HEALTHCARE EVOLUTION

Starvation Mode, Metabolic Adaptation, or Broken Metabolism?

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FOUNDER OF HEALTHCARE EVOLUTION

EMPOWERING AS MANY PEOPLE AS POSSIBLE TO LIVE A HAPPIER AND HEALTHIER LIFE!

Presenter Disclosures

I have the following relationships with these commercial interests:

- Founder: Healthcare Evolution Inc.
- Consulting/Contracting Fees: SRx Pharmacy – Calgary, AB; Muse Aesthetic Inc.
- Grant Funding: Canadian Foundation for Pharmacy – Innovation Fund Grant
- Advisory Board: CPhA Board Representative on the Pharmacy Examination Board of Canada (PEBC) Board of Directors

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Today’s Learning Objectives

- Review energy balance
- Discuss metabolic adaptation and its role in weight management
- Postulate the future of obesity management?

Energy Expenditure

- Weight-Maintenance - Calories IN = Calories OUT
- Weight-Gain - Calories IN > Calories OUT
- Weight-Loss - Calories IN < Calories OUT

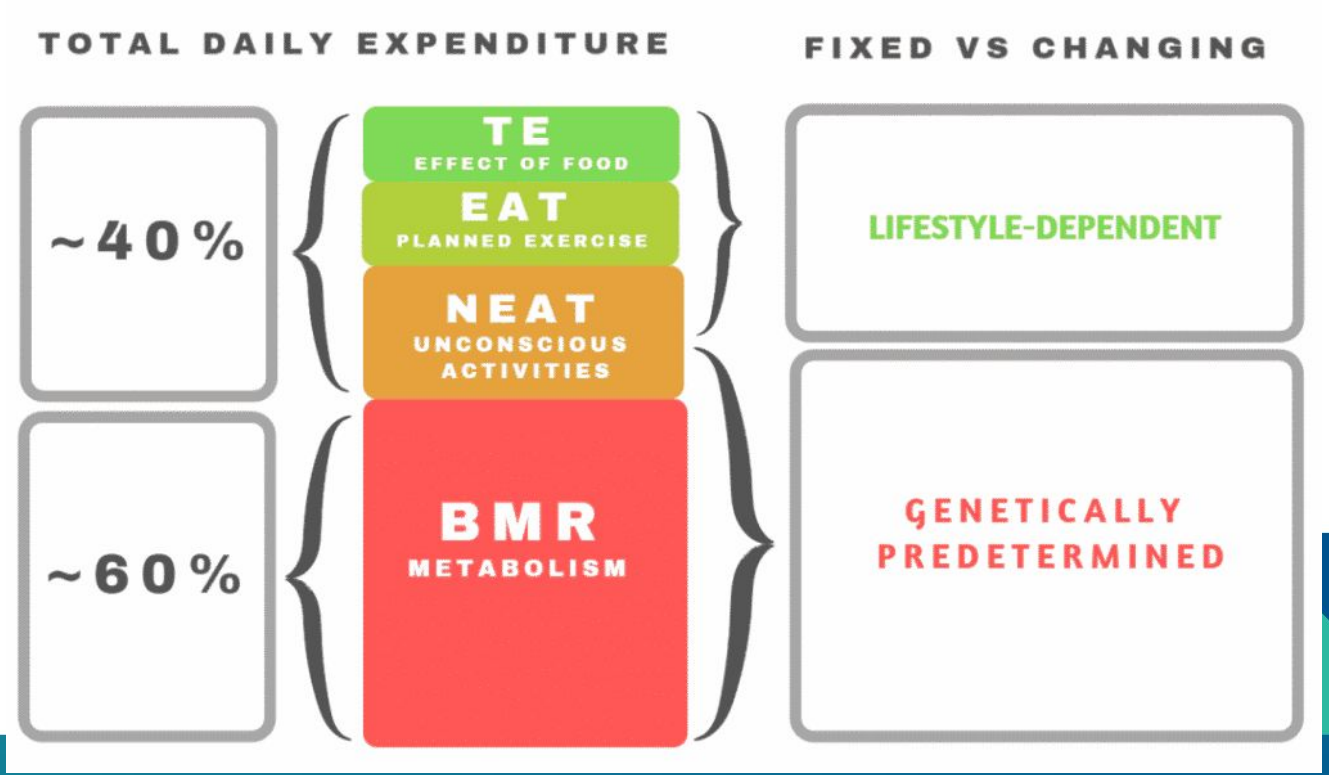
Calories IN?!

