



Review

Body composition changes after weight-loss interventions for overweight and obesity

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SUMMARY

Background & aims: Weight-loss interventions to correct overweight and obesity are very popular but often inappropriate and unsuccessful.

Methods: In this review we evaluated studies on body composition changes during and after different medical and surgical interventions aimed at achieving stable weight loss in overweight and obese individuals.

Results: Most of the available literature and good clinical practice observations deal mainly with post-menopausal overweight and obese women, and, to a lesser extent adolescents and elderly, female and male, populations. These studies suggest that weight-loss maintenance interventions should have greater consideration and priority than simple weight-loss treatments. At a long term follow up (over one year), relatively high protein, moderately low calorie, low glycemic index diets, associated with a daily, moderate intensity, physical exercise (of at least 30 min), appear to be more successful in limiting long term relapse, maintaining fat free mass and achieving the highest fat loss. Diet alone or physical exercise alone does not produce similar results. Health professional training and practice also appear a challenging target.

Conclusions: Adequate dietetic advice plus regular physical exercise avoid the fat-free-mass loss usually observed in the relapse of the weight cycling syndrome and prevent the onset of sarcopenic obesity.

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1. Introduction

The uncontrolled overweight and obesity epidemic is continuously emphasized by national and international health care reports as well as by popular newsmagazines; its worldwide diffusion represents one of the main current health hazards.¹ Prevention and treatment still appear very far from being even partially achieved, due to the poor efficacy of preventive interventions and pharmacological treatments.² Due to their diffusion, another drawback is represented by the side effects of inadequate “popular” interventions for weight loss, usually leading to the weight cycling syndrome and significantly impairing body composition. Finally national health care systems do not usually give adequate attention to obesity management and to the training of health professionals to prevent and treat obesity.^{3,4}

The aim of this review is focused on body composition changes as related to current clinical practice, during and after intentional

weight loss in overweight and obesity, trying to address several questions as summarized in [Table 1](#). In particular: are there differences in body composition after weight loss due to medical approaches? What is therefore the preferred medical intervention to improve weight-loss maintenance? Does physical exercise (PE) have an additive effect on weight loss, and which type of PE should be prescribed? Are there predictive factors for weight loss directly or indirectly linked to body composition? Does the composition of a low calorie diet affect body composition during and after weight loss? Do low calorie/high protein diets contribute to a better body composition and to maintain weight loss? Does the weight cycling syndrome affect body composition; if so how can its occurrence be reduced? Are there differences in the characteristics of body composition following acute weight loss immediately after bariatric surgery, or after stable weight loss obtained with medical interventions? Finally, is intentional weight-loss deleterious?

1.1. Medium and long term weight loss and the type of medical intervention

A systematic review of this topic has been recently published by Franz et al.⁵ The authors consider 80 clinical trials with at least one

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Table 1
Body composition changes during weight loss in overweight and obesity: a synopsis.

Question	Evidence	Reference no.
Long term WL and type of medical intervention	The combination of a reasonably low energy diet and regular aerobic PE helps to obtain long term positive results on weight loss. WL is higher after pharmacological treatments	5,6,11 7
Effectiveness of hypocaloric diet plus physical exercise	Diet with a daily 500 kcal restriction, plus 30 min of moderate intensity PE, five times a week, is appropriate.	10,12 –14,17
Weight loss and body composition	PE plus diet enhances FFM maintenance versus diet only.	16
Predictive factors of weight loss	Higher baseline serum leptin is associated with limited weight and % fat loss.	18
Diet composition (Prot/CHO ratio)	High protein intake is associated with FFM sparing and moderately greater body fat loss. A balanced intake of proteins at each meal positively affects protein synthesis. Similar WL regardless of the Prot/CHO ratio of the diet.	20–24,26 27 25
Effect of weight cycling on body composition	More FFM lost during WL as compared with that gained during relapse periods	34,35
Composition of maintenance diet	Addition of 30 g proteins/day limits weight regain after WL	36
Bariatric (LGB) versus medical treatment	Greater FFM loss compared with a conventional low calorie diet plus PE	42
Body composition changes after bariatric surgery	L-RYGB versus LVBG appears to be effective in achieving more fat and less FFM loss.	37,39
Is intentional weight loss deleterious?	Stable body weight loss has no adverse effects on body composition and protein metabolism.	43

WL = weight loss; FFM = fat-free-mass loss; laparoscopic Roux-en Y-gastric bypass (L-RYGB); laparoscopic vertical banded gastroplasty (LVBG); laparoscopic gastric banding (LGB).

