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Changes in body composition in response to a low energy mediterranean diet: towards an operational definition of quality of weight loss

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Abstract

Introduction: Obesity is a multifactorial chronic disease. Dietary treatment represents the first line of intervention, with the low energy diet being the classic approach. Weight loss in response to a hypocaloric diet is heterogeneous. There is a lack of an operational definition of the quality of weight loss. **Aim:** To establish a definition of the quality of weight loss, based on 25 body composition parameters. Material and methods: **Inclusion criteria:** both sexes, ≥18 years old, % Fat Mass (FM): M≥20; F≥30 and sedentary individuals who achieved the weight loss goal following a low energy mediterranean diet. Baseline and final body composition were estimated using BIA (Inbody 770, Inbody Co., Ltd, South Korea). Tertiles of the differences (X2-X1) in body composition parameters were calculated, where│X2-X1│≤P25 and │X2-X1│≥P75 indicate high and low quality respectively, for those associated with adiposity and │X2-X1│≤P25 and │X2-X1│≥P75 suggest low and high quality respectively, for those related to lean mass and its ratio and ratios associated with adiposity. SPSS (V. 25) was employed. Results: n=59 (M:23; F:36). X2-X1: weight (Wt)=-13.89±6.83 kg (T1=-15.7; T2=-9.3); %FM=-8.7±3.47 (T1=-11.5; T2=-5.9); Visceral Fat Area (VFA)=-59.46±26.5 cm2 (T1=-77.6; T2=-40.1); FM/Wt=85.52±13.24% (T1=75.51; T2=93.81); VFA/Wt=-4.42±1.19 cm2/kg (T1=-3.7; T2=-5.34); and Appendicular Lean Mass Index (ALMI)=-0.36±0.35 (T1=-0.48; T2=-0.17). **Conclusions:** These data allow for the evaluation of the quality of weight loss estimated by BIA, in response to a low energy Mediterranean diet.

Keywords:

- Obesity
- Weight loss
- Low energy mediterranean diet
- Body composition
- Weight loss quality

Introduction

Obesity is a complex, multifactorial disease associated with an increased morbidity and mortality, resulting from an interplay between genetic, epigenetic, lifestyle and environmental factors. The dominant paradigm of energy balance attributes its manifestation to a long-term positive energy gap (1). However, the aforementioned dogma is being highly questioned in the scientific community.

Other paradigms such as the carbohydrate-insulin are gaining popularity. This one postulates that obesity would be an expression of compensatory hyperinsulinemia in response to hyperglycemia induced by the intake of ultra-processed, rich in high-glycemic index carbohydrates. Insulin boosts adipogenesis, decreases Resting Energy Expenditure (REE) and has an orexigenic effect (2).

Overweight encompasses overweight and obesity, two pathophysiological conditions that share an increase in adiposity and are part of the same spectrum. The former involves lower adiposity and it usually presents a lower risk of comorbidities than the latter (3).

According to data from the ENPE study, the estimated total prevalence of overweight in Spain is 36.1% (men: 41.8% and women: 30.6%) and obesity is 22% (men: 22% and women: 22%) (4). These values are very close to predictions made for 2030, globally level (38% overweight and 20% obesity).

Obesity treatment is based on the following pillars: dietary treatment, physical activity, pharmacotherapy, psychological therapy and metabolic surgery. The first two are conservative treatments and are considered the first line of intervention(6).

Losses of 5-10% of initial weight are related to a decrease in morbidity.

The optimal diet in terms of Food Pattern (FP), energy, macronutrients and bioactive compounds to foster weight loss in patients with obesity is a challenging and has not been fully elucidated yet, although some proposals have been made. Qualitatively, it should be personalized, varied, balanced, healthy, safe, sustainable, sensorially appealing, affordable and satiating. Energy deficit is the most important factor (7).

The Mediterranean Diet (MedDiet) is likely the best candidate to be used in the treatment of obesity because it is part of Spanish cultural heritage and meets the aforementioned premises that should be verified by an optimal diet (8).

Weight loss in response to a low energy diet is heterogeneous and depends on multiple factors: race, genetic background, hormonal status, sex, age, adherence, metabolic efficiency, among others (9).

Deep phenotyping in obesity has gained prominence in recent years (10).

The characterization of body composition phenotype is a cornerstone of intervention, as it allows the identifcation of the quality of weight loss, understanding the distribution of adipose tissue (particularly Subcutaneous Adipose Tissue -SAT- and Visceral -VAT-) and evaluating the response to a particular nutrition and/or physical activity and/or pharmacological intervention (11).

