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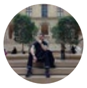

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Making the Weight: A Case Study From Professional Boxing

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Professional boxing is a combat sport categorized into a series of weight classes. Given the sport's underpinning culture, boxers' typical approach to "making weight" is usually via severe acute and/or chronic energy restriction and dehydration. Such practices have implications for physical performance and also carry health risks. This article provides a case-study account outlining a more structured and gradual approach to helping a professional male boxer make weight for the 59-kg superfeatherweight division. Over a 12-week period, the client athlete adhered to a daily diet approximately equivalent to his resting metabolic rate (6–7 MJ; 40% carbohydrate, 38% protein, 22% fat). Average body-mass loss was 0.9 ± 0.4 kg/wk, equating to a total loss of 9.4 kg. This weight loss resulted in a decrease in percent body fat from 12.1% to 7.0%. In the 30 hr between weigh-in and competition, the client consumed a high-carbohydrate diet (12 g/kg body mass) supported by appropriate hydration strategies and subsequently entered the ring at a fighting weight of 63.2 kg. This nutritional strategy represented a major change in the client's habitual weight-making practices and did not rely on any form of intended dehydration during the training period or before weighing in. The intervention demonstrates that a more gradual approach to making weight in professional boxing can be successfully achieved via a combination of restricted energy intake and increased energy expenditure, providing there is willingness on the part of the athlete and coaches involved to adopt novel practices.

Keywords*:* dehydration, body fat, DXA, combat sports

Professional boxing is categorized into a series of weight classes that are intended to promote fair competition by matching opponents of equal stature and body mass (commonly referred to as weight in the sport). Boxing is a sport that has its own tradition and culture, particularly in relation to weight-making practices (Hall & Lane, 2001). Typically, boxers aim to compete at the lightest weight possible in the belief that it will result in a competitive edge over opponents. Consequently, many boxers achieve their target weight via the combination of acute and chronic means that involve severe energy restriction and dehydration (Hall & Lane). The latter weight-making method is common in the days preceding the weigh-in and is known in the sport as "drying out." Although data concerning weight-making practices of boxers are scarce, research examining amateur boxers reported weight losses of 3–4 kg in the week preceding competition (Hall & Lane). Furthermore, the acute dehydration that is common to making weight can impair boxing performance, as evidenced by reduced punching force (Smith et al., 2001), and the effects of dehydration and energy restriction carry obvious health risks. Indeed, the reduction in energy and fluid intake during training and in the days before competition may increase the risk of infection and impair mood, and the increased cardiovascular and thermoregulatory strain may result in severe injury and, in extreme cases, death (Centers for Disease Control and Prevention, 1998).

In the current article, we provide a case study outlining a more scientific and structured approach to making weight, in which a professional male boxer (a former world featherweight champion) serves as the client athlete. It is important to note that this weight-making approach represented a major change in the athlete's habitual weight-making practices and is very different from that used in traditional boxing culture. Although the athlete provided permission for publication of this case history, we refer to him as the client throughout to respect issues of anonymity and confidentiality. In the concluding section, the first author offers some reflections on engaging in the support process, adopting a more personalized writing approach.

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Presentation of Athlete and Overview of Sporting History

The client is a 25-year-old professional boxer who was aiming to make weight for the 59-kg superfeatherweight division. As an amateur, his achievements included both junior and senior national amateur champion titles, as well as a junior Olympic gold medal. He turned professional at the age of 18 and soon achieved success, acquiring a national featherweight title, and later became a world featherweight champion. Through informal conversations with the first author, the client outlined his typical approach to making weight, which he had frequently employed in the 6–8 weeks preceding competition. This strategy involved

- Reliance on a daily diet consisting of one meal only, usually consumed at lunchtime and consisting of one Subway sandwich and a diet Coke.
- Daily use of sweat suits during training.
- No consumption of food or drink for 1–2 days preceding the weigh-in. In these instances, he would suck on ice cubes to prevent his mouth from drying up.
- Use of sweat suits and low-intensity exercise (e.g., skipping) in the hour preceding the weigh-in.
- Refueling strategies between weigh-in and competition consisting of high-fat foods such as ice cream and fried breakfast—for example, bacon, eggs, sausages.

