depend on the frequency of competition, but may include:

  — Maximum off-season BM target

  — BM targets for 2, 4, 6, 8 (or other) weeks prior to weigh-in, to avoid reliance on AWL other than acknowledged i.e., 5% body mass loss

> Although determining targets for optimal BM throughout a season/year is not an exact science, it is recommended that a weekly weight loss target should not be greater than ~1% BM. Working backwards from the commencement of the AWL period, targets might be set according to the following formula

  — 7 days prior to weigh in: Pre-AWL BM

  — 14 days: Pre-AWL BM + 1%

  — 21 days: Pre-AWL BM + 2% and so on

> Additionally, the 'season' competition schedule, which determines the frequency at which the athlete needs to be "at weight", should be taken into consideration. When competition is more frequent, there is less opportunity for the athlete to allow an increase in BM between events

> Even if there is a lengthier period between competitions, theoretically providing more freedom to the athlete to regain and reduce BM between events, large fluctuations should be avoided. It is well established that chronic energy restriction is linked to a range of performance, health and psychological complications. By choosing a suitable weight category and maintaining BM within a sensible range of this target between competitions, the athlete should be able to find a balance between the periods in which they are energy-replete and able to train optimally, and the periods in which the priority of BM manipulation potentially interferes with such goals

> These guidelines represent a theoretical plan for maximal rates and amounts of BM manipulation. In real life, it is recognised that athletes and coaches often try to "push the envelope". Therefore, there is a rationale that suggested rates and cut-offs for BM manipulation should be reduced to take the "enthusiasm" or "overshoot" into effect. The decision to promote theoretical or more pragmatic/conservative cut-offs ultimately should be undertaken via consultation between the athlete, coach and their CMT

> An example of the time frame necessary to achieve the specified weight loss required for the athlete mentioned above who weights 80kg follows over page...

Goal mass prior to AWL = 72.9kg or a total of 7.1 kg loss, which equates to ~9% BM loss. Allowing 9 weeks to achieve this goal should help to maintain fuel availability to maintaining training capacity and equates to ~800g loss per week. Start 10 weeks out, allowing the last week to accommodate any necessary AWL.

The above assumes all weight loss is derived from reductions in FM alone. In reality, the creation of a negative energy balance can also result in loss of FFM. The proportion of weight loss as lean tissue varies over time and is determined by multiple factors including level of energy intake, diet composition, sex, baseline adiposity, type and level of training, and potentially the athlete's metabolic state or hormonal response.

Further reading

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Acute weight loss

The fundamental premise of an athlete's attempt to qualify for a lower weight division is that some components of BM are labile and can be acutely manipulated. Specific body compartments amenable to acute manipulation are listed in Table 1, with an approximation of the magnitude by which they can be rapidly reduced (and regained). The magnitude of the change represents the difference between the "replete" body compartments in an athlete who is following optimal dietary practices and the degree of depletion/reduction which can be considered "acceptable". "Acceptability" is based on the principles that the body component can be restored within hours (e.g. the period between weigh-in and competition) and/or that it poses a minimal-small risk to health and performance. The nature of these components of BM, and the strategies for reducing their mass presented in these guidelines, are summarised below.

Table 1. Potential weight loss associated with different acute weight loss strategies.

Body compartment	Magnitude of possible/ acceptable change	Strategies for reducing the body compartment
Glycogen and bound water	~2-4% BM*	Low carbohydrate diet combined with training for 3-7 days
Gastro-intestinal tract contents	~1% BM	Low residue, low weight, high energy density diet for 2-4 days
Total body water	3-4% BM	Decreased sodium intake for 2-3 days, 1 day fluid restriction (with or without prior 3 days of water loading), passive and/or active sweating

** Specific weight loss achievable from depletion of muscle and liver glycogen stores alone remains to be confirmed, especially when matched against an isoenergetic meal plan, similar in total weight, fluid, fibre, sodium content etc.*

Although a simple aggregation of these strategies can achieve AWL of >5% BM, the safety and reality of such a protocol requires careful consideration. Table 2 provides a summary of the advantages and disadvantages of individual acute weight loss strategies, with detailed dialogue on each strategy also addressed below. The protocol that could be implemented by a specific athlete is dependent on a number of factors that relate to the sport, the potential for recovery after the weigh-in and the athlete's presenting body composition. However, the following issues should be considered:

1. The athlete's BM in relation to their weight division
   - > If an athlete is close to their weight target (i.e. within 2-4% of their weight category), AWL plans can be less aggressive. For athletes who are further from their competition weight target (i.e. >5% above target) despite low body fat levels, an intensive plan for AWL is required or, consideration given to competing in a higher weight division
2. The physiological demands of the sport
   - > Events involving brief duration bursts of power (e.g. weightlifting) may not be affected by glycogen depletion and moderate levels of dehydration. Athletes may be able to implement maximal AWL strategies to achieve a lower weight division with minimal effect on performance, potentially enhancing competitive success
   - > Moderate to longer duration sports (e.g. combat sports, rowing) are potentially compromised by the effect of moderate levels of hypohydration and/or muscle glycogen depletion. These sports require sufficient recovery time between weigh-in and the event to replenish carbohydrate and/or body water stores. If recovery time is short, significant glycogen depletion should not be included in AWL strategies
3. The recovery time frame between weigh-in and competition
   - > Sports with long recovery time frames (> 12 h) between weigh-in and competition have greater capacity to recover from glycogen depletion and hypohydration than those with shorter recovery time frames (<2 h). A longer recovery period can permit a greater magnitude of AWL as long as strategic recovery plans are in place
4. The requirement for multiple weigh-ins over a multi-day competition/tournament
   - > A reduction in BM from gastrointestinal tract (GIT) contents can be maintained over the duration of the competition via continued use of low residue, energy dense food choices that provide a "low weight" source of targeted nutrients/energy.
   - > Multiple weigh-ins typically reduce an athlete's ability to repeatedly implement, then recover from, strategies involving dehydration and glycogen depletion and require thoughtful implementation. A longer-term approach to weight maintenance over the duration of competition involves manipulating glycogen stores to meet the needs of the event (a 'fuel for the work required' approach), then using shifts in body fluid to meet weight targets. The process of repeatedly dehydrating to make weight, rehydrating prior to competition, then repeating the fluid loss process prior to the next weigh-in requires consideration around the magnitude of loss and recovery patterns.
5. Limitations around weight regain
   - > Adjustments to AWL strategies are needed in scenarios where sports implement a second weigh-in immediately prior to competition, with rules around the magnitude of permitted BM regain. This can include a decision to limit recovery strategies around rehydration or refuelling so that the increase in BM is curtailed (not recommended) or to reduce the magnitude of the initial AWL so that the permitted recovery restores physiological and psychological preparation for competition
   - > Example: Assuming that manipulation of GIT contents can achieve a loss of 1-2% BM, in sports where competition rules prohibit a post weigh-in weight gain of > 5% BM, an athlete should set a cut-off for AWL strategies to < 7% BM. Theoretically, this will allow substantial recovery of glycogen and body water stores, while remaining under the +5% limit. In practical terms, the athlete should rehydrate/refuel by consuming foods of no greater than the +5% limit, before reassessing the net gain after equilibrium has occurred (e.g. ongoing urine losses)
6. The physical and psychological makeup of the individual athlete
   - > Individual response to AWL protocols is noted, both in terms of the magnitude of BM change associated with different strategies and in the specific tolerance to the effects of these strategies. There are differences in the physiological response to changes in glycogen and fluid loss between individuals. The variable effects of different AWL strategies on mental health is also noted.
7. The athlete's chronic management of BM and body composition
   - > Future strategies for competition preparation should consider whether habitual BM and chronic management of BM and body composition can be improved to provide a different starting point from which AWL is undertaken. The variable effects of chronic BM management on mental health should also be acknowledged and monitored.

Table 2. Advantages and disadvantages of different acute weight loss strategies.