We are not aware of any research that has adressed the concept of weight loss quality. This could be defined as a healthy change in the various body compartments that make up an individual´s body weight. High-quality weight loss should maximise the reduction of Fat Mass (FM), particularly VAT and minimise the Appendicular Lean Mass (ALM).

The aim of this study is to establish an operational definition of high versus low-quality weight loss, based on 25 body composition parameters.

Material and methods

A longitudinal study was conducted between two time frames: at the beginning of the intervention (administration of a hypocaloric MedDiet with a macronutrient distribution of 40% carbohydrates, 30% lipids and 30% proteins relative to Total Energy Value -TEV-) and at the end of it (once the weight loss was achieved).

Patients were recruited from a nutrition clinic seeking weight loss weight between March 19, 2019 and May 05, 2023. The patiens filled out an informed consent form.

Inclusion criteria were men and women, ≥18 years old, with overweight (%FM: M≥20; F≥30) and sedentary individuals, who accomplished the weight loss goal in response to a low energy MedDiet.

Height was measured (stadiometer SECA 222 -SECA GmbH & Co-) and baseline and and post-intervention body composition were estimated using BIA (Inbody 770, Inbody Co., Ltd, South Korea).

Descriptive statistics of body composition variables were calculated. Data are presented as means and standard deviations (SD).

Tertiles of the differences (X_2-X_1) in body composition parameters were calculated, where X_2 and X_1 represent the final and initial measurements respectively, so that values:

-$|X_2-X_1| \leq P_{25}$ and $|X_2-X_1| \geq P_{75}$ indicate high and low quality respectively for those associated with adiposity: weight (Wt, kg), Body Mass Index (BMI, kg/m^2), Fat Mass (FM) (%), FM (kg), right arm FM (FMra, kg), left arm FM (FMla, kg), trunk FM (FMt, kg), right leg FM (FMrl, kg), left leg FM (FMll, kg), Visceral Fat Area (VFA, cm^2) and Edema Index (Ei).

-$P_{25} < |X_2-X_1| < P_{75,}$ indicate moderate quality of weight loss for all body composition parameters.

-$|X_2-X_1| \leq P_{25}$ y $|X_2-X_1| \geq P_{75}$ suggest low and high quality respectively for those related to lean mass and its ratio and the ratios associated with adiposity: Fat Free Mass (FFM) (%), FFM (kg), Lean Mass (LM, kg), right arm LM (LMra, kg), left arm LM (LMla, kg), trunk LM (LMt, kg), right leg LM (LMrl, kg), left leg LM (LMll, kg), Appendicular LM (ALM, kg), ALM Index (ALMI, kg/m^2), Skeletal Muscle Mass (SMM, kg), phase angle (φ, º), FM/Wt and VFA/Wt (cm^2/kg).

SPSS (V. 25) was employed.

Results

The final sample included 59 patients with overweight or obesity that were adhered to a low energy MedDiet to lose weight for 241±123 days (60-688 days). The average weight loss was -13.89±6.83 kg, with a maximum of -49.3 and a minimum 6.6 kg.

As regards to changes in body composition parameters associated with adiposity, the decrease in mean BMI of -4.86±2.29 kg/m^2 stands out, with a maximum of -16.8 and a minimum of -2,1 kg/m2, the reduction in mean %FM of -8.7±3.47, reaching a maximum of -19.2 and a minimum of -3.1, the drop in mean trunk FM of -5.84±2.35 kg (representing the 50% of the total FM loss), with a maximum of -15.2 and a minimum of -2.6 kg and the fall in mean VFA of -59.46±26.5 cm^2, with a maximum of -169.4 and a minimum of -5.6 cm^2.

As concerns to changes in body composition parameters related to lean mass, it is worth noting the decrease in mean ALM of -1.02±1 kg, with a maximum of –6.7 and a minimum of +0.57 kg/m^2 and the drop in mean φ of -0.27±0.35^0, with a maximum of -1.9 and a mínimum of +0.4^0.

Regarding adiposity ratios, it should be noted that the mean reduction in FM relative to total weight loss (FM/Wt) expressed as percentage, of -85.52±13.24 and the decrease in mean VFA relative to total weight loss (VFA/Wt) of -4.42±1.19 cm^2/kg of weight loss, with a maximum of -6.61 and a minimum of -0.7 cm^2 /kg of weight loss después de cm^2.

Concerning the ratio associated with lean mass, the fall in mean ALMI was -0.36±0.35, with a maximum of -2.28 and a minimum of +0.16 kg/m^2.

Table 1 shows the means of the differences (X_2-X_1) in the components of body composition.