Table 1 Client Characteristics From Initial Objective Assessment

Client characteristic	Value
Age (years)	25
Height (m)	1.7
Body mass (kg)	68.3
Percent body fat	12.1
Fat mass (kg)	8.5
Lean-tissue mass (kg)	56.6
Bone density (g/cm^2)	1.432
Resting metabolic rate (MJ/day)	7.3
Maximal oxygen uptake (ml · kg^{-1} · min^{-1})	61.4
Strength assessment (8-repetition maximum)	
bench press (kg)	55
military press (kg)	30
bent-over rows (kg)	30
back squats (kg)	60
barbell lunges (kg)	20

Athlete Assessment

Before the intervention, the client had not boxed competitively or undergone structured training for 3 months. During this time, his typical diet consisted of high intakes of carbohydrate (CHO), sugar-based drinks, and saturated fat (assessment based on informal conversation; because he had no previous education in undertaking dietary recording procedures and because of errors with subjective food-recall approaches, detailed analysis was not undertaken). In Week 1 of the intervention, the client was assessed for body composition via dual-energy X-ray absorptiometry (QDR Series Discovery A, Hologic Inc., Bedford, MA), resting metabolic rate (RMR, using the prediction equation of Cunningham, 1980; we chose this equation because it has been validated for athletic populations), maximal oxygen uptake (VO_{2max}), and basic strength of all major muscle groups using standard free-weight training exercises. For the latter assessment, eight-repetition maximal lifts (8-RM) were used (as opposed to the conventional 1-RM) based on the fact that we deemed it unsafe to be handling maximal loads without assessing lifting technique first (the client had revealed that he had performed no structured weight training in his career). Results of this initial athlete assessment are shown in Table 1.

Overview of Nutritional and Conditioning Intervention

Based on the objective assessment undertaken, it was evident that the 59-kg weight limit could only be feasibly achieved by a body-mass loss consisting of a combination of both fat- and lean-mass loss and, potentially, an intended acute dehydration of 1–2 kg with the opportunity to subsequently rehydrate in the 30-hr period between weigh-in and competition. Given the 12 weeks available before competition, our intended weight-loss goal was 0.5–1 kg/week. To achieve this target weight loss, we opted to attain an energy deficit via a combination of restricted energy intake (restricted to approximate values of RMR) and increased energy expenditure.

Relative to the client's habitual energy intake, our nutritional intervention consisted of reduced fat and CHO intake with a concomitant increase in protein intake. The rationale for reduced CHO intake (2–2.5 g/kg body mass) was to enhance lipid oxidation, stimulate gluconeogenesis, and result in protein oxidation to achieve lean-mass loss (Lemon & Mullin, 1980). In order to not induce the latter process at too great a rate and to maintain daily calorie intake at our intended level, we also chose to increase protein intake to approximately 2 g/kg body mass. Fat intake was achieved via consumption of unsaturated fats from fish sources and oils to provide the client with the essential fatty acids required to maintain vital organs' and systems' function. CHO food sources were consumed from low- to moderate-glycemic-index foods to achieve attenuated blood glucose and insulin responses and minimize the suppression of lipolysis in the postprandial period and during subsequent training sessions (Wee, Williams, Tsintzas, & Boobis, 2005). Protein-based supplements were consumed in the form of a whey and casein mixture to increase feelings of satiety and induce a prolonged feeding effect (Hochstenbach-Waelen, Veldhorst, Nieuwenhiuzen, Westerterp-Plantenga, & Westerterp, 2009). In addition to the macronutrient prescription, the client consumed a multivitamin supplement providing 100% of the recommended daily allowance (Complete A-Z, Boots, UK) and the herbal extract echinacea (Echinacea High Strength, Boots, UK) to potentially maintain immune function in conditions when energy intake is compromised (Barret, 2003). Finally, fluid was restricted to water or low-calorie flavored water and was consumed ad libitum throughout each day, although the client was instructed (after education) to consume the necessary fluid to rehydrate immediately after each training session (Shirreffs, Taylor, Leiper, & Maughan, 1996).

