以上資料由運動員及科研事務科轄下的運動營養部提供，只供參考。

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如有查詢，請致電26816277與運動科學部聯絡。

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身體組成及體重控制對運動表現的重要性
The Importance of Body Composition and Weight Control to Sports Performance

HONG KONG SPORTS INSTITUTE
香港體育學院

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身體組成及體重對運動表現的重要性

擠身於國際性大賽，技術固然重要，但原來體重及身體組成也影響運動表現。控制體重固然重要，而優化身體組成亦有助發揮。身體組成是指「體內脂肪與瘦組織（包括肌肉、骨骼和水）的比例」。不同的項目對體重及身體組成有不同的要求（見表一），例如，參與耐力項目如公路單車、三項鐵人的運動員有較低體脂比率以助散熱和提高功率。運動員如需要改變體重或身體組成應採用適當飲食和訓練。

表一）各運動應有的身體組成

運動類別	例子	理想的身體組成	理由
耐力	公路單車、三項鐵人、長跑	低體脂、身輕、瘦而結實	低體脂能提高功率重量比。於長距離項目中減少負重。亦有助散熱。
體重級別	輕量級賽艇、空手道	低體脂。賽前要上磅，體重不可超過其體重級別	設體重級別可確保公平作賽。[1, 2]低體脂能提高功率重量比，加快動作。
短跑和跳躍	一百/ 二百/ 四百米跑、跳高、跳遠、三級跳、撐桿跳	低體脂。較多肌肉，某些部位肌肉較發達	低體脂能提高功率重量比。常用的肌肉較發達，以提供最大的力量。
技術	乒乓球、壁球、羽毛球、劍擊	各種體型都有，也不乏低體脂者。視乎運動項目，或會有較多肌肉	低體脂使身體更靈活、動作更快。低體脂及適量肌肉能提高力量。

Importance of body composition and body weight to sports performance

Competing at elite or international levels, not only skills play an important part, but also body weight and body composition affect sports performance. While it is important to control body weight, achieving an appropriate body composition is equally important to maximize performance. Body composition refers to the proportion of fat mass to fat-free mass (including muscles, bones and water) in our body. Certain criteria for body weight and body composition are thought to be beneficial to performance in certain sports (Table 1). For example, athletes in endurance sports like road cycling, triathlon have lower body fat levels to enhance efficiency and heat dissipation. Proper eating habit and exercise regime are necessary for athletes who wish to make change in their weight or body composition.

Table 1: Body composition of different sports

Category	Examples	Ideal body composition	Reason
Endurance	Road Cycling, Triathlon, Distance Running	Low body fat, light-weighed and lean.	Low body fat increases power-to-weight ratio. Beneficial for carrying less body weight over long distance. Advantageous to heat dissipation.
Weight Class	Lightweight Rowing and Karatedo	Low body fat. Weight must not be greater than specified at 'weigh-in'.	Setting weight class ensures fairness.[1, 2] Low body fat increases power-to-weight ratio, enables quicker movements.
Sprints and Jumps	100m/200m/ 400m Run, High/Long/ Triple Jump, Pole Vault	Low body fat. Muscle mass is typically higher, developed muscles at particular sites.	Low body fat increases power-to-weight ratio. Well-developed muscles at particular sites facilitate maximal power output.
Skill	Table Tennis, Squash, Badminton, and Fencing	Low body fat in general, yet players come in all shapes and sizes. May be moderately muscular, depending on sports.	Low body fat enables quicker movements. Low body fat and moderate muscularity produce more power.

身體組成評估方法

要獲知一個人的身體組成有數個方法，而選擇用哪種方法，就要考慮所需時間、費用、準確性和應用的環境，每個方法都有其優缺點，以下是其中一些方法：

表二） 身體組成的評估方法

方法	需時	費用	準確性	備註
體重指數(BMI)	少於一分鐘	無	反映體重與身高的關係	不能獲知身體組成(脂肪及肌肉量)，並不適合用作評估身體組成。
皮褶厚度(Skinfold thickness)	數分鐘	相宜	視乎量度人員的技術	需要專業的人員來量度。讀數顯示所選部位的皮下脂肪厚度，並需用公式轉化為體脂百分比，否則難以理解及比較。
生物電阻抗分析(BIA)	一、兩分鐘	差異很大，視乎型號及科技	視乎身體的水分含量	如每次量度時，體內水分含量相若及充足，常規量度可反映身體組成的走勢。
雙能量X射線骨密度儀(DXA)	大約7分鐘	昂貴	準確	身體需承受小劑量的幅射。不宜用作常規檢測。