year follow up, dealing with different types of weight-loss interventions: diet alone, physical exercise alone, meal replacement, very low energy diets, diet plus physical exercise, weight-loss medications, simple dietetic advice. The main conclusions of the review are that weight loss tends to reach a plateau, ranging between 5.0 and 8.5 kg (5–9% initial body weight) after six months' treatment, gradually decreasing to 3.0–5.0 kg (3–6% initial body weight) after 48 months. Less effective types of intervention are dietetic advice alone and physical exercise alone. The final suggestions by the authors are that more attention should be focused on continued weight-loss management and maintenance, and that the prescription of a reasonably low energy diet (about 1200 kcal/day in women and 1500 kcal/day in men) plus regular aerobic physical exercise may help to obtain long term positive results. In conclusion, the combination of diet and physical exercise intervention is successful but not when considered separately. Similar results have been obtained by Curioni and Lourenco who compared, after a 1 year follow up, a weight-loss (WL) intervention based on diet and physical exercise (PE) versus diet alone, observing a WL of 6.7 versus only 4.5 kg respectively.⁶ Dovketis et al. compared diet plus lifestyle intervention lasting 2–4 years versus pharmacological treatments, taken for 1–2 years: in the first case WL was of about 5 kg and in the second it ranged between 5 and 10 kg.⁷ Finally, a recent review by Kirk et al. highlights the value of multi-disciplinary interventions to obtain an effective weight management, when proposed for a sufficiently long period of time and worked in cooperation with health care professionals.⁸

1.2. Additional effects of physical exercise on weight loss

Physical activity can be defined as any voluntary body movement generated by the contraction of skeletal muscles resulting in energy expenditure. The crucial role of a physically active lifestyle for maintaining and improving physical, physiological and psychological health is well recognized. Several reports document beneficial effects of aerobic physical exercise on type 2 diabetes, cardiovascular diseases (in particular arterial hypertension), osteoporosis etc.⁹ Aerobic exercise in fact exerts a positive influence, among others, on aerobic capacity, mitochondrial enzyme activities, insulin sensitivity, thus suggesting a potential common pathway with the beneficial effects of calorie restriction.¹⁰ For these reasons, aerobic physical exercise should also promote higher body fat loss and WL maintenance in overweight and obese individuals.

Franz et al. and Fogelholm and Kukkonen-Harjula addressed this topic in two meta-analysis, reaching similar conclusions.^{5,11} Franz et al. found an extra WL of about 1.3 kg achieved with PE associated with diet in a 24-month follow up, whilst in the other study, the additional effect of PE was slightly higher, about 1.8 kg after 20 months of observation. As expected and remarked by Franz et al., PE has further positive effects, in terms of improved blood lipid, insulin sensitivity and all-cause mortality.

1.3. Which type of diet and physical exercise are usually prescribed in good clinical practice, and why?

Good clinical practice suggests to prescribe a diet with a daily intake of approximately 500 kcal less than the estimated habitual intake, at least in overweight and type 1 and 2 obesity. Concerning PE, it is recommended to provide effective and personalized lifestyle interventions.^{10,13} A general advice is to carry out 30 min of moderate intensity PE five times a week, gradually increasing up to 60 min per session, if appropriate.^{13,14} As reported by Nicklas et al., a moderate intensity PE should induce an extra weekly energy expenditure of about 700 kcal/week, corresponding to 8 kcal/kg/body weight/week: these indications appear in accordance with public health exercise recommendations for post-menopausal women.^{12,15} Nicklas et al. have also elegantly shown, by dual-energy X-ray absorptiometry (DXA) measurements and in obese post-menopausal women, that moderate intensity PE (plus diet) is as effective as vigorous intensity PE to obtain significant extra fat loss – associated with lower fat-free-mass (FFM) loss – when compared to diet alone. In particular overall WL was similar, but body composition changes were much better after 6 weeks of diet plus PE, compared to diet alone. Direct or indirect evidence of the beneficial effects of PE on FFM have also been described in other studies; Ballor et al., using hydrostatic weighing to measure body composition, showed in an 8 weeks study, in 40 obese individuals, that exercise training plus diet enhanced (of about 0.43 kg) FFM maintenance versus diet only, with a reported FFM loss of about –0.91 kg.¹⁶ Similar results have been described by Kerkick et al., who, using DXA, showed that PE plus diet improved WL, visceral fat loss, aerobic capacity and maximal strength which, taken together, are functional signs of improved FFM.¹⁷ In the same study energy expenditure was not depressed as when only diet was prescribed.

1.4. Are there predictive factors of weight loss directly linked to body composition?

Several possible predictive factors of WL have been described although their analysis is outside the scope of the present manuscript. In this review we simply focus on serum leptin, which is produced by adipose tissue to an extent directly proportional to fat

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