The client was provided with sample menu plans for the initial 2-week period highlighting recommended food sources and suggested timings of food intake (these menus were not further modified during the intervention because the client's weight loss over this time scale was in accordance with our intended goals, and he also reported compliance with these nutritional plans). Throughout the intervention, he undertook regular weighed food-intake analysis in which the data were analyzed via dietary-analysis software (Microdiet, Downlee Systems, UK). We present a sample training day (chosen at random according to Altman, 1991) of which energy intake and estimated energy expenditure (assessed by heart-rate analysis using a Polar S610i heart-rate monitor preprogrammed with the personal characteristics of age, body mass, height, and VO_{2max}) are shown in Tables 2 and 3, respectively. This day is typical of the other training days occurring Monday through Friday, with the exception that in Weeks 1–8, the Tuesday and Thursday evening training sessions consisted of high-intensity interval running that induced energy expenditure in the region of 2.5–3.8 MJ. An overview of the client's strength and conditioning program is shown in Table 4. The weekend consisted of rest days when the client maintained energy intake similar to that of training days to support RMR. It is interesting that he often consumed less than the energy intake prescribed in the sample diet plans (in such instances calorie intake was typically 0.4–1.2 MJ below RMR), which he later reported was caused by his perception (based on his previous nutritional practices) that it was too much food for him to consume to be able to achieve his weight without wearing sweat suits during training. Examination of training and nutritional diaries revealed that the client was achieving an estimated energy deficit in the region of 31.5–63 MJ/week. Although we acknowledge that this deficit is greater than general guidelines for weight loss, it would appear that in this instance of an elite performer accustomed to high training intensities and volume, such deficits were necessary to induce weight loss at the required rate (see next section). Furthermore, despite the high energy deficits incurred, the client reported no symptoms of ill health or overtraining at any stage during the intervention period.

Table 2 Energy Intake During a Typical Weekday Training

Meal component	Portion (g)	Time of intake
Breakfast		8 a.m.
bran flakes	100	
semiskim milk	250	
protein drink	40	
cod liver oil	10	
Snack		10 a.m.
apple	172	
yogurt	200	
Lunch		2 p.m.
salmon	145	
whole-meal pita bread	90	
broccoli	88	
cauliflower	84	
Evening meal		6 p.m.
protein drink	40	
yogurt	200	
Macronutrient intake		
energy (MJ)	6.27	
carbohydrate (g)	149	
fat (g)	37	
protein (g)	141	

Note. This day is fairly typical of the macronutrient composition of the daily diet. Timings of intake are approximate, and the client was usually in bed by 9 p.m. each night.

Table 3 Energy Expenditure During a Typical Weekday Training Session

Activity	Time	Duration (min)	Expenditure (MJ)
Running[a]	7 a.m.	45	1.79
Boxing-specific training[a]	11:30 a.m.	90	2.49
Strength and conditioning	4 p.m.	60	2.06

[a]Training sessions devised and supervised by boxing-specific coaches that were not part of the authors' intervention.

Outcome of the Intervention

Changes in the client's body mass, fat mass, lean mass, and percent body fat during the 12-week period are shown in Figure 1. The mean body-mass loss per week was 0.9

Table 4 Overview of Periodized Strength and Conditioning Intervention

Training day	Weeks 1–4	Weeks 5–8	Weeks 9–12
Monday	bench press	dead lifts	upper body plyometric drills[a]
	pull-ups	bench press	box jumps
	incline bench press	pull-ups	speed ladder drill
	bent-over rows	dumbbell shoulder press	ladder punch drill
	flyes	iron cross	barbell roll-outs
	reverse cable flyes	woodcutters	
	dips		
	barbell curls		
	Swiss ball roll-outs		
Tuesday	high-intensity interval running	high-intensity interval running	no session
Wednesday	jump squats	jump squats	jump squats
	power shrugs	power shrugs	hang cleans
	box jumps	hang cleans	box jumps
	upper body plyometric drills[a]	box jumps	speed ladder drill
	barbell roll-outs	speed ladder drill	ladder punch drill
		ladder punch drill	upper body plyometric drills[a]
		barbell roll-outs	barbell roll-outs
Thursday	high-intensity interval running	high-intensity interval running	no session
Friday	back squats	overhead squats	upper body plyometric drills[a]
	leg press	back squats	box jumps
	barbell lunges	stiff-leg dead lifts	speed ladder drill
	military press	upper body plyometric drills[a]	barbell roll-outs
	upright rows	Swiss ball roll-outs	
	iron cross		
	Swiss ball roll-outs		