Acute weight loss method		Advantages	Disadvantages
GIT content manipulation	Laxatives/bowel preparation products used prior to medical procedures on the GIT*	Loss of ~1-2% BM in <1d	Associated with decreased in exercise capacity Body water loss Electrolyte imbalances
	Food restriction	Loss of ~1-2% BM in 1 d (likely from combination of reduced GIT content and glycogen depletion)	Decreased energy intake Sub-optimal pre-event nutrition Hunger
	Low residue diet	Achieves reduction in bowel contents in 2-4 d, similar to use of bowel prep Minimal effect on acute nutritional status or performance	Decreased satiety Requires planning and nutrition knowledge Care necessary to avoid constipation, particularly when combined with body water manipulation
Glycogen depletion	(low carbohydrate intake + glycogen depleting training)	Loss of ~2-4% BM in 3-7 d Lack of effect on strength and power for brief efforts	Associated with impaired performance of exercise dependent on anaerobic glycolysis (e.g. performance lasting ~ 5 min) Requires aggressive carbohydrate intake to reverse: may be difficult to achieve if weigh-in is on same day as event
Body water manipulation	Moderate hypohydration (>4% BM loss)	Represents largest component of BM that can be manipulated	Associated with decreases in heat tolerance and exercise capacity/performance of many events Requires aggressive fluid and electrolyte replacement to reverse: may be difficult if weigh-in is on same day as event
	Mild hypohydration (≤3-4% BM loss)	Can be achieved rapidly (e.g. 1-3 h) Can be reversed in ≤4 h	As above, although issues are less severe
	Fluid restriction	Loss of ~1-2% BM in 1d Appears to cause less physiological disturbances than other forms of dehydration	Increased thirst sensation during restriction period
	Active sweating (exercise induced)	Can be easily incorporated into existing training sessions before weigh-in Maintain plasma volume to a greater degree than passive sweating	Additional exercise may induce fatigue/soreness if athlete is unaccustomed to specific exercise modality/volume High intensity exercise can impact on gastric emptying/GI distress
	Passive sweating (heat-induced: sauna, hot bath, heated rooms etc.)	Relatively easy method of weight loss May relax athlete/improve mood etc.	Preferential loss of fluid from plasma leading to reduced plasma volume Significant risk of heat stress and associated significant health implications
	Sodium restriction (1-5 d pre weigh-in	May reduce BM by reducing acute water retention May be incorporated into low residue diet preparation	Effectiveness in reducing BM is largely untested
	Water loading (intake of large volume of fluid for 3 d) before 1 d of fluid restriction	May lead to overshoot in urine production during fluid restriction allowing for greater BM loss without need for extra sweat loss techniques	May increase the risk of hyponatremia (water intoxication), especially if undertaken with extreme practices

**not recommended*

Gastrointestinal tract content manipulation

The GIT contains undigested food material, fluid and faecal matter. Reducing the weight of the food and fluid in transit in the GIT can contribute to AWL with minimal impact on performance. Although some weigh-making athletes reduce their bowel contents by simply restricting total food intake, this tactic can interfere with optimal pre-event fuelling. The preferred strategy is to reduce food volume and undigestible food components while continuing to consume sufficient energy and key nutrients for competition preparation. This can be achieved by adopting a meal plan in the days and hours prior to weigh-in based on low fibre ("low residue") foods and compact energy and macronutrient dense food choices. An individual who normally consumes a diet based on "healthy guidelines", emphasizing fruit, vegetables, wholegrain cereals and other sources of dietary fibre, can reduce BM by ~1% BM via 48-96 h of low residue eating (< 10 g/d fibre), the specific timing of the strategy depending on individual GIT transit times. This is a key tactic for athletes who have fewer opportunities for strategies involving dehydration or glycogen depletion; for example, when the limited duration of the recovery period limits opportunity for reversal of these effects via aggressive rehydration and refuelling practices, or in events where repeated weigh-ins over the course of the competition require the AWL to be maintained.

Glycogen manipulation

Glycogen is bound to water in a typical ratio of 1 g glycogen to ~3 g water. Normalised stores of muscle glycogen and its associated water represent ~2-4% of an athlete's BM. Since, they can be significantly reduced within hours via exercise and replaced within ~24 h with appropriate dietary carbohydrate intake, they potentially represent a significant component of BM that can be manipulated. The exact amount of weight loss attributable to glycogen depletion and associated bound water remains to be confirmed, given that glycogen stores are rarely fully depleted. Furthermore, it remains to be confirmed that the water bound to glycogen is excreted from the body, upon metabolism. One could speculate this would merely join the total body water pool. Thus, a more precise estimate of potential weight loss attributable to glycogen depletion alone remains to be confirmed, especially when matched against an isoenergetic meal plan, similar in total weight, fluid, fibre, sodium content etc. Until that time, weight loss potential of glycogen depletion should be assessed individually in training, to confirm on absolute loss, plus perceived impact on subsequent performance.

Two methods are available to deplete muscle glycogen: to consume a low-carbohydrate diet to prevent refuelling from the depletion achieved via normal training or to perform additional exercise to deplete glycogen reserves more rapidly. Since competition preparation typically involves tapered training, most athletes will find it more practical to restrict dietary carbohydrate rather than rely on exercise alone to deplete glycogen stores. Current evidence for the likely magnitude of weight loss associated with glycogen depletion is reliant on general research on athletes who undertake low carbohydrate diets as well as anecdotal observations of real-life practices of combat athletes. Recommended protocols include a reduction in carbohydrate intake to < 50 $g \cdot d^{-1}$ for 3-7 days, however, individual prescription will depend on the targeted level of depletion and the volume/intensity of training taking place over the same time. The effect of glycogen depletion on competition outcomes needs to be considered in terms of the importance of muscle glycogen as a substrate and the athlete's ability to restore glycogen levels sufficiently to accommodate the metabolic demands of competition. Sports in which event demands for glycogen are low (e.g. weightlifting, brief combat sports) and those which provide recovery periods > 12 h offer greater opportunities for glycogen manipulation strategies than those involving sustained high-intensity exercise and the requirement to weigh-in shortly before a race (e.g. lightweight rowing). Given the variation in opportunities to use exercise to deplete glycogen, the uncertainty of the effect on BM changes and the residual effects on competition performance, all strategies should be well practiced by the athlete to develop a suitable plan.

Body water manipulation

Body water loss presents the largest opportunity to achieve AWL prior to weigh-in. Mild hypohydration (loss of body water equivalent < 3-4% BM) is unlikely to affect exercise capacity in most sporting events and is reflective of levels routinely experienced in day-to-day training. However, a greater magnitude of fluid loss may contribute to significant compromises in competition performance, with the overall impact reflecting complex interactions between the effects of strategies used to achieve dehydration, the opportunity for rehydration between the weigh-in and the event, and the characteristics of competition performance. The potential for restoration of fluid balance during the post weigh-in recovery period will largely determine the magnitude to which dehydration should contribute to AWL. In sports where the post recovery period is very short (<2 h), the athlete should not attempt to dehydrate by greater than 3% BM, since it will be difficult to achieve adequate restoration of body fluids prior to competition.

The methods used to achieve dehydration incur different physiological effects. A reduction in body water (and BM) will occur via a reduction in daily fluid intake and/or the promotion of fluid loss. Indeed, 24 hours of restricted fluid intake (< 300 ml) in the face of normal body water turnover from obligatory urine production, sweat and respiratory losses may achieve a fluid deficit equivalent to ~1.5-2% BM loss. However, significantly greater losses are achieved via deliberate sweating methods, which can be described as active (exercise-induced) or passive methods (i.e. the use of hot baths, saunas, heated environments etc.) The pros and cons related to the characteristics of each method need to be considered. Whereas additional exercise to promote active sweating may increase muscle fatigue, particularly if it is unaccustomed or poorly planned, passive sweating is associated with a relatively greater reduction in plasma volume and increases in serum osmolality and body heat. The most pragmatic approach to dehydration may involve a combination of fluid restriction and active sweating, via existing training sessions. Additional passive sweating should only be used sparingly and when ample recovery time is available. If saunas are used, dry heat saunas offer the advantage of greater fluid loss and less physiological strain for a given period than steam saunas. However, it must be emphasized that exposure to such thermally stressful environments carries with it significant risk of heat stress illness, the implications of which can be tragic. As such, consideration of such an approach to AWL should only occur if direct athlete supervision by one or more members of the athletes CMT can be assured. Further investigation is warranted of the real-life practices employed by weight category athletes involving passive sweating. In particular, there is interest in the anecdotal use of hot baths, with variables including the temperature and duration of exposure, as well as the addition of salts to the baths to produce an osmotic gradient between the bath water and body fluids.

Although there have been no specific studies of its contribution to AWL, a decrease in dietary sodium intake may contribute to an acute loss of BM via a reduction in water retention. The optimal protocol for manipulating sodium intake to reduce body water is unknown, but a 1-5 d period of restriction (<500 $mg \cdot d^{-1}$) may be useful and could be aligned with the period of restricted fibre intake for manipulation of GIT contents. Finally, "water loading" prior to fluid restriction is a popular strategy undertaken in some weight-making sports, targeting acute alterations in the renal mechanisms controlling urine production. This protocol involves several days of consuming large volumes of fluid (e.g. 100 $ml \cdot kg \cdot d^{-1}$ for 3 d) with the aim of creating an overshoot in urine losses during the subsequent fluid restriction (e.g. 15 $ml \cdot kg \cdot d^{-1}$ for 1 d), effectively reducing body water without active promotion of sweat losses. Although preliminary research has confirmed that this practice is apparently safe and able to create a greater BM loss than fluid restriction alone, the magnitude of the enhanced loss is small (~0.6% BM). Athletes who choose to use this strategy should seek the guidance of an ASD to implement an evidence-based protocol to avoid excessive haemodilution and consequent risk of hyponatraemia. Regardless of whether water loading is undertaken as a "priming" strategy, fluid restriction should be considered a short-term activity; 24 h prior to weigh-in is a good guideline for most individuals.