Variable	X̄±SD	T1=P25	T2=P75
X2-X1_Wt (kg)	-13.89±6.83	-15.7	-9.3
X2-X1_BMI (kg)	-4.86±2.29	-5.7	-3.7
X2-X1_FM (%)	-8.7±3.47	-11.5	-5.9
X2-X1_FM (kg)	-11.65±4.92	-13.9	-8.6
X2-X1_FM/Wt	85.52±13.24	75.51	93.81
X2-X1_FM_ra (kg)	-1.31±0.91	-1.4	-0.8
X2-X1_FM_la (kg)	-1.31±0.93	-1.4	-0.8
X2-X1_FM_t (kg)	-5.84±2.35	-7.4	-4.1
X2-X1_FM_rl (kg)	-1.52±0.85	-1.8	-1.2
X2-X1_FM_ll (kg)	-1.50±0.85	-1.8	-1.2
X2-X1_VFA(cm2)	-59.46±26.5	-77.6	-40.1
X2-X1_VFA/Wt (cm2/kg)	-4.42±1.19	-3.7	-5.34
X2-X1_FFM (%)	8.99±4.32	5.9	11.5
X2-X1_FFM (kg)	-2.1±2.35	-3	-0.7
X2-X1_LM (kg)	-2.05±2.23	-3	-0.8
X2-X1_Ei	0.003±0.003	0.001	0.006
X2-X1_LM_ra (kg)	-0.28±0.21	-0.37	-0.18
X2-X1_LM_la (kg)	-0.27±0.18	-0.34	-0.16
X2-X1_LM_t (kg)	-2.11±2.76	-2.5	-1.2
X2-X1_LM_rl (kg)	-0.25±0.42	-0.38	-0.07
X2-X1_LM_ll (kg)	-0.25±0.35	-0.36	-0.11
X2-X1_ALM (kg)	-1.02±1	-1.34	-0.52
X2-X1_ALMI (kg/m2)	-0.36±0.35	-0.48	-0.17
X2-X1_SMM (kg)	-1.43±1.43	-2	-0.6
X2-X1_φ (°)	-0.27±0.35	-0.5	0

X_2: final value; X_1: baseline value; X_2-X_1: difference between final and baseline value; $\overline{X}$:Mean; SD: Standard Deviation; T_1: tertile 1; T_2: tertile 2; Wt: weight; BMI: Body Mass Index; FM: Fat Mass; FM_ra: Fat Mass right arm; FM_la: Fat Mass left arm; FMt: Fat Mass trunk; FM_rl: Fat Mass right leg; FM_ll: Fat Mass left leg; VFA: Visceral Fat Area; FFM: Fat Free Mass; LM: Lean Mass; Ei: Edema Index; LM_ra: Lean Mass right arm; LM_la: Lean Mass left arm; LMt: Lean Mass trunk; LM_rl: Lean Mass right leg; LM_ll: Lean Mass left leg; ALM: Appendicular Lean Mass; ALMI: Appendicular Lean Mass Index; SMM: Skeletal Muscle Mass; φ: Phase angle.

Table 1: Descriptive statistic of the changes in body composition following adherence to a low energy MedDiet, stratified by tertiles.

Discussion

Although several researchs have assessed changes in body composition in response to a low energy diet, none have addressed the concept of quality of weight loss.

The most notable findings, from a practical standpoint, are that the best versus worst patients mobilised 94% vs. 76% of FM relative to total weight loss, 5.3 cm^2 vs. 3.7 cm2 VFA/kg of weight loss and -0.17 vs. -0.48 kg/m2 ALMI.

This research stands out for three reasons. First, this is the first study, to our knowledge, that defines the concept of quality of weight loss (low, moderate and high) in both qualitative and quantitative terms. Second, its practical nature means that body composition values can be used by any health professional to asess the quality of weight loss in an individual following a low energy MedDiet. Third, this study can inspire other researchers to conduct studies in this line of research or related areas.

Four limitations were identified in this research, inherent to the methodological design and its practical application. The first objection is the small sample size, which limits the generalization of the results. The second is the lack of sex differentiation, which would likely reveal a sexual dimorphism in the changes in body composition in response to the hypocaloric MedDiet. The third hindrance is that a gold standard method for estimating body composition, such as Dual Energy X-ray Absorptiometry (DEXA) was not employed. Instead, a doubly indirect method like BIA was used. The four drawback is that the findings should only be employed to compare subjects who have achieved the target weight loss with a MedDiet having the same macronutrient distribution (40/30/30) and monitored body composition with the same brand and model of BIA equipment (Inbody 770, Inbody Co., Ltd, South Korea).

Conclusions

The body composition data presented resulting from a weight loss intervention in response to a MedDiet, will be useful to healthcare professionals working with overweight patients, allowing them to assess the quality of the weight loss.

Conflicts of interest

The authors declare not to have conflicts of interest.

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