Note. In Weeks 1–4, emphasis was on working major muscle groups and teaching exercise technique, using 8–12 repetitions of 5 sets per exercise with 90 s recovery between sets and 2 min rest between exercises. In Weeks 5–9, emphasis was on improving overall strength, and more compound exercises were performed consisting of 3–5 repetitions per set, 3–5 sets per exercise, and recovery duration was increased to 2–3 min between sets. In this period, we also introduced further exercises related to power, speed, and speed endurance to progress exercise technique for the final training phase wherein these fitness components were the main training goals. During Weeks 1–8, the client also performed high-intensity interval training (six 3- to 4-min intervals at 90% of maximal heart rate interspersed with 2 min active recovery) to improve overall cardiovascular fitness and achieve high calorie expenditure.

[a]Denotes upper body plyometric drills performed with medicine balls of varying weight designed to increase explosive power.

± 0.4 kg. There was one occasion, between Weeks 6 and 7, when he actually increased body mass, which he later revealed was the result of consuming a large amount of confectionary-type foods in the weekend rest period. The total reduction in body mass over the 12-week period equated to 9.4 kg. As a result of these changes in body composition, the client's percent body fat dropped from 12.1% to 7.0%. There was also no appreciable change in whole-body bone-mineral density during the 12-week period (Week 1, 1.432 g/cm^2, *Z* score of 2.5; Week 12, 1.445 g/cm^2, *Z* score 2.7). These values equate to ~20% above that expected of a sedentary White male of the same age. Although it is not uncommon for bone-mineral density to decrease in conjunction with caloric restriction and