Summary of AWL strategies

Athletes should experiment with AWL methods in isolation and collectively prior to important competition under the guidance of at least one member of their CMT, to note their individual responses, including both weight loss potential but also health and performance implications. Such experiences can be used to construct a personalized AWL and recovery plan that is continually refined via further feedback after each competition. The following guidelines should be included in the plan, with Figure 1 providing a step-by-step guide to integrating AWL with chronic management of body mass and choice of competition weight categories.

- An ASD should always be consulted when an athlete is devising an AWL plan
- If AWL is required, limit to 5% BM, with the specific approach taken dependent on nuances of the sport and time frame between weigh-in and competition
- A reduction in GIT contents, achieved by a low fibre diet (<10 $g \cdot d^{-1}$ for 48-96 h), should be the first strategy used in most situations
- Moderate depletion of glycogen stores via the reduction of carbohydrate intake provides a potential additional contribution to acute BM loss
  - Substantial muscle glycogen depletion via severe restriction of carbohydrate intake (<50 $g \cdot d^{-1}$ for 3-7 days) should be implemented only if there is sufficient recovery time (>12 h) to restore sufficient glycogen to meet the fuel needs of the event (e.g. events with less demand on glycogen stores)
- For sports in which the weigh-in is conducted close to competition (<2 h), AWL via reduction in body water stores should not exceed 3% BM and should be achieved via fluid restriction and/or active sweating
- For sports with longer recovery times, such as those in which the weigh-in is on the day before competition, greater magnitudes of dehydration (up to 4%) and the use of passive sweating techniques may be considered sparingly so long as proactive recovery strategies are used to reverse the effects and the athlete is closely monitored
- Exposure to thermally stressful environments like sauna or hot baths should be avoided wherever possible. Similar adverse outcomes can occur as a consequence of wearing impenetrable clothing (plastic sweats) for extended periods of time.

A robust understanding of the effect of AWL on competition outcomes in weight category sports is complicated by several factors, including the shortcomings of research design. Most studies which have investigated the effect of AWL or its individual components on performance fail to mimic real-world sporting situations by including a recovery period and its associated nutrition practices between weigh-in and the performance assessment. Indeed, in many studies where ample time and appropriate recovery strategies have followed the weigh-in, the negative performance effects of moderate levels of AWL have been reversed or negated. Another consideration is that success in weight category sports involves a comparison *between* competitors rather than comparison of an individual's absolute performance *pre versus post* the AWL strategy. In other words, it may not be important if AWL reduces an athlete's performance, as long as it remains superior to that of an opponent. Some studies of real-world competitions in combat sports have looked for correlations between competition success and the magnitude of the loss of BM between "usual weight" and the weigh-in (or the magnitude of BM gain between weigh-in and the event as a proxy for this). The results have been mixed, with some studies reporting that the "winners" were more likely to be naturally larger and heavier than the "losers" in an event, while others show that natural size does not confer an advantage when the effects of AWL and recovery are integrated into the performance outcome. This may be explained by the type of combat sport, with grappling activities (which underpin the sport of wrestling and judo), involving the manipulation of an opponent's BM, whereas striking sports (Taekwondo and boxing) are potentially more dependent on the tactical movements of ones own BM. In summary, the final effect of AWL on sports performance in weight category sports involves a complex interaction of factors, including the method(s) of AWL, the opportunity for post-weigh in recovery, the characteristics of the specific event and contributors to success, environmental conditions and the individual's own characteristics and responses.

Further reading

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MAKING WEIGHT DECISION TREE

AIS

Conduct morning body mass (BM) ± body composition assessment in accordance with best practice guidelines, with athlete guided on presentation i.e euhydrated, overnight fasted & rested, with voided bladder & bowel

Is athlete heavier than weight division?

YES
Is weigh-in >7 days in the future?

NO
Maintain current BM with focus on pre-training fuelling & post-training recovery nutrition strategies

YES
Does the athlete have excess fat mass (i.e. body fat >5% males, >12% females) & sufficient time to focus on fat loss? Aim for no more than 1% body mass loss per week

NO
Is BM >6-7% above weight division OR >5% above weight division with <4hr recovery between weigh-in competition?

YES
Consult sports dietitian & implement fat loss dietary strategies, while also supporting fuelling & recovery goals[1]

NO
Acute weight loss is required during week prior to weigh-in

NO
Is BM >5% above weight division or >3% above weight division with <4hr recovery between weigh-in & competition

YES
Do not compete, devise BM management plan for next competition. If body fat <5% males, 12% females consider moving up a weight division. If body fat >5% males, >12% females consult sports dietitian & implement fat loss dietary strategies – aim for 1% BM loss per week

YES
Utilise low carbohydrate diet.
Begin 3-7 days prior to weigh-in[2]

NO
Dietary carbohydrate intake can be manipulated to support fuelling & recovery goals

48-96hr pre weigh-in	48-72hr pre weigh-in	24-36hr pre weigh-in	0-24hr pre weigh-in
Reduce consumption of bulking foods (<10g fibre per day) until weigh-in.[3] Focus on very low weight foods 24hrs pre weigh-in.	Reduce dietary sodium intake (<500mg per day) until weigh-in).	Moderate fluid intake until weigh-in. Utilise scheduled training sessions to promote further sweat losses (can utilise extra clothing layers, sweat suits etc.)	Passive dehydration via hot bath/sauna should never exceed 1-2% BM & only be considered if direct athlete supervision by CMT[4] can be assured. Once weight is achieved begin cooling strategies.

Where time permits, all acute weight loss strategies should initially be trialled in advance of competition in isolation to assess weight loss potential, plus perceived impact on performance & health. Any subsequent combination of strategies should also be trialled in advance of competition, as should targeted strategies post-weigh-in.

1. A small amount of acute weight loss may still be required to achieve specified weight division limits, depending on the time available before weigh-in, presenting body fat & other nuances of the athlete & specific sport.
2. Duration of carbohydrate restriction required to maximally reduce glycogen mass will vary depending on current glycogen status & training volume/intensity in the 7 days prior to weigh-in. For athletes engaged in greater training loads, fewer days of carbohydrate restriction will be required to deplete glycogen stores.
3. Duration of fibre restriction required to maximally reduce gut contents will vary depending on individual whole gut transition time – athletes should note individual responses to low fibre intakes.
4. Core Multidisciplinary Team.

Modified from Reale et al. Acute weight loss strategies for combat sports and applications to Olympic success. Int J Sports Physiol Perf. 12:142-51, 2017.

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Post weigh-in recovery

The (potential) competitive advantage derived from qualifying for a lower weight division may be sacrificed if the athlete fails to use the post-weigh in recovery period to proactively reverse the effects of the strategies used to achieve AWL. An audit of the contribution of various strategies to the AWL should be undertaken with plans to address rehydration, glycogen restoration and management of GI comfort as appropriate. The precise focus of recovery efforts will depend on which methods of AWL were utilised, any requirements for subsequent weigh-in, and the demands of the specific sport. The period between the weigh-in and the event should integrate recovery from AWL with targeted preparation for competition. It is important that athletes review each "making weight" experience with their CMT in order to optimise the process since individual responses vary considerably.

Rehydration

Where practical, the athlete should aim to minimise any potential negative effects of dehydration on event performance by restoring fluid losses during the recovery period to within ~2% of their euhydrated BM. Factors which may interfere with this goal include insufficient recovery time and difficulty in assessing the magnitude of the fluid deficit (i.e. the contribution of water losses to the acute change in BM achieved via AWL). Maximal rates of fluid absorption are often reported at ~1L·h^{-1}, thus fluid intake in excess of this should not be recommended. It is likely that the restoration of a substantial fluid deficit requires electrolyte replacement to counter the losses associated with sweat-induced dehydration. The restoration of electrolytes, particularly sodium, is required to facilitate the re-equilibration of body water stores. Targeted electrolyte replacement in association with fluid intake, via electrolyte supplements/oral rehydration solutions and/or salt-containing foods, promotes simultaneous restoration of plasma osmolality and volume, maximising fluid retention and minimising unnecessary urine losses during the rehydration period. This may be particularly pertinent for athletes who weigh-in the night before competition, so as to support aggressive rehydration by limiting urine production and avoiding interruption to sleep.

