

اصول فیزیولوژیک انرژی پایه متابولیسم در برنامه های کاهش وزن

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Resting Metabolic Rate (RMR)

- RMR is defined as the energy expended at rest for physiological functionality and comprises ~60–70% of energy expenditure in the normal population

RMR

- Its preservation during weight loss has been targeted as a potential strategy to prevent the compensatory reductions in energy expenditure and subsequent weight regain

Fat Free Mass vs Fat Mass

- FFM loss can account for up to 50% of total weight loss and thus may at least partially explain the variability observed in RMR following weight loss.
- Yo-Yo effect

- RMR is reduced by a magnitude of ~100 kcal (~7%) in response to weight loss of ~11%
- Story of Lucky 5kg savers!

- 60% of the total reduction in RMR were explained by losses of energy-expending tissues
- The remaining 40% of RMR reduction can be attributed to metabolic adaptations.

Energy Homeostasis

- Homeostasis is the tendency of an organism to maintain a stable internal state.
- Energy homeostasis (EH), this supposes that the energy balance (EB) between the energy supplied and dissipated is stable

Obesity Pandemic

- The worldwide epidemic of increased obesity in humans



- Mechanisms of EH seem to be poorly efficient against excessive EI in individuals
- In weight management, we are fighting against human physiology!

Hunter Gatherer Human



Adipose Tissue

- EH must not be represented by a simple input/output model.
- Between the two lies a very flexible energy storage compartment which is the target of many physiological factors
- Homeorhesis vs Homeostasis

The set-point theory

- The set point theory supposes that a regulated hypothalamic body weight or white adipose tissue (WAT) mass would be defended against voluntary (e.g., dieting) or involuntary excessive weight gain

Allostasis Hypothesis

- One hypothesis is that EH is not centered on the stability of energy stores or the equilibrium between energy needed and supplied
- The allostasis concept in which the body "anticipates needs and prepares to satisfy them before they arise"

- Multiple substrates, hormones, neurotransmitters and brain neurons were found to exert an action on EH through their effects on EI and/or EE, and new molecules are constantly discovered

hormones and neurons linking the peripheral system to the CNS

- The adipokines leptin and adiponectin
- Pancreatic hormones: insulin, amylin and pancreatic polypeptide 9 (PP)
- Gut hormones such as the anorexigenic cholecystokinin (CCK), glucagon-like peptide 1 (GLP-1), oxyntomodulin, peptide tyrosine tyrosine (PYY)
- Orexigenic ghrelin
- Vagal neurons

- The second component is the hypothalamus, the brain area where peripheral messages induce homeostatic responses altering EI and EE

- The third component is the brainstem and notably the nucleus tractus solitarius (NTS)

The fourth component is the reward system

1) the mesolimbic dopamine system. The hedonic and reward response to eating are established based on previous experiences

2) the opioid system

• مَثَلُ الْجَنَّةِ الَّتِي وَعِدَ الْمُتَّقُونَ تَجْرِي مِنْ تَحْتِهَا الْأَنْهَارُ أُكُلُهَا دَائِمٌ

- Fourth: the amygdala, through its connection with the LH, is crucial for conditioning processes i.e., associating food to cues

- The fifth component, often overshadowed by the directly altered EI effect of these factors, is the neuronal efferent pathway represented by the **sympathetic nervous system**.

Energy homeostasis challenges

Energy homeostasis challenges: exercise

- Studies showed that when shifted from inactivity to exercise on a treadmill, rats did not increase their EI but decreased it and lost weight
- It was not before reaching 60 min of daily exercise that EI reached a higher level than when they were inactive

High-fat diets, Energy Intake and EH

- The fact that rats can drastically increase their EI without apparent need and become obese when either high-fat or highly varied, palatable and high-energy density foods are provided i.e., cafeteria diet
- Suggests that EH can be easily overridden with a simple modification of dietary environment.

Overfeeding and Energy Expenditure

- A recent systematic review concluded that overfeeding leads to a 7 to 18% increase in TEE, allowing ~25% of excess energy to be stored.
- This suggests that the efficiency for EE to realize EH is limited.

Weight Relapse

- Relapses after diet-induced weight loss are relatively frequent (~50% at year 1)
- Strongly depends on the type of tissue lost i.e., decreased energy needs if more fat-free mass is lost
- Adaptative thermogenesis

- We need to recognize that these well-intentioned approaches are fighting natural **human tendencies** to eat more and exercise less.

- Subjects will require a **rebalancing of energy intake and expenditure** to reduce the physiologic accumulation of body fat

Failure in obesity tackling!

- For years we have been focusing on public education, but the numbers kept rising.
- Resulting in more chronic diseases and social problems such as social inequality, high healthcare costs and less labor productivity.

ICD 10

- Obesity is a disease and deserves treatment
- ICD Codes
- [E66](#) Overweight and obesity
 - [E66.0](#) Obesity due to excess calories
 - [E66.01](#) Morbid (severe) obesity due to excess calories
 - [E66.09](#) Other obesity due to excess calories
 - [E66.1](#) Drug-induced obesity
 - [E66.2](#) Morbid (severe) obesity with alveolar hypoventilation
 - [E66.3](#) Overweight
 - [E66.8](#) Other obesity
 - [E66.9](#) Obesity, unspecified

Integrative approach

- Diet therapy
- Drug therapy
- Complications management
- Complementary & Alternative Therapy (CAT)
- Psycho therapy
- Therapeutic exercise
- Physical activity prescription
- Aesthetic
- Surgical approach

Diet therapy

- Corner stone of weight management
- Simple energy intake reduction
- LCD, VLCD, KEN diet

Eating control

- Induced satiety feeling: POMC inhibitor
 - Naltrexone: food craving
 - Liraglutide
- Inhibit appetite feeling: dopaminergic
 - Bupropione: reduced appetite
- Fullness feeling
 - Fibers
- Macronutrients components
 - Glycaemic index, Ketogenic diet

Malabsorption

- Lipase inhibitors
- Fat chelators
- Alpha amylase/alpha gluosidase inhibitors
- Prebiotics

Basal metabolic rate

- Frequent dieters
- Low muscle mass
- Old age

- Thyroid hormones
- Nor-adrenergic/sympathomimetic medicine
- Caffeine

Complementary and Alternative Therapies (CAT)

- Biological based: Nutraceuticals
- Energy based: Accupuncture
- Mind-body therapy: Hypnosis

- Psycho therapy
- Therapeutic exercise
- Physical activity prescription

Aesthetic

- Need for optimum fitness and beauty
- Not for everyone
- Invasive and Non-invasive

Bariatric surgery

- Appetite/satiety control
 - Time limitation
 - Body overcome/adaptation
 - Large weight loss
- Mal-absorption
- Complications management

Integrative Approach: therapy

- Increased hunger feeling
- Lower satiety feeling
- Reduced basal metabolic rate

- Energy homeostasis plays a major role in human body weight
- All treatments should be focused on reducing energy intake and increasing energy expenditure

متشکرم.