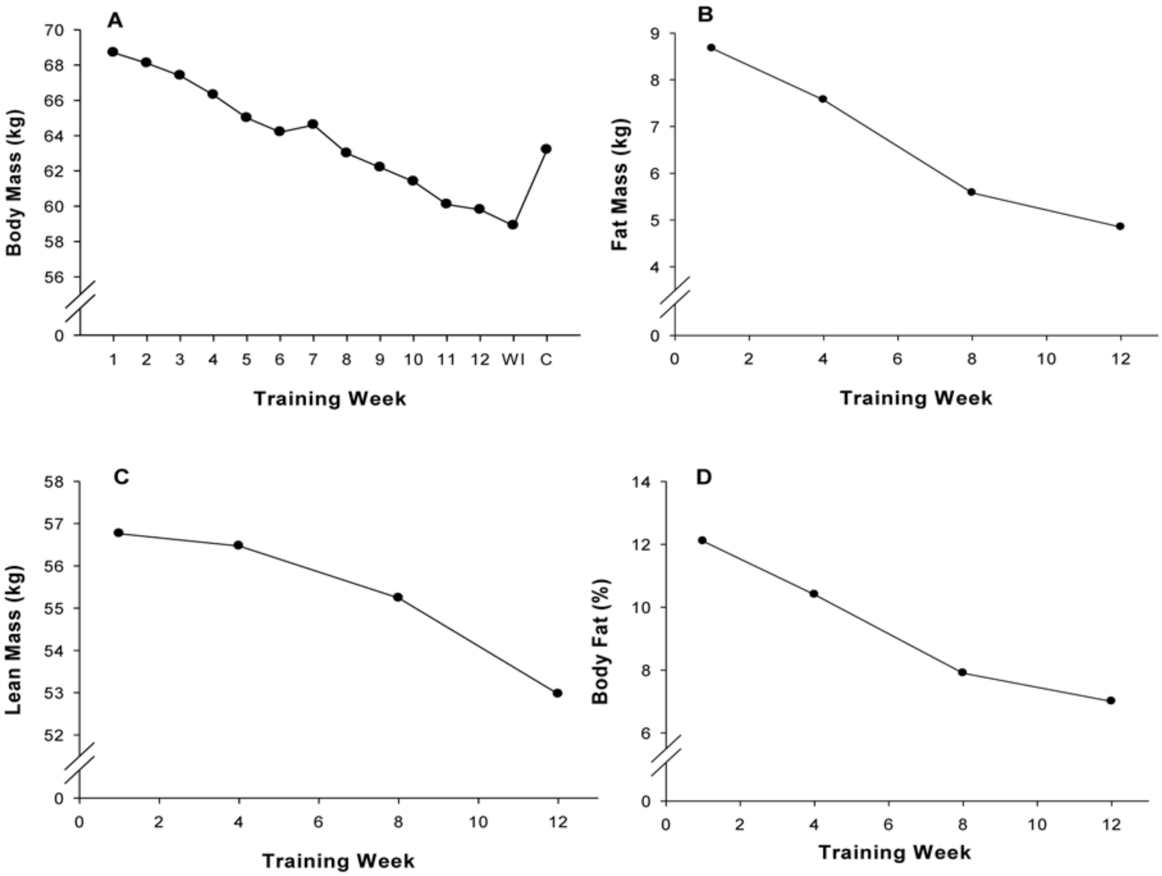

Figure 1 – Client's (A) body mass, (B) fat mass, (C) lean mass, and (D) percent body fat throughout the 12-week intervention period. WI = weigh-in; C = competition.

decreases in body mass, it is possible that the combination of training modes and controlled gradual decrease in body mass served to protect against any appreciable loss in the bone-mineral compartment (Layne & Nelson, 1999).

The client weighed in at 2 p.m. on the day before competition at 58.9 kg. This weight loss had been achieved via no form of intended acute dehydration throughout daily training sessions or in the day preceding weigh-in, and for the first time in his professional career, the client actually consumed food (one cereal bar) and fluid (300 ml of water) on his own accord on the morning of the weigh-in. In the 30 hr between the weigh-in and competition, he consumed a diet consisting of approximately 12 g/kg of CHO (consisting of both high- and low-glycemic foods, the latter being the focus of the lunch and dinner meals on the day of competition) supported by appropriate hydration strategies to maximize CHO storage. As a result of this refueling intervention, he entered the ring at a fighting weight of 63.2 kg and reported no symptoms of gastrointestinal discomfort throughout the interim period between weigh-in and competition.

Practitioner Reflections From the First Author and Future Directions

On initial client assessment, I had obvious health concerns regarding the traditional weight-making practices of professional boxers. Furthermore, I was ethically challenged when faced with the realization that the target weight goal would have to be achieved by losing both fat and lean mass (nevertheless, I am certain that this is commonplace for many professional boxers, but they have never had the knowledge that lean mass will be compromised). However, given that the client and his coaching staff were set on making superfeatherweight, I was faced with the challenge of making this weight as safely as possible. As a result, we collectively devised the nutritional and conditioning intervention with the aim of adopting a gradual approach to weight loss (i.e., 0.5–1 kg/week) that did not involve any form of intended acute dehydration, while simultaneously maximizing athletic development. Our chosen nutritional and conditioning intervention represented a major change to the client's previous approach to making weight. First, he frequently commented that he was consuming more food than ever, despite the fact that he was still often consuming a daily energy intake below his RMR. Second, not once during the training period did he wear any form of sweat suit. Despite the obvious change in practice, both the client and his coaching staff were extremely receptive and open minded to this new approach.

In terms of the nutritional intervention itself, on reflection I wonder if we should have maintained 1 or 2 kg of lean mass and lost the remaining weight through intended acute dehydration on the day preceding the weigh-in. However, the client expressed a desire not to rely on this method given the physiological and psychological stress associated with drying out, so I decided that the benefits of not relying on acute dehydration would outweigh the benefit of having an extra 1–2 kg of lean mass. Nevertheless, this is an issue that we may decide to change for future competition, especially if lean mass is required to be compromised further than it was in this study. Because of the client's developing knowledge and improved food choices when out of training, I also envisage that he will return for his next training camp in the region of 65 kg, and if this is the case, daily energy intake will be increased accordingly during his training program. Finally, we hope that the intervention outlined here has demonstrated that a more gradual and structured approach to making weight can be implemented in professional boxing, despite being very different from the traditional practices inherent to the boxing culture. The success of this approach is, however, underpinned by the willingness of the client and his coaching staff to experiment with novel nutritional and conditioning practices.

Postscript

At the time of formal acceptance of this paper, we had finished another nutritional and conditioning intervention leading up to our second fight together. In this instance, we attempted to maintain 1–2 kg of lean mass via increased daily calorie intake and lose the remaining mass through intended acute dehydration in the day preceding competition. Consequently, the client's strength gains were on average 10% higher than that of the corresponding time point in our initial training camp. Furthermore, as predicted, the client returned for our second training camp (7 weeks in duration) at an initial weight of 66.1 kg, which we believe attributable to improved food choices when out of formal training.

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