Glycogen restoration

Although maximized glycogen stores are not needed for optimal performance in most weight category sports, inadequate stores can impair performance in all events, except perhaps those lasting only seconds (e.g. weightlifting events). Furthermore, a post weigh-in increase in BM due to glycogen/water restoration may indirectly enhance performance in events where body mass is imposed on your opponent (e.g. grappling combat sports like wrestling). Therefore, recovery food and fluid choices should provide sufficient carbohydrate to meet fuel for competition needs, and, if time permits and intake does not interfere with rehydration goals or cause GIT discomfort, to maximize glycogen storage for recovery of BM. In scenarios in which glycogen depletion has contributed to AWL and there is short time to refuel between weigh-in and competition (e.g. <2 h), a reasonable target may be as little as 2 g·kg^{-1}, given maximal rates of glycogen resynthesis are within the range of 1g·kg^{-1} BM·h^{-1}. However, when time to refuel between weigh-in and competition are longer (e.g. > 12 h), targets for carbohydrate intake may range from 5 - 12 g·kg·day^{-1}. The lower end of this range may suit events in which the glycogen fuel demands are modest, and scenarios in which shorter recovery times or the risk of GIT discomfort create a limit on carbohydrate intake. Meanwhile the upper end of the range may suit athletes who have a lengthy period between weigh-in and event, and desire maximal restoration of BM. Although individual's preferences should be considered, general recommendations include the choice of foods that are familiar, easily digested, and practical to prepare and consume. Foods that are high in fat or fibre may cause GIT discomfort and delayed digestion/absorption, particularly if they are suddenly reintroduced after being avoided during the period of AWL. Additional strategies to promote glycogen resynthesis during the recovery period include selecting carbohydrate-rich foods with a high glycaemic index and including protein in recovery meals/snacks in which carbohydrate intake is below refuelling targets.

Pre competition nutrition

There is a time point following weigh-in at which the athlete's priorities cross from the reversal/recovery of AWL strategies to the specific preparation for competition - nutritionally, mentally and physically. When weigh-in occurs on the day prior to competition, it is logical to prioritise recovery strategies prior to sleep before concentrating on pre-competition issues on the day of the event. However, when weigh-in occurs on the morning of competition, the crossover point is less clear. Indeed, strategies around the restoration of hydration and glycogen may need to be implemented with some degree of pragmatism. For example, caution around the risk of incurring GI distress during subsequent exercise may dictate that the athlete aims for a nutrition plan that is *achievable* rather than *optimal*. The quantity and timing of the pre-event intake of all foods and fluids should be practised in training, but should also consider the effects of competition "nerves" and carryover effects of AWL strategies on GIT function and comfort.

Most sports involving weight categories are too brief in nature to allow or require nutritional support during the bout or event. Even where there are exceptions, such as professional boxing matches conducted over multiple rounds separated by short breaks, concerns around GIT comfort/function are likely to limit the intake of fluids or foods. However, there may be further opportunities in the period before the event, or between rounds, to implement other nutrition strategies which enhance performance via a reduction in the effects of fatigue. This is particularly relevant in scenarios where the effects of AWL strategies could not be reversed during the recovery period between weigh-in and event, leaving a residual performance impairment. There is clear evidence that caffeine supplementation, even in low-moderate doses (3-6 mg·kg^{-1} BM), can enhance performance across a range of sports due to its effect in masking fatigue and pain. In addition, "mouth rinsing" with a small amount of carbohydrate can enhance performance of various types of exercise, without needing to be consumed in sufficient quantities to provide a source of muscle fuel. Parts of the brain centre that control pacing, muscle recruitment and perception of effort are activated by brief (5-10 s) exposure of receptors in the mouth and throat to carbohydrate. Although there is a lack of evidence of the benefits of this effect on the specific performance of most sports involving weight categories, swishing or swilling a carbohydrate source before or during an event is a low-risk strategy. Furthermore, it has several characteristics of particular interest to weight-making sports: it appears to be more potent when the athlete has sub-optimal carbohydrate stores and the effect can be achieved without needing to swallow the carbohydrate source.

Summary of nutrition for post-weigh in recovery and competition preparation

Guidelines for nutritional practices to reverse the outcomes of AWL and prepare for competition are provided below:

> An ASD can assist the athlete to calculate their post weigh-in nutrition needs and determine an appropriate plan for food and fluid intake between weigh-in and competition. When there is a lengthy period between these timepoints (> 12 h), this plan may encompass separate strategies for recovery and pre-competition preparation. However, when the period is brief (< 2 h), goals may be consolidated into a pragmatic approach of what can be comfortably achieved.

> To address the hypohydration associated with AWL strategies, the athlete should aim to rehydrate to within 2% of their euhydrated BM.

  — To restore fluid balance, a volume equivalent to 125 - 150% of the fluid deficit needs to be ingested to offset ongoing urine losses during the recovery period, bearing in mind a maximal fluid absorption rate from the GIT of 1L·h^{-1}.

> The ideal pattern of fluid intake after weigh-in may involve a balance between strategies to promote fluid retention and speedy re-equilibration of body fluid compartments, as well as GIT comfort. The consumption of a large fluid bolus (~600–900 mL) immediately after the weigh-in, followed by continued ingestion of smaller volumes at regular intervals, offers the advantages of maintaining a high gastric volume to enhance the rate of gastric emptying, while reducing the need to ingest fluids close to the start of competition. This may be an important strategy to facilitate rapid rehydration when the period between weigh-in and the event is brief (< 2 h).

> When sweat losses have been the principal contributor to hypohydration, simultaneous replacement of the accompanying electrolyte losses (particularly sodium) is needed to promote fluid retention and re-equilibration of body water stores. Sodium/electrolyte replacement is less important when fluid restriction in the face of normal daily fluid loss is the main strategy used to reduce body water.

> Targeted sodium replacement can be achieved by the intake of sodium-containing drinks and/or sodium-rich foods in conjunction with water or other low-sodium fluids. A general goal is to replace ~ 1150 mg sodium with each litre of fluid

  — If sodium intake is derived solely from fluids, drink choices should contain a sodium concentration of >50 mmol·L^{-1}. Since most commercial sports drinks are considerately lower in sodium (e.g. 10-25 mmol·L^{-1}), oral rehydration solutions (ORS), commonly used in the treatment of acute diarrhea are the preferred choice to address rehydration goals.

> If substantial glycogen depletion was involved with AWL strategies and there is sufficient recovery time for glycogen storage to occur (> 12 h), glycogen restoration should be targeted according to the fuel demands of the event as well as consideration of the benefits of maximum BM regain.

  — Targets for carbohydrate intake may range from 5 g·kg^{-1} BM (modest glycogen use) to 12 g·kg^{-1} BM (maximised carbohydrate loading and BM gain)

  — Carbohydrate-rich choices that are high in glycaemic index may be associated with greater glycogen storage, while the addition of protein can also increase glycogen storage when meals are unable to meet the carbohydrate targets for maximal refuelling

> If glycogen depletion did not contribute significantly to AWL strategies and/or the recovery period is short, carbohydrate intake in the pre-event meal should be guided by typical pre-competition fuelling goals
  - Carbohydrate availability during the event is typically supported by pre-event meals or snacks (1-4 h pre-event) providing a carbohydrate intake equivalent to 1-4 g·kg^{-1} BM from easily digested carbohydrate-rich foods and drinks
> Overall, the athlete's recovery/pre-event nutrition plan should safeguard GIT comfort. Goals may need to be set in terms of what is possible/tolerated rather than what is optimal
  - Recovery/pre-competition nutrition plans should be based around foods that are familiar, carbohydrate-rich (especially high glycaemic index), low-moderate in protein, and well tolerated. Restriction of fat and fibre content may reduce the risk of GI discomfort/distress and delayed gastric emptying/absorption.
  - Athletes often prefer to consume fluids in the period immediately after the weigh-in, before progressing to solid foods. When recovery periods between weigh-in and the event are brief, finding the correct balance between energy/macronutrient dense foods and more easily tolerated drinks may require experimentation
  - Nutrition plans should be practised in training and fine-tuned with competition experience, particularly to account for issues such as competition "nerves" and the effects of AWL strategies
> Other nutrition strategies known to enhance performance could be of value for competition use in weight category sports, particularly if they can address issues of residual impairment or fatigue that could not be reversed between weigh-in and the event. These include the use of moderate doses of caffeine (3-6 mg·kg^{-1}) as a performance aid 60 minutes before competition, or mouth-rinsing with carbohydrate solutions to activate central drive.

Further reading

Burke, L.M. (2008). Caffeine and sports performance. Applied Physiology Nutrition and Metabolism, 33(6):1319-34.

Burke, L.M., & Maughan, R.J. (2015). The Governor has a sweet tooth–mouth sensing of nutrients to enhance sports performance. European Journal of Sport Science, 15(1):29-40.