Body Composition Assessment Methods

There are several ways to assess a person's body composition. Taking into consideration time, cost, accuracy and institutional setting, there are advantages and disadvantages to each method. The following are some methods:

Table 2: Some methods of assessing body composition

Methods	Time	Cost	Accuracy	Comments
Body Mass Index (BMI)	Takes less than one minute	Nil	Reflects body mass in relation to body height	Not sensitive to body composition (fat and muscle mass). Not suitable for assessment of body composition.
Skinfold thickness	Takes a few minutes	Affordable	Depends on the technique of the measurer	Needs well-trained personnel to take the measurements. Skinfold shows thickness of selected sites of subcutaneous fat, which requires formulae to translate into body fat percentage. Otherwise, it may be difficult to understand and to compare.
Bioelectrical Impedance Analysis (BIA)	Takes one to two minutes	Wide price range, depends on model and technology	Depends on subject's hydration level	Under similar and adequate hydration situations, it is suitable for periodic measurements to monitor trends in body composition change.
Dual Energy X-Ray Absorptiometry (DXA)	Takes about 7 minutes	Expensive	Accurate	Exposure to small dose of X-ray is a concern. Unsuitable for routine use.

體重控制常見的謬誤

吃米飯容易肥，應避免。

米飯含豐富碳水化合物，而碳水化合物應佔日常飲食最大的比重。每克碳水化合物提供的4千卡比每克脂肪提供的9千卡為少，因此米飯不及高油分食物那麼致肥。如運動員有足夠運動量去消耗從食物所物攝取的熱量，那麼吃米飯是不會致肥。加上，運動員需要熱量以應付練習和恢復所需，而米飯，尤其是糙米和其它全穀物，是一個好選擇。

吃宵夜會導致體重增加。

假設一個人的飲食已經足夠提供一天所需的熱量，那麼吃宵夜會提供額外熱量，從而導致體重續漸增加。但是，如果日間的飲食不足夠，宵夜可補償不足。在這種情況下，由於沒有熱量過剩，吃宵夜不會導致體重增加。

體重管理其實是熱量平衡的計算。不管熱量是來自宵夜或正餐，過剩的熱量攝取都會轉化為脂肪。

Common Misconceptions in Weight Control

Rice is fattening and should be avoided.

Rice is a carbohydrate (CHO) rich food. CHO is recommended to make up the biggest proportion of a person's diet. CHO provides 4kcal of energy per gram and are less than fat which provides 9kcal per gram. Rice is therefore not as "fattening" as foods high in fat or oil. If an athlete has enough exercise to use up the energy consumed from food, eating rice will not lead to weight gain.

In addition, athletes need CHO to supply energy for training and recovery. Rice, particularly brown rice and other whole grain, is a good option.

Eating late night snack will cause weight gain.

Assuming a person has met the energy needs of the day, then having late night snack will contribute to excessive energy, which would lead to weight gain progressively. However, if a person is not eating sufficiently during the day, late night snack will compensate for the deficit. In this situation, late night snack will not lead to weight gain because total energy consumption is not in excess.

Weight control is a balance of energy intake and expenditure. Excessive energy intake, whether it is due to late night snacks or main meals, will be converted to fat.

運動後立刻進食會導致體重增加。

有些人擔心「運動後進食會導致過分吸收」，或「運動後進食會使食量增加」。科學上並沒有證據支持這些說法。無論什麼時候進食一片麵包，它所提供的熱量都是一樣的。關鍵是有沒有需要進食及吃什麼食物。

運動後立刻進食的最大好處是促進肌醣恢復和防止肌肉蛋白分解。運動過後，體內燃料和養分被消耗。若能把握時間，盡早進食含碳水化合物、蛋白質和水分的食物，可達到最佳的恢復。這對接著有賽事的運動員更為重要。[3]（請參看運動營養教育系列IX“運動恢復營養學”）

低碳水化合物餐可減肥。

是可以的，但可能會影響運動表現。低碳水化合物餐指由碳水化合物所提供的熱量佔全日總攝取的10-40%。初期的減肥效果比傳統熱量限制的方法更明顯（首數天可減1-3公斤）。[4, 5]這是由於耗盡了肌醣和失去了肌醣鎖著的水分所致。[6]肌醣提供運動時所需的熱量，低肌醣量會削弱運動表現。