- Food we eat
  - Includes all food, beverages, alcohol, etc.

Calories OUT?!

- TDEE = Total Daily Energy Expenditure
  - How much energy you expend during the day - BMR, NEAT, EAT, TEF
- BMR = Basal Metabolic Rate or Resting Metabolic Rate (RMR)
  - Energy burned to maintain basic; life sustaining functions
  - Breathing; Heart Pumping; etc.
- NEAT = Non-Exercise Activity Thermogenesis
  - Energy burned for daily activities such as work, cooking, cleaning the house, fidgeting etc.
  - Does NOT include sleeping, eating or formal sports-like exercise
- EAT = Exercise Activity Thermogenesis
  - Energy burned via formal exercise or activity
- TEF = Thermic Effect of Food
  - Energy expended digesting food
  - Protein >> Carbs and Fats

Calories OUT?!



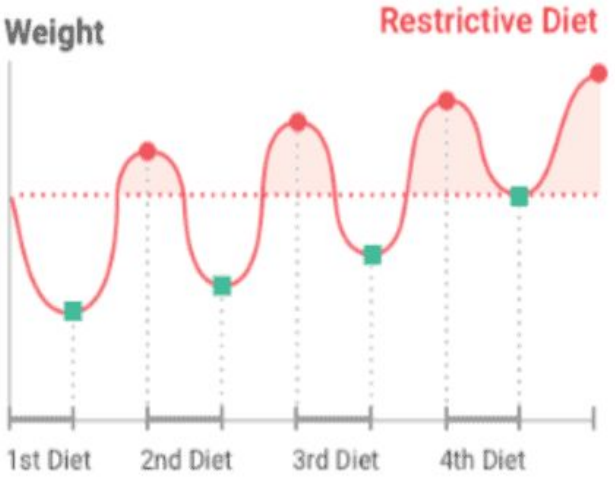
OK our goal is to lose weight?!

- Reduce your Calories IN
  - Calories IN < Calories OUT
  - Create a calorie deficit

At first everything seems great...

But then….

- Recognize the cycle?
  - Diet 1 - Success but regain
  - Diet 2 - Success but even more regain
  - Over and over again - sometimes called ‘Yo-Yo’ Dieting



Quote

‘Best way to gain 5 pounds, is to lose 20.’

-Dr. Arya Sharma, Founder of Obesity Canada and Past Scientific Director

obesity canada / obésité canada

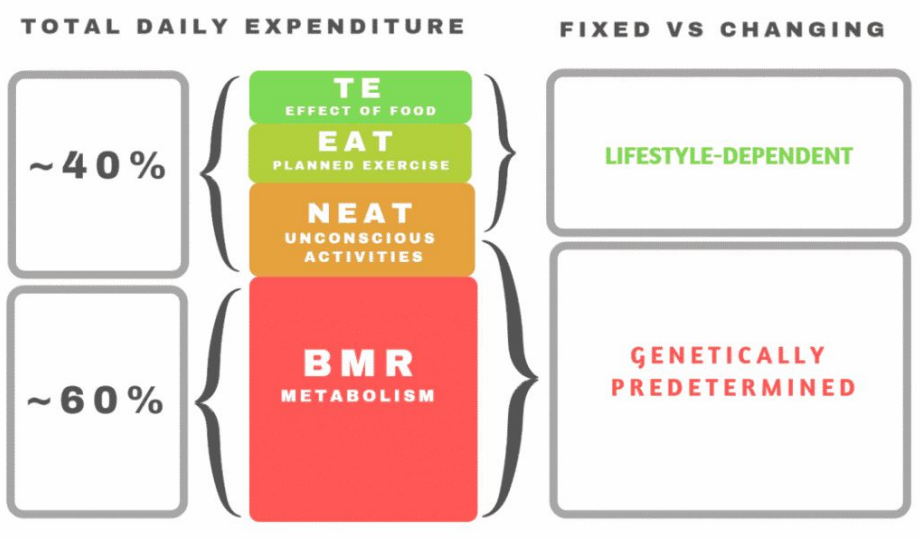
So what the hell is going on!?

Why do I gain the weight back and then struggle to lose it again?!

What happens when you lose weight?