Evans, G. H., James, L. J., Shirreffs, S. M., & Maughan, R. J. (2017). Optimizing the restoration and maintenance of fluid balance after exercise-induced dehydration. Journal of Applied Physiology, 122(4), 945-951.

Reale, R., Slater, G., & Burke, L. M. (2017). Individualised dietary strategies for Olympic combat sports: Acute weight loss, recovery and competition nutrition. European Journal of Sports Science, 17(6), 727-740.

Considerations for sports with multiple weigh-ins

Several sports, including boxing and lightweight rowing, require athletes to undertake multiple weigh-ins throughout a single competition. This is most often seen in multi-day events or tournament style competition, where the athlete must re-qualify for their weight class each time they compete or race. Repeated weigh-ins typically reduce the athlete's ability to recover from AWL strategies that deplete glycogen stores and body water. This should, therefore, be balanced by a reduction in the magnitude of BM that is lost via AWL. The manipulation of GIT contents and its contribution to AWL can be sustained over the duration of the competition via the adoption of nutrition plans based on low residue, energy-dense foods. Glycogen stores should be maintained according to a "fuel for the work required" approach that sustains stores according to daily event demands. Consequently, day-to-day manipulations in BM will be predominantly achieved by shifts in body water (de-/rehydration). With smaller losses of BM being achievable before each weigh-in, the athlete will need to rehydrate and fuel for the imminent bout/race, then weigh themselves afterwards to plan for the next weigh-in while still addressing day-to-day nutrition needs and future fuel requirements. It can be difficult to find a single optimal strategy for this scenario. Athletes may overly restrict dietary intake in order to maintain their weight as low as possible over the competition period. Conversely, they may overcompensate with food and fluid intake after one weigh-in, creating an additional burden in terms of the weight that must be shed for subsequent cycles. It is strongly recommended that athletes consult with an ASD to develop and practice bespoke plans that can cope with the demanding scenarios of recurrent weigh-ins.

APPENDIX: CASE STUDIES

Four case studies are provided in this appendix to demonstrate various aspects of chronic and acute weight loss practices. While the first three case histories are aimed at ASDs, providing details of the nutritional management of different weight making plans, the final case study targets the CMT with the account of an athlete who wishes to qualify for a lower weight category.

Case Study 1

Athlete presentation:

- 26 yr old male taekwondo athlete with BM of 85.6kg
- 7% above weight division (80kg), after being 9% above weight division 2 weeks ago
- Following a high-volume meal plan, rich in lower energy density foods from across the food groups. No restriction with fluid intake, waking once during the night to go to the toilet, and urine is very pale
- Currently 7 days out from weigh-in
- Weigh-in will take place at 5pm on the evening before a morning competition i.e. recovery >12 h

Scenario Summary:

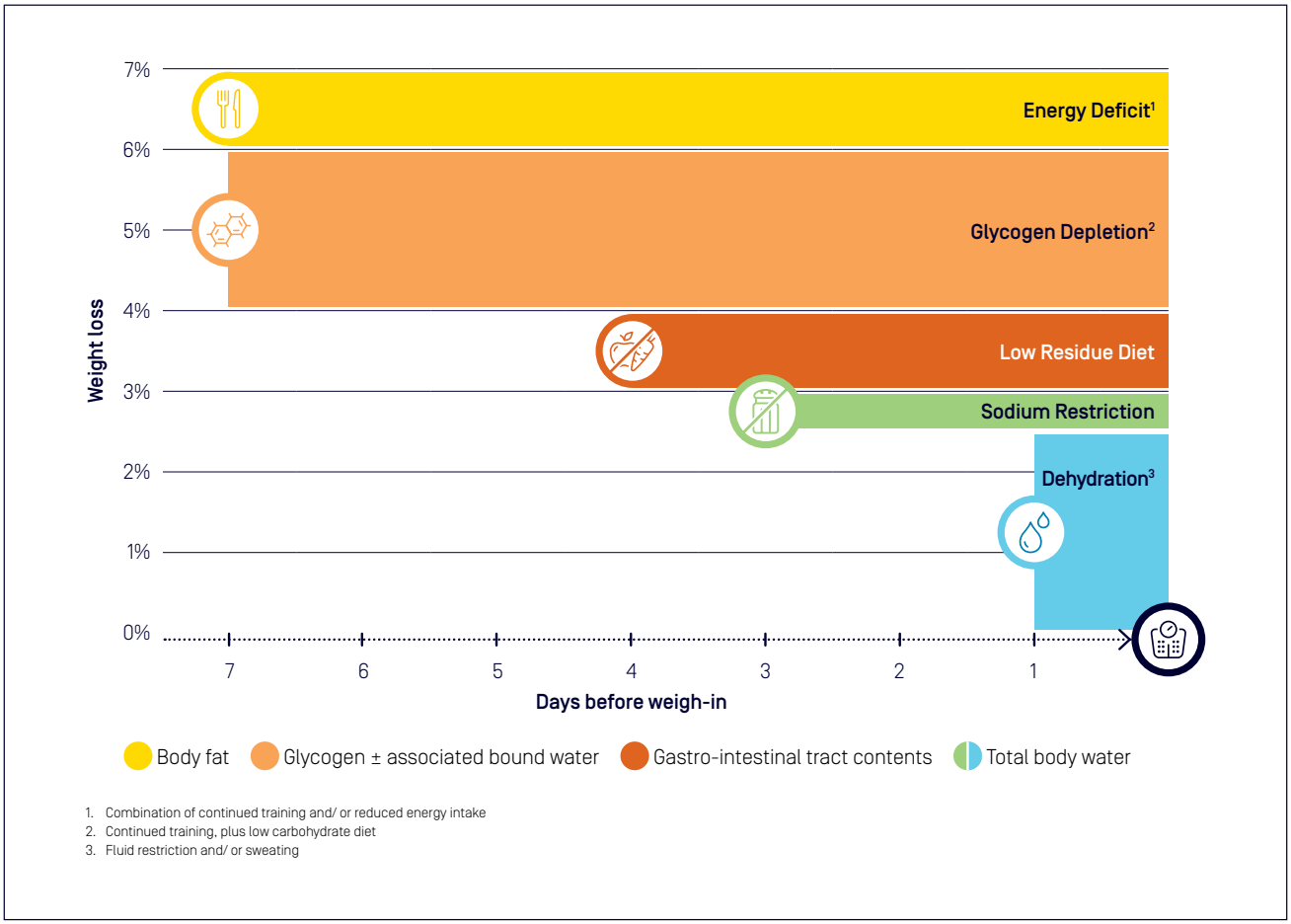
- Athlete is at the upper limit of what can be achieved by an AWL plan that preserves health and performance to acceptable level, recognising recovery time between weigh-in and competition is prolonged
- A systematic and well-constructed plan including all elements of AWL is required
- At the Olympic Games, only 4 weight categories exist for males: < 58 kg, < 68 kg, <80 kg, and > 80 kg. In non-Olympic competition, an additional 4 weight categories exist, including < 87 kg and > 87 kg
- Consideration could be given to competing in the > 80 kg (or < 87 kg, depending on the event) category into the future but this would require an assessment of present body composition, plus discussions between the athlete and their coach, and their CMT.
- If presenting body mass was any higher than ~86 kg euhydrated, or athlete presented already restricting fluid, carbohydrate and fibre intake, advocate competing in < 87 kg weight category, with dietary focus on supporting adequate fuelling for, and recovery from, training. This guidance would be further justified if subsequent body composition assessment confirmed body fat levels were within the 5-10% range

AWL plan (see graphic for visualisation of plan and sample menus for the various stages):

- Athlete continues with same energy density of meal plan, assuming similar energy expenditure from training. Given recent changes in mass, this should result in another 1% BM loss, leaving 6% loss via AWL. Given the degree of AWL necessary, all strategies are likely needed i.e. reduce GIT contents (1% BM), limit glycogen stores (2-4% BM) and induce a state of hypohydration (3-4%)
- 4 days out from weigh-in, athlete initiates a low carbohydrate diet (50 $g \cdot d^{-1}$), in conjunction with prescribed training
  - Adequate protein intake (~1.2-1.7$g \cdot kg^{-1}$) is maintained
  - Fat intake increased to maintain energy intake
- Fluid intake (water) remains high i.e. up to 100 $ml \cdot kg^{-1}$ BM or 8 litres per daily
- 3 days before weigh-in, the low carbohydrate diet is continued with the added focus on reducing GIT contents as well as restricting sodium intake. Care is taken to continue to prevent the overconsumption of energy
  - Food choices are low residue (< 10 $g \cdot d^{-1}$ fibre)
  - Preference is given to “light” energy-dense foods, high in fat and protein
  - Low sodium foods are chosen with care not to add salt/sodium in seasonings, sauces or other meal condiments