低碳水化合物餐可再分為兩種 — 低碳水化合物、高脂的「食肉減肥餐」（每天進食碳水化合物20-40克/ 碳水化合物為總熱量攝取的10%；脂肪＞60%；蛋白質＞25%）和低碳水化合物、低脂、高蛋白質餐（碳水化合物40%；脂肪30%；蛋白質30%）。[4, 5, 7]研究指這兩種餐都提供較所需要為少的熱量，所以有減肥的功效。然而，以一年後計算，以上所述的各種減肥餐，包括傳統減肥餐的功效相若。[4, 5, 8]

不能不提的就是食肉減肥法有一個潛在風險。有研究發現進食這餐單會令血總膽固醇及低密度脂蛋白膽固醇（壞膽固醇）上升，從而增加患上心血管病的風險。[4]因此，不建議使用食肉減肥法。如需減肥，請諮詢營養師。

Eating immediately after exercise will cause weight gain.

Some people might worry “If I eat immediately after exercise, I will absorb energy from food more efficiently”, or “eating immediately after exercise will expand my appetite”. There is no strong evidence to support these statements. A slice of bread has the same amount of energy no matter when you eat it. The important point is whether the meal is necessary and the content of the meal.

The greatest benefit of eating immediately after exercise is to promote fast recovery of muscle glycogen and preventing muscle protein breakdown. After exercise, a lot of body fuels and nutrients are used up. Supplying CHO, protein and fluid at an early stage after exercise can ensure the best possible recovery, which is especially important if another competition is following closely.[3] (Please refer to Sport Education Series IX “Recovery Nutrition”)

Low CHO diets lead to weight loss.

Yes, they do, but may affect sport performance. Low CHO diets (providing 10-40% of daily energy intake from CHO) lead to faster initial weight loss (up to 1-3kg in first few days) than the traditional energy-restricted diet.[4, 5] This is a result of losing muscle glycogen and water.[6] Muscle glycogen is a fuel, its depletion will affect exercise performance.

Low CHO diets can be further classified into two types - the low CHO-high fat Atkin’s diet (20-40g CHO per day; or 10% of daily energy intake from CHO; >60% fat; >25% protein) and the low CHO-low fat-high protein diet (40% CHO; 30% fat; 30% protein).[4, 5, 7] Studies show that both diets work in weight reduction by providing less energy than a person’s need. Yet, the amount of weight lost in any of these diets, including traditional energy restricted diet, are similar after one year.[4, 5, 8]

There is a potential hazard for Atkin’s diet – it was found to elevate serum total cholesterol and LDL-cholesterol (bad cholesterol) levels, which would contribute to cardiovascular risk.[4] Hence, Atkin’s diet is not advised. Please consult sport nutritionist for further advice if weight reduction is needed.

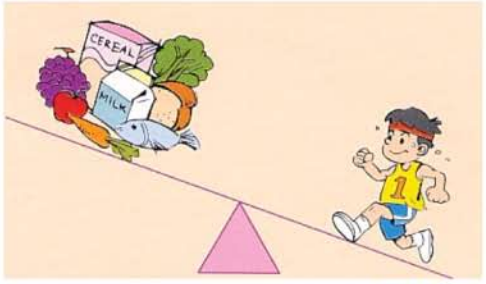
正確體重控制須知

1. 需要有均衡飲食。
2. 每人都有自己的自然體重。要改變體重，就需要努力和時間。
3. 改變體重必須以適當速度進行、注意安全和可持續性。
4. 適當而可實踐的體重改變為每星期0.5-1公斤。[9]
5. 突然的體重改變可能是由於身體水分或醣原的改變，而非源於脂肪、肌肉的增減。
6. 運動營養師會指導你如何達到目標體重。
7. 與教練商討及尋求適當的訓練。

1. 減肥（減脂肪為主）

減肥的首要條件就是熱量攝取要比熱量支出少，而能維持這樣子一段時間。成功的關鍵在於減少食量和增加運動量。請參考以下貼士：

攝取量少



消耗量大

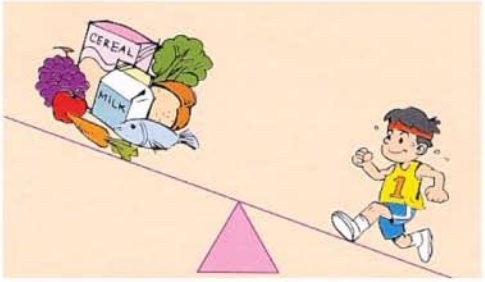
Proper weight control – what you should know