- 1 day prior to the weigh-in, the athlete reduces fluid intake to 15 ml·kg^{-1} BM (1.2 litres) for the rest of the day
- On the morning of the weigh in, the athlete takes note of their "upon waking" BM.
- A small amount of low carbohydrate, energy dense, low residue foods is consumed on the day of the weigh-in to assist with mood and manage hunger, fatigue etc. Small volumes of fluid may also be ingested, with specific quantities of food/ fluid to be negotiated on a case-by-case basis, and largely dictated by preference and the disparity between waking BM and weight category limit of 80 kg
- If body mass remains > 80 kg on the day of weigh-in, the athlete may need to undertake active/passive sweating, preferably in the last 3-4 h prior to weigh-in and dependent on previous trials in training to assess sweat rate. Given the longer recovery period following weigh-in, active sweating is encouraged, taking advantage of the thermal stress created by training alone while withholding fluid replacement
- Upon waking BM is measured each morning in the 4 days prior to weigh-in. The measurement of upon-waking BM is used to calculate post weigh-in fluid recovery strategies. For example, if the athlete is 2 kg above weight 1 day prior to weigh-in, it is assumed that 2 litres of fluid will be removed from the body to achieve the weigh-in target. Following, weigh-in, the calculated fluid replacement goal of 125-150% of the fluid deficit will equate to 2.5-3 litres
- Following weigh-in, the athlete immediately begins recovery nutrition practices. Being mindful of GI upsets, he focusses first on liquids and liquid foods, before progressing to solid foods several hours later
- His goal is to consume carbohydrate-rich foods and drinks providing ~5g·kg^{-1} BM carbohydrate and 125% of fluid losses before going to bed, with an emphasis on higher sodium choices to minimise urine production throughout the evening
- The same philosophy to food and fluid intake can continue upon waking on the day of competition, although GIT comfort becomes increasingly important. As such, the regular consumption of smaller, carbohydrate rich snacks and drinks may assist in restoring glycogen stores and a state of euhydration while also optimising GIT comfort

Example timeline of how to combine various acute weight loss strategies for Case Study 1.



1. Combination of continued training and/ or reduced energy intake
2. Continued training, plus low carbohydrate diet
3. Fluid restriction and/ or sweating

Sample meal plans for the 4 different stages of Case Study 1

STAGE 1	STAGE 2	STAGE 3	STAGE 4
Low carbohydrate (Begin 4 days pre-weigh-in)	**Low fibre, sodium and carbohydrate (begin 3 days out)**	**Weigh-in day, before weigh-in**	**Weigh-in day, after weigh-in**
Breakfast 3 eggs with handful of grated cheese 2 cups of vegetable (omelette) **Lunch** 200g chicken thigh with 2 cups of bok choy + low carbohydrate 'konjac' noodles, soy sauce and sesame oil dressing **Dinner** 200g steak with large eggplant, capsicum, tomato and onion salsa, plus olive oil dressing **Snacks** 2 x thin rice cake with 1 tablespoon peanut butter 1 x low fat low sugar Greek yogurt	**Breakfast** 3 whole eggs + 1 egg yolk **Lunch** 200g chicken thigh with 100g of tofu, with sesame oil **Dinner** 200g steak with 100g tofu, with low sodium mayonnaise dressing **Snacks** 1 x low fat low sugar Greek yogurt 2 x boiled egg	**Breakfast** 2 x fried egg **Throughout the day prior to weigh-in** 1 x Low carb, low fibre protein bar 3 x tablespoon of peanut butter (as need to curb hunger/ assist with energy throughout the day)	**1st hour** 1 litre oral rehydration solution 1 x Carbohydrate gel (towards the end of the hour) **2nd hour** 1 litre oral rehydration solution 2 x white bread and honey sandwich **3rd hour (dinner)** 500 ml sport drink 1 x Carbohydrate gel (towards the end of the hour) 200 g white rice/noodle with high sugar and sodium sauce with small amount of meat **4th hour + (post dinner/ pre bed)** 500 ml oral rehydration solution 200 g pancake + maple syrup
Fluid 8 litres water throughout the day	**Fluid** 3 and 2 days out... 8 litres water per day 1 day out... 1.2 litres	**Fluid** Water intake limited to < 1.2 litres prior to weigh-in, depending on BM relative to 80 kg weight category limit	

Case Study 2

Athlete presentation:

> Female boxing athlete with BM of 63 kg

> Currently 5% above weight category (60 kg), and weighty stable the last 2 weeks

> 7 days out from weigh-in

> Weigh-in will take place at 7.30am on the morning of competition (11.30am bout)

Scenario summary:

> Athlete will need to undertake a weigh-in each day of competition

> There is limited time for recovery between each weigh-in and bout

  — AWL should not completely deplete glycogen stores or rely too heavily on dehydration

> A systematic and well-constructed plan including all elements of AWL is required

> At the Olympic Games, only 5 weight categories exist for females: <51 kg, < 57 kg, <60 kg, <69 kg, and <75 kg. In non-Olympic competition, an additional 5 weight categories exist, ranging from < 48 kg to > 81 kg, and including < 64 kg i.e. welterweight

> Consideration could be given to competing in another category into the future but this would require an assessment of present body composition, plus discussions between the athlete and their coach, and their CMT.

AWL plan (see graphic for visualisation of plan and sample menus for the various stages):

> Athlete continues with same energy density of meal plan, assuming similar energy expenditure from training. Given BM is stable, assume athlete will remain in energy balance, ensuring all weight loss will be via AWL. Given the degree of AWL necessary, requirement to weigh-in prior to each bout and short recovery time between weigh-in and competition, all strategies should be implemented, albeit to a moderated degree i.e. reduce GIT contents (1% BM), reduce glycogen stores (1-2% BM) and induce a state of hypohydration (2-3%)

> 4 days out from weigh-in, athlete initiates a low to moderate carbohydrate diet (2-3 $g \cdot kg^{-1}$ $BM \cdot d^{-1}$), in conjunction with prescribed training

  — Adequate protein intake (~1.2-1.7$g \cdot kg^{-1}$) is maintained

  — Fat intake adjusted to maintain energy balance

> Fluid intake (water) remains high i.e. up to 100 $ml \cdot kg^{-1}$ BM or 6 litres per daily

> 3 days before weigh-in, the low to moderate carbohydrate diet is continued with the added focus on reducing GIT contents as well as restricting sodium intake. Care is taken to continue to prevent the overconsumption of energy

  — Food choices are low residue (< 10 $g \cdot d^{-1}$ fibre)

  — Preference is given to “light” energy-dense foods, high in fat and protein

  — Low sodium foods are chosen with care not to add salt/sodium in seasonings, sauces or other meal condiments

> 1 day prior to the weigh-in, the athlete reduces fluid intake to 15 $ml \cdot kg^{-1}$ BM (0.9 litres) for the rest of the day

> The athlete also takes note of their upon waking BM on this morning (prior to dehydration) to allow for the calculation of the post weigh-in fluid prescription (e.g. if the athlete wakes up 1.5 kg over their BM target, it can be assumed that 1.5 litres of fluid will be removed from the body and need to be replace during recovery. Following, weigh-in, the calculated fluid replacement goal of 125-150% of the fluid deficit will equate to 1.9-2.3 Litres

> The athlete checks their BM in the afternoon prior to weigh-in to assess the need to sweat prior to sleep. Knowing that a loss of 250-750 g will occur overnight (confirm specifically for each athlete across several days prior to weigh-in), if the athlete is within 0.75-1 kg of weigh-in target in the evening, sweat activities can be left until weigh-in morning.