1. You still have to eat a balanced diet.
2. There's a norm weight for everyone. It requires effort and time to change it.
3. Weight change should be done at a suitable rate, emphasizing on safety and sustainability.
4. Realistic and achievable rate of weight change is 0.5kg to 1kg per week.[9]
5. Sudden weight change may be due to changes in fluid and glycogen storage, but not fat mass nor muscle mass.
6. Sport nutritionist will guide you on how to achieve your target body weight.
7. Seek advice and discuss with coaches for appropriate training.

1. Weight loss (Primarily reducing fat mass)

To achieve weight loss, daily energy intake must be less than expenditure, and to maintain this for a period of time. The key is to reduce food intake and increase physical activity levels. The following tips should be helpful:

Lower energy intake



Higher energy output

減肥小貼士

- 定時用膳。不要缺餐。
- 定時和定分量進食的好處是讓身體適應較細的食量。
- 避免不必要的零食或飯餐。
  - 是否需要額外進食視乎運動量和正餐份量。
- 選用低脂食物，避免熱量密度高（即含大量油、糖）的食物。
  - 例如：100毫升脫脂奶較100毫升奶昔為佳
- 多選高纖維或高蛋白質的食物。它們更有飽肚感。
  - 例如：水果、綠葉蔬菜、低脂牛奶製品和瘦肉

如果在一段時間內突然大幅度減少熱量攝取或會導致新陳代謝率下降。[10]這不是好現象，因為有研究指低新陳代謝率和體重增加有關連。[11]因此，每天減少攝取500-1000千卡已經足夠。[9]

額外的運動往往有助減肥，因為它有助確保熱量支出，建議在教練的同意下加入緩跑步或游泳。[9]

怎樣避免進食過量脂肪

- ✓ 用低油煮食法，如蒸、炆、灼
- ✓ 切去可見的脂肪和皮
- ✓ 只用瘦肉的部分
- ✓ 限制使用含隱藏脂肪的食物，如含椰奶為主材料的咖喱和某些甜品、曲奇餅、奶油蛋糕、芝士、白汁、骨湯或忌廉湯、酥皮類及堅果等
- ✓ 用低脂牛奶製品
- ✓ 限制進食香腸、午餐肉等高脂肪食物
- ✓ 避免高熱量、高脂肪零食，蔬果是較佳選擇

Tips for weight loss

- Have regular meals daily. Do not skip meals.
- Ensure meal times are regular with regular portion sizes. This helps the body to adapt to a smaller appetite.
- Avoid unnecessary snacks or meals.
  - Whether extra meals are needed depend on activity levels and the amount of food eaten at main meals.
- Choose foods that are low in fat. Avoid energy dense foods (i.e. foods with a lot of fat and/or sugar).
  - e.g. 100mL of skim milk is preferable to 100mL of milkshake.
- Choose foods that are high in dietary fiber or protein. These foods provide greater sensation of fullness.
  - e.g. fruits, leafy vegetables, low-fat dairies and lean meat.

A sudden and excessive drop in energy intake for a period of time may lower a person's basal metabolic rate.[10] This is not good because study has shown that low basal metabolic rate was predictor of weight gain.[11] Therefore, a moderate reduction of 500-1000kcal per day is appropriate.[9]

Adding extra exercise often helps, as this will ensure sufficient energy deficit. With the consent of coaches, adding exercise, such as jogging or swimming, is recommended.[9]

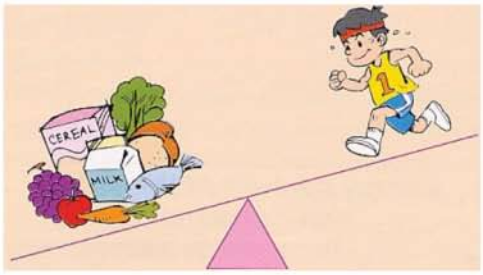
How to avoid consuming excessive fats

- ✓ Use cooking methods with less oil, e.g. steam, simmer, boil
- ✓ Trim off visible fat and skins of all meats
- ✓ Use only lean cuts of meats
- ✓ Limit foods with hidden fats e.g. dishes with coconut milk as a major ingredient (e.g. curry, certain desserts), cookies, cream cakes, cheese, cream sauce, soup prepared with bones or cream, pastries, nuts, etc.
- ✓ Use low fat dairy products
- ✓ Limit consumption of high fat foods like sausages, luncheon meats, etc.
- ✓ Avoid high energy, high fat snacks. Fresh fruits and vegetables are better choices

2. 增加體重（增加肌肉為主）

若要增加體重，每日攝取的熱量要比消耗大。視乎想增加的重量，需要持續一段時間，關鍵是增加食量，再配合有效的力量訓練。請參考以下貼士：

消耗量少



攝取量大

增加體重小貼士

- 將飯餐分佈於整天，每天多吃幾餐
  - 如每天吃6餐
- 每餐吃多一點。這有助逐步增大食量
- 使用熱量密度高的食物，例如：
  - 吃麵包時加花生醬或果醬
  - 用含能量及營養的飲品（例如：好立克、阿華田）代替清水
- 帶備營養豐富零食，例如：
  - 不需冷藏的紙包裝牛奶、果汁
  - 麥條
  - 乾果
  - 粉狀恢復飲品，例如：Powerbar Recovery、加營素
- 劇烈運動後，流質食物較固體食物易被接受
- 進食優質蛋白質，例如：
  - 雞蛋
  - 牛奶
  - 肉類
  - 黃豆及其製成品

2. Weight gain (Primarily increasing muscle mass)

To achieve weight gain, daily energy intake must be greater than expenditure. This has to be continued for some time, depending on the amount of weight to be gained. The key is to increase food intake and an effective weight training program. The nutrition tips below are useful:

Higher energy intake

Lower energy output

Tips for weight gain

- Spread meals throughout the day, and have more meals.
  - e.g. 6 meals a day
- Increase food intake in each meal. This can help to expand appetite gradually.
- Use foods that are energy dense.
  - Adding spreads (e.g. peanut butter, jam) to bread
  - Replacing water with drinks that have energy and nutrients (e.g. Horlick, Ovaltine)
- Bring along nutritious snacks, e.g.
  - Tetra packs of non-perishable beverages, like milk and fruit juice.
  - Cereal bar
  - Dried fruits
  - Recovery beverages, e.g. PowerBar Recovery, Ensure
- After intense exercise, consume liquid foods. They are more tolerable than solid foods.
- Consume good quality protein, e.g.:
  - Egg
  - Milk
  - Meat
  - Soy and soy products

要增加肌肉，必須透過力量訓練。[3]力量訓練能促進肌肉的使用、肌肉纖維撕裂及肌肉再造。訓練後，只要體內有適當的營養素，肌肉便會進行恢復及再造。因此，訓練前後的進食十分重要。如能把握時間，於運動後的30分鐘內攝取含碳水化合物及蛋白質的食物或飲品，可確保最佳的肌肉恢復和再造。[3]要知道更多，請參看運動營養教育系列IX“運動恢復營養學”。

謹記要監測進度。在這方面，運動營養師可確保你使用正確的方法達到目標體重，並同時幫助你突破停滯不前的現象。

不良體重控制方法所帶來的後果

如前文提到，體重改變須循序漸進、安全和可持續。然而，總有些運動員想在最後一刻用極速方法減磅。這些方法會對健康造成損害、削弱運動表現和有可能違反禁藥條例。

極端減肥法的例子

- 焗汗／ 脫水
- 長期使用低碳水化合物餐單（如食肉減肥法，每天只吃20-40克碳水化合物，或全日總熱量攝取的10%。請看第7頁）
- 極速節食
- 禁食／ 饑餓
- 扣喉
- 瀉藥
- 減肥藥（有些可能含禁藥成分）[12]
- 利尿劑（屬禁藥）[12]

To gain muscles, weight training is essential.[3] Such exercise stimulates muscle usage, muscle fiber tearing and re-synthesis. With proper nutrients in the body, muscle recovery and re-building occurs after weight training. It is useful to eat snacks before and after training. Consuming food or drink with CHO and protein within 30 minutes after training can ensure optimal muscle recovery and resynthesis.[3] For more information, please refer to Sport Education Series IX “Recovery Nutrition”.