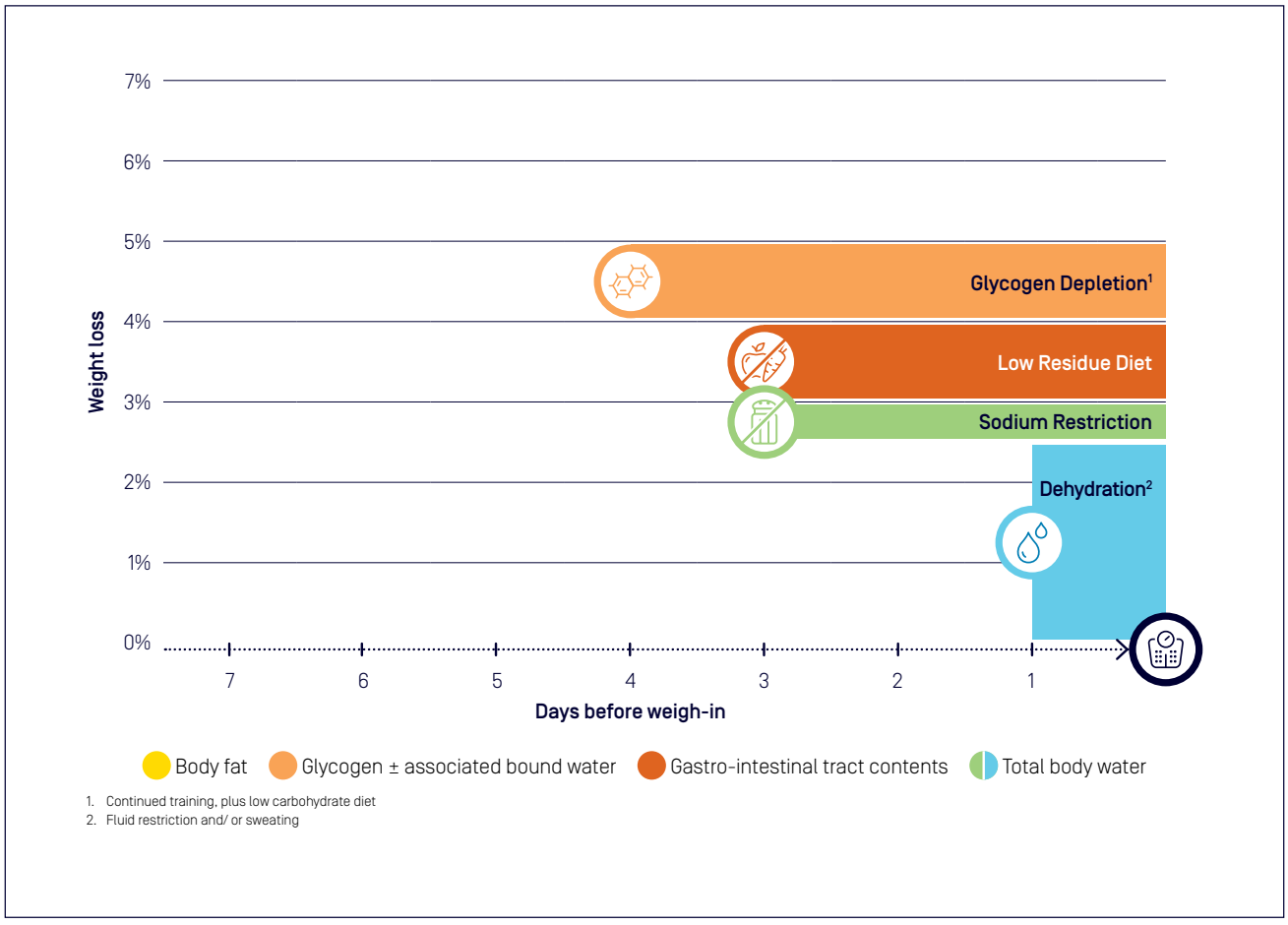
> The athlete sets an alarm on the morning of weigh-in to allow enough time to "sweat off" any remaining weight prior to weigh-in. This will be decided on a case-by-case basis, and largely dictated by the athlete's BM prior to going to bed and previous experience
  - In the morning, the athlete refrains from drinking or eating (unless they are below competition weight)
  - The athlete undertakes sweating activities as required. Active sweating methods involving low intensity exercise are typically preferred by boxers; if well-practised, these should not interfere with competition performance. Furthermore, this method preferentially preserves plasma volume relative to passive sweating methods such as steam baths and saunas

> Following weigh-in, the athlete immediately begins recovery nutrition practices. Being mindful of GI upsets, she focusses first on liquids and liquid foods, before progressing to solid foods several hours later. Her primary goal is to consume at least 125% of fluid losses and a carbohydrate target of 1 g·kg^{-1} BM prior to the bout, towards a total of ~3 g·kg^{-1} BM over the day (i.e. including post-bout intake). Sodium intake is moderated following weigh-in, ensuring weight gain following weigh-in is also moderated.

> Following the bout, the athlete assesses BM once event-associated sweating has stopped and begins planning for the following day's weigh-in
  - The same overnight weight loss predictions are assumed, and the athlete consumes food to achieve carbohydrate targets from low-residue foods plus a small amount of fluid, minimising total BM regain
  - An alternative method used by other athletes is to rehydrate fully post bout, and then undertake sweat loss activities prior to bed; this decision will be decided on a case-by-case basis, and largely dictated by preference and previous experience)

> The athlete repeats this pattern over the duration of the competition

Example timeline of how to combine various acute weight loss strategies for Case Study 2.



Example meal plans for the 4 different stages of Case Study 2:

STAGE 1	STAGE 2	STAGE 3	STAGE 4
Moderate carbohydrate (Begin 4 days pre-weigh-in)	**Low fibre, sodium and moderate carbohydrate (begin 3 days out)**	**Weigh-in/bout day, after weigh-in, before bout**	**Weigh-in/bout day, after bout, before next day weigh-in**
Breakfast 2 eggs with 2 slices of whole wheat bread + 1 piece of fruit **Lunch** 125g chicken thigh with 2 cups of bok choy + 1 cup quinoa **Dinner** 125g lean steak with 2 cups broccoli and 3 cups mashed potato **Snacks** 1 x sandwich with jam 2 x piece of fruit 1 x low fat low sugar Greek yogurt Fluid: 6 litres water throughout the day	**Breakfast** 3 whole eggs + 3 slices of low sodium white bread (or 1 cup white rice) **Lunch** 125g chicken thigh with + 1.5 cups white rice **Dinner** 125g lean steak with 3 cups mashed potato **Snacks** 1 x low fat low sugar Greek yogurt **Fluid** 3 and 2 days out... 6 litres water per day 1 day out... 0.9 litre	**1st hour** 1 litre sports drink 1 x white bread and honey sandwich **2nd hour** 1 litre sports drink	**Lunch** 125g chicken thigh with + 0.5.5 cup white rice **Dinner** 125g lean steak with 1 cup mashed potato **Snacks** 1 x low fat low sugar Greek yogurt **Fluid** Water only, but limited to ensure athlete remains within 1 kg of weigh-in BM prior to bed

Athlete should repeat stage 3 and 4 throughout competition, adjust body mass via fluid intake/ sweating method

Case Study 3

Athlete presentation:

- Male wrestling athlete with BM of 67kg
- Currently 3% above weight category (65 kg)
- 7 days out from weigh-in
- Weigh-in will take place at 7.30-8.30 am on the morning of competition (9.30 am first bout)
- Will need to make weight 2 days in a row
- Each day's competition involves 1-5 bouts, depending on the athlete's success

Scenario summary:

- Athlete is currently only 3% above weight category which is ideal as post weigh-in recovery is short
- Athlete currently consumes a high fibre diet and reports to be well hydrated
- Should be able to make weight via manipulation of GIT contents, plus a small amount of dehydration alone i.e. no need to deplete glycogen stores

AWL plan (see graphic for visualisation of plan and sample menus for the various stages):