Remember to monitor progress. Sport Nutritionist can make sure you are on the right track to reach your target weight, and help you break through plateau.

Detrimental effects of improper weight control methods

As mentioned previously, weight change has to be done in a safe, gradual and sustainable manner. Athletes who want to lose weight at the last minute may use extreme methods. However, such methods will damage health, impair sports performance, and may even contravene doping regulations.

Examples of improper weight control methods

- Hot spa / dehydration
- Long term use of low carbohydrate diet (e.g. Atkin's Diet with 20-40 grams of CHO, or ~10% of daily energy intake from CHO. Refer to page 8)
- Crash dieting
- Fasting / Starvation
- Self-induced vomiting
- Laxatives
- Diet pills (some may contain prohibited substance) [12]
- Diuretics (prohibited) [12]

極端減肥法會引致的損害：

營養上：[13]

- 營養不良
- 耗掉肌醣儲備

生理上：[10, 15, 16]

- 減低新陳代謝
- 造成荷爾蒙失調（如減少製造雌激素及睾酮）
- 減少肌肉量
- 月經失調
- 阻礙骨骼製造
- 脫水可削弱運動表現，包括令力量、爆炸力和耐力下降。[17]脫水亦會增加中暑、疲勞和抽筋的機會。[11]嚴重時會令血液中鉀含量下降（可致命的）。[17]

心理上：[14]

- 增加心理壓力
- 有可能導致進食失調症（如厭食症和暴食症）

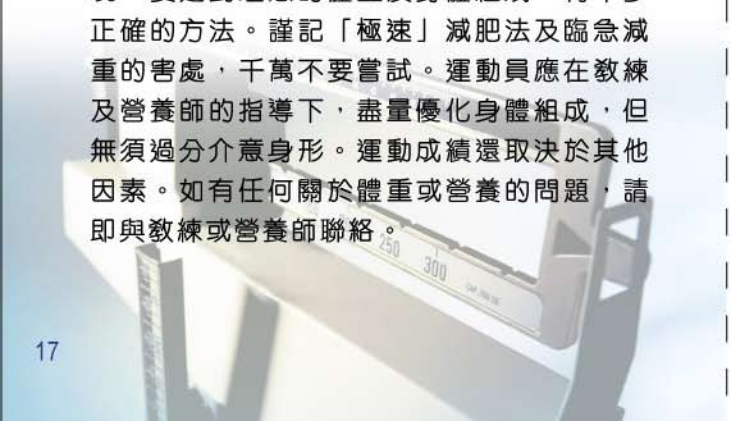
長遠而言：[10, 15]

- 體重反復波動（以後的減肥將更艱難）

謹記：極端減肥法會削弱運動表現！

總結

擁有理想的體重及身體組成可提升運動表現。要達到理想的體重及身體組成，有不少正確的方法。謹記「極速」減肥法及臨急減重的害處，千萬不要嘗試。運動員應在教練及營養師的指導下，盡量優化身體組成，但無須過分介意身形。運動成績還取決於其他因素。如有任何關於體重或營養的問題，請即與教練或營養師聯絡。



Harmful consequences of improper weight control methods

Nutritionally:[13]

- Nutrient inadequacy
- Deplete muscle glycogen

Physiologically: [10, 15, 16]

- Decrease basal metabolism
- Lead to hormonal disorder (e.g. decrease in estrogen and testosterone)
- Decrease muscle mass
- Menstrual disturbance
- Impair bone formation
- Dehydration leads to a decline in performance, including impaired strength, power and endurance.[17] Dehydration also increases the risk of heat stroke, fatigue and cramps.[11] In the worst case, it may cause low blood potassium, which is fatal.[17]

Psychologically:[14]

- Increase mental stress
- May lead to eating disorder (e.g. anorexia nervosa and bulimia nervosa)

In the long term: [10, 15]

- Weight cycling (leads to harder to lose weight next time)

The bottomline is: Extreme weight loss will reduce sport performance!

Conclusion

Working towards an ideal body weight and body composition will enhance your sport performance. There are proper ways to achieve a suitable body weight and body composition. Please remember the detrimental effects of extreme and last minute weight loss methods and do not practice them. With the guidance from coaches and sport nutritionist, try your best to optimize body composition, but don't get over anxious about your physical appearance. Remember that your success also counts on other factors. Don't hesitate to talk to the coach or sport nutritionist if there is any concern about body weight or nutrition.

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