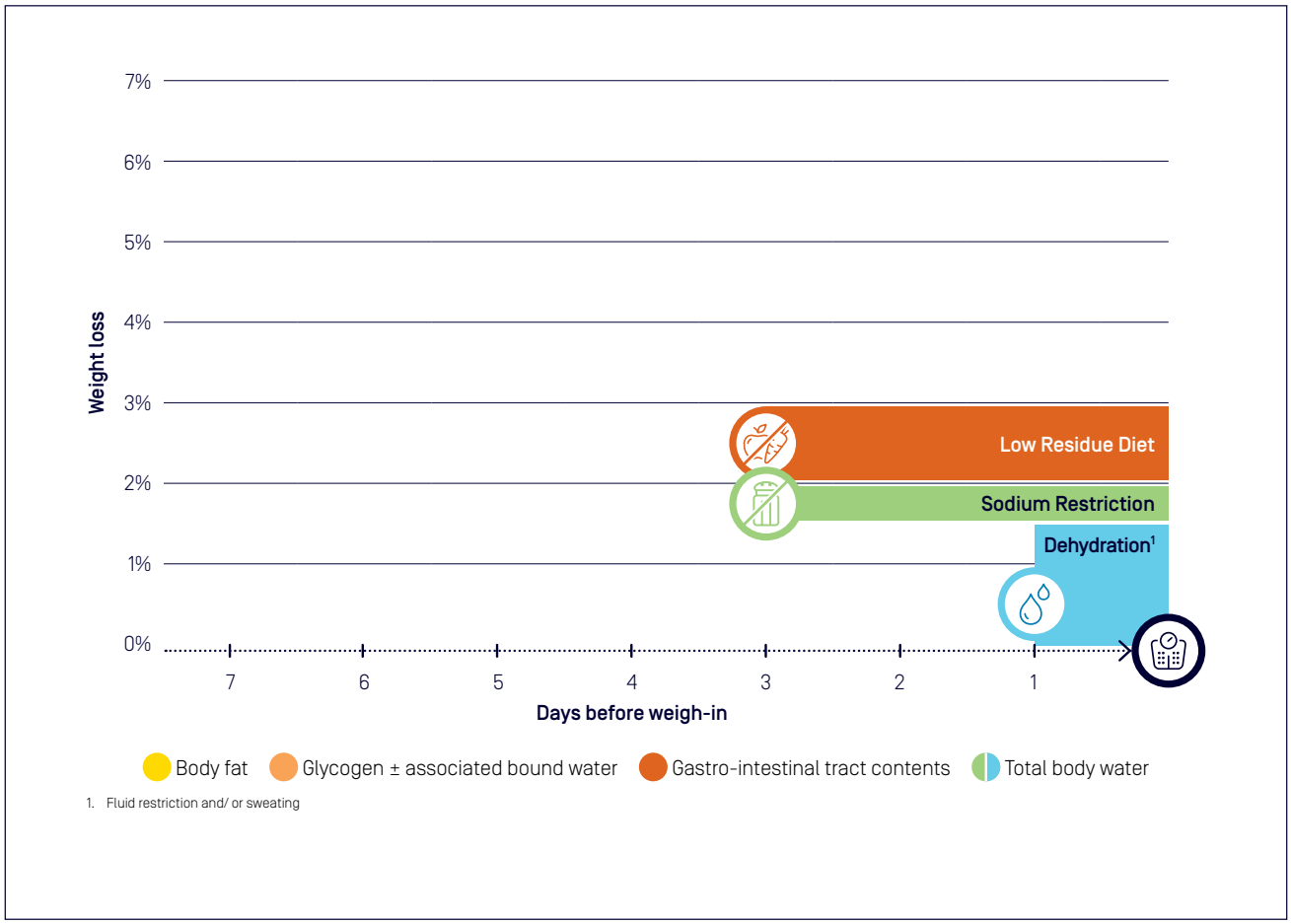
- Athlete maintains current energy/carbohydrate intake
- Fluid intake remains high
- 3 days (72 hours) before weigh-in, the athlete switches to diet to reduce GIT contents while also restricting sodium intake.
  - Carbohydrate intake continues but with food choices that are low residue (< 10 $g \cdot d^{-1}$ fibre)
  - Preference is given to "light" energy-dense foods
  - Low sodium foods are chosen with care not to add sodium in seasonings, sauces or other meal condiments
- 24 hours prior to weigh-in, the athlete begins to reduce (but not entirely restrict) fluid intake. Although BM checks could be undertaken to calculate the estimated likely fluid deficit, in reality the recovery time between weigh-in and competition is so short that GI comfort will take priority over meeting a fluid intake target
- The athlete checks weight throughout the day to assess the amount of sweat likely required to make weight. Because the athlete was only 3% above the weight category 7 days out, after adopting a low fibre diet for 3 days and a mild fluid restriction the day before weigh-in, the athlete is very close to weight targets by the afternoon (e.g. ~1% above the weight category)
- The athlete sets an alarm on the morning of weigh-in to allow enough time to "sweat off" any remaining weight prior to weigh-in. This will be decided on a case-by-case basis, and largely dictated by the athlete's BM prior to going to bed, and previous experience
  - Prior to weigh-in, the athlete eats some "light" high-carbohydrate, energy-dense foods 2-3 hours prior to estimated first match time, ensuring the total food weight is less than the margin by which the athlete is below his weigh-in target (e.g. if athlete is 64.5 kg, food intake can be < 500 g)
  - Athlete sweats as required, using active sweating techniques. If the athlete is close to weigh-in target, the warm-up prior to competition is used as a sweat loss activity
- Following weigh-in, the athlete immediately begins preparing for competition, consuming fluid as tolerated/ desired, complemented by a "light" carbohydrate-dense snack that is also low-fibre and low in fat (e.g. sports drink and sports bar/ jam sandwich). Since glycogen depletion was not used in preparation, dietary intake needs only to "top up" competition carbohydrate availability
- Throughout the day, the athlete focusses on performance nutrition, achieving optimal rehydration and fuelling between matches using food/ fluids that are carbohydrate-rich and well-tolerated. Sodium intake is moderated following weigh-in, ensuring weight gain following weigh-in is also moderated.

> Following the last match of the day, the athlete assesses BM after event-associated sweating has stopped and begins planning to make weight again the following day

— Utilizing the same overnight weight loss predictions previously stated, the athlete eats and drinks to minimize weight gain, while achieving carbohydrate intake targets

— An alternative is to rehydrate fully post bout, and then sweat again prior to bed. This decision will be decided on a case-by-case basis, and largely dictated by preference and previous experience.

Example timeline of how to combine various acute weight loss strategies for Case Study 3.



Example meal plans for the 4 different stages of Case Study 3:

STAGE 1	STAGE 2	STAGE 3	STAGE 4
Low fibre, sodium and moderate carbohydrate (begin 3 days out)	**Weigh-in/comp day, pre weigh-in** **2-3 h prior to first match**	**Throughout competition day, in between matches**	**Evening of first day of competition, prior to second days weigh-in**
Breakfast 3 whole eggs + 3 slices of low sodium white bread (or 1 cup white rice) **Lunch** 125g chicken thigh with + 2.5 cups white rice **Dinner** 125g lean steak with 3 cups mashed potato **Snacks** 2 x low fat low sugar Greek yogurt	White bread and honey/ jam sandwich Protein + carbohydrate sports bar	White bread and honey/ jam sandwich Protein + carbohydrate sports bar Whey protein shake Fruit puree Candy/ sports gels Sports drink Water	**Dinner** 125g steak with 3 cups mashed potato **Fluid** Water only, as desired based on athlete preference to either drink less/ sweat more

Case Study 4

Athlete presentation:

- National team male judo athlete with BM of 92 kg
- Currently competes in the 90 kg division
- Coaches and athlete feel he is "too small" to be competitive in this competition and should move down to 81 kg division

Scenario summary

- Athlete is currently competing against "naturally" larger and heavier opponents who use aggressive AWL strategies to make weight for 90 kg division
- Regulations in competition prohibit a gain of > 5% of weight category between weigh-in and competition
- Coach and athlete seek involvement of Sporting Organisation to provide input into consideration of suitability for a lower weight category
- Sporting Organisation organises professional assessment by their Core Multidisciplinary Team (CMT)

AWL plan (see graphic for visualisation of plan and sample menus for the various stages):

- ASD is engaged to undertake first assessment
- Calculations based on maximum post weigh-in regain are undertaken
  - If a regain of +5% BM of weight category is added to 2% maximum residual dehydration, an athlete could theoretically achieve AWL of 7% BM
  - Such an athlete would need to achieve a "training weight" of 87 kg to allow a 5 kg AWL (= 7% BM)
- ASD organises for athlete to have body composition assessment (DXA, undertaken according to Best Practice Protocol)
  - Results are interpreted by ASD: 83.7 kg fat free mass, 8.3 kg fat mass, 9% body fat
- Calculations are undertaken by the ASD
  - Loss of 5 kg of body fat would reduce body fat to 4%: this is below recommended minimum levels for health, and is potentially unachievable
- Alternative scenarios are identified by the ASD to accommodate qualification in 81 kg division:

  a. Acknowledge weight loss in very lean individuals is typically characterised by loss of both fat mass and lean mass, ensuring 5% body fat limit isn't surpassed

  b. Increase AWL > 7% BM
- ASD concludes both scenarios are potentially not without adverse health and performance implications
- Consultations with doctor and psychologist are organised to assess medical and psychological implications of the different scenarios
- Further consultations with the ASD and psychologist reveal that the athlete is already experiencing social and mental health issues in relation to sport
  - Struggling with external pressures and lifestyle concerns
  - Suffering from body image issues, and stress related to food and weight control
- Decision is made that it is unsuitable for athlete to move to lower weight category
  - A new focus is identified that the athlete should gain BM (muscle mass) to increase strength/power and competitiveness at the current weight category

Note that this represents a hypothetical situation. If different results were achieved from the CMT assessment, a plan to manage manipulation of body mass to a lower division may have been appropriate

- current body fat = 16%, allowing opportunity to lose 5 kg body fat and remain at "healthy" level
- no past experience of failed weight management practices, healthy relationship with food and positive body image
- ongoing access to CMT to support planned BM manipulation with adequate time before next competition

ADDITIONAL RESOURCES

https://www.sportsdietitians.com.au/sda-blog/make-weight-competition/

https://www.sportsdietitians.com.au/#find-sports-dietitian

https://www.gssiweb.org/en/sports-science-exchange/Article/acute-weight-management-in-combat-sports-pre-weigh-in-weight-loss-post-weigh-in-recovery-and-competition-nutrition-strategies

https://journals.lww.com/acsm-csmr/Fulltext/2015/11000/Rapid_Weight_Loss_in_Sports_with_Weight_Classes.9.aspx

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