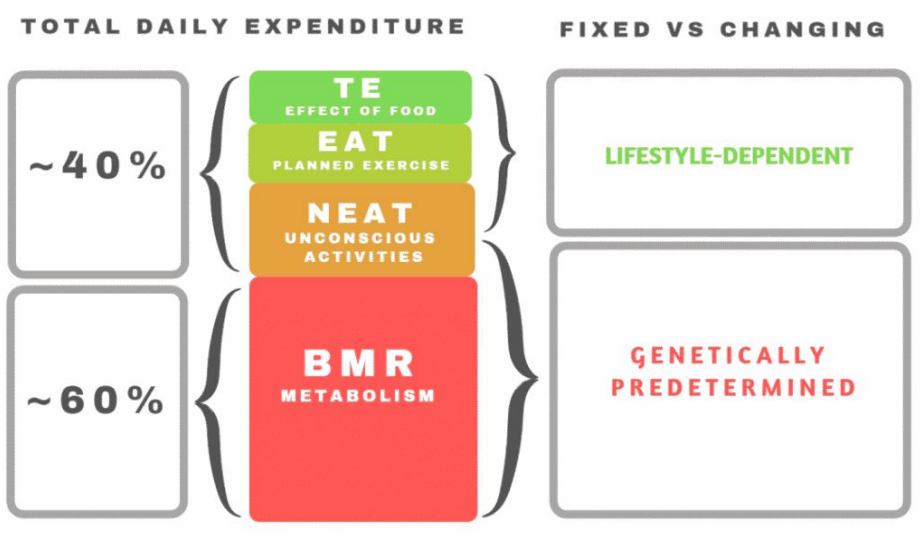
- Decrease in BMR
  - You become smaller therefore like a smaller engine you burn less fuel
- **Decrease in NEAT**
  - You fidget and move less
- Decrease in TEF
  - You are eating less food therefore less energy needed to burn food
- Decrease in EAT
  - You become smaller so less energy burned by moving

The above all makes sense, right?!



But wait there's more...

- Increase in appetite hormones
  - Ie. Ghrelin
  - Cravings and hunger increases - even for foods you don’t normal crave
- Decrease in satiety hormones
  - Ie. GLP-1
  - Decrease in fullness after a meal
- **Increase in fuel efficiency**
  - What energy you do put in gets used more efficiently and you burn less



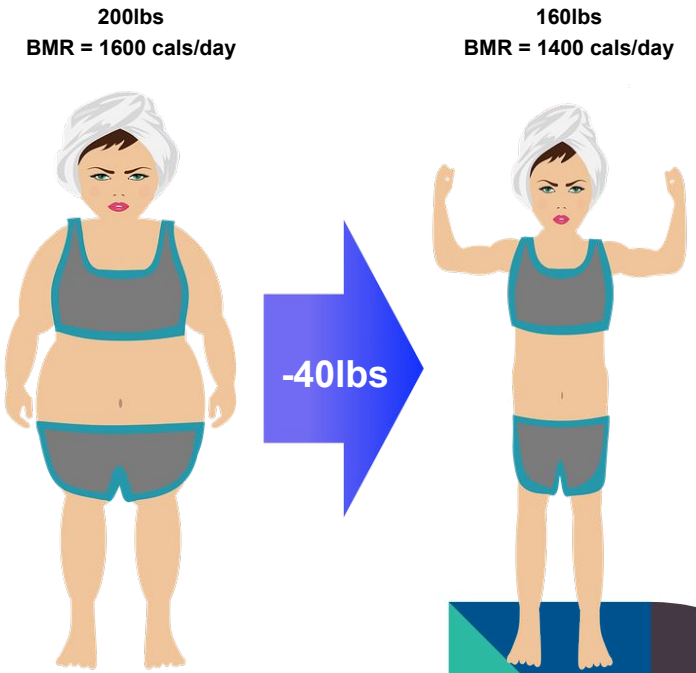
Example - Expected

Female 46 years old 5’4 and weighs 200lbs:

- BMR = 1600 calories/day

She then loses 40lbs and now weighs 160lbs

- Expected BMR = 1400 calories/day



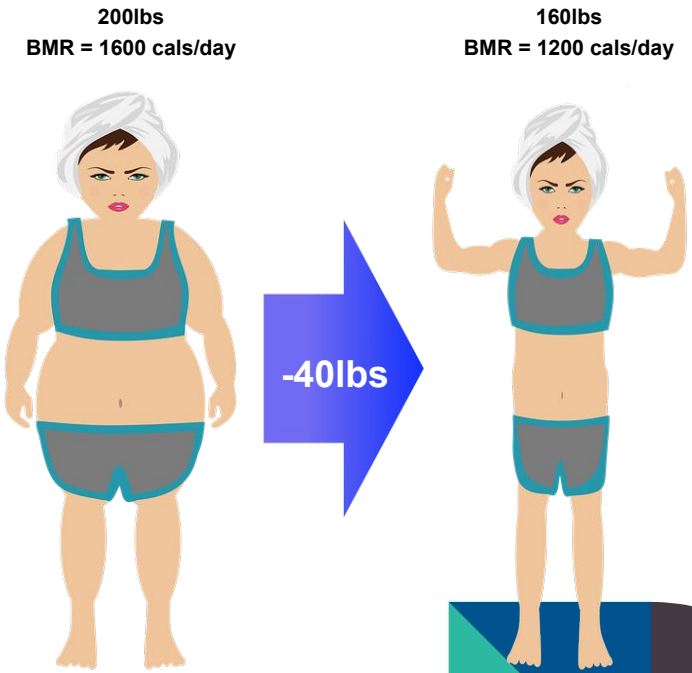
Example - Reality

Female 46 years old 5’4 and weighs 200lbs:

- BMR = 1600 calories/day

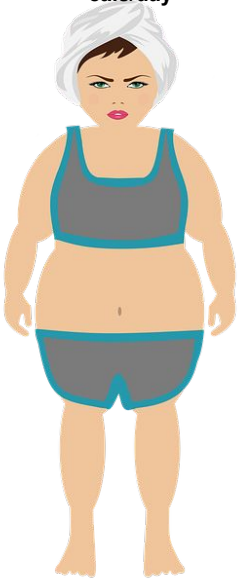
She then loses 40lbs and now weighs 160lbs

- **Actual BMR = 1200 calories/day**



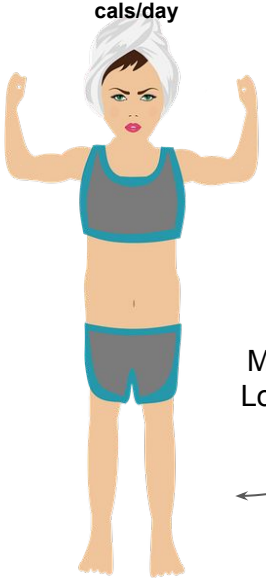
Say what?!

200lbs
BMR Burning = 1600
cals/day



-40lbs

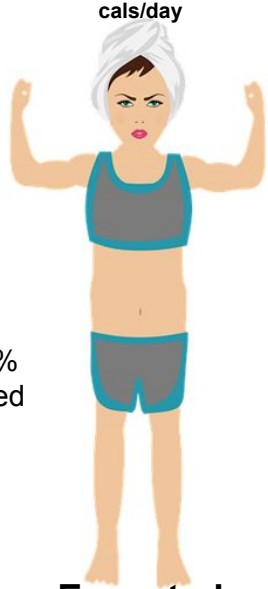
160lbs
BMR Burning = 1200
cals/day



vs.

Metabolic Rate 15%
Lower than Expected

160lbs
BMR Burning = 1400
cals/day

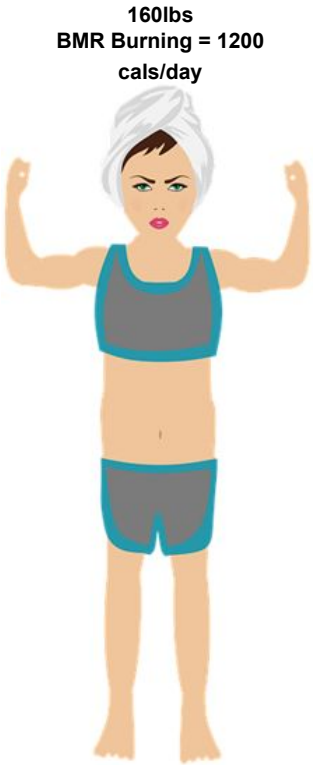


Never lost weight

Expected Metabolic Rate

Say what?!

- BMR is determined by body size and composition
  - We expect a decrease with a smaller body
  - BUT during a period of energy restriction there is a great reduction in BMR than expected
- Could this explain why weight-loss becomes more challenging and harder to maintain?!



WHY does my body do this?!

- Survival
  - 30,000 years ago losing weight was a bad thing
  - Our bodies want to hold onto as much energy as possible in case there is a famine or interruption in the food supply!

Is this Starvation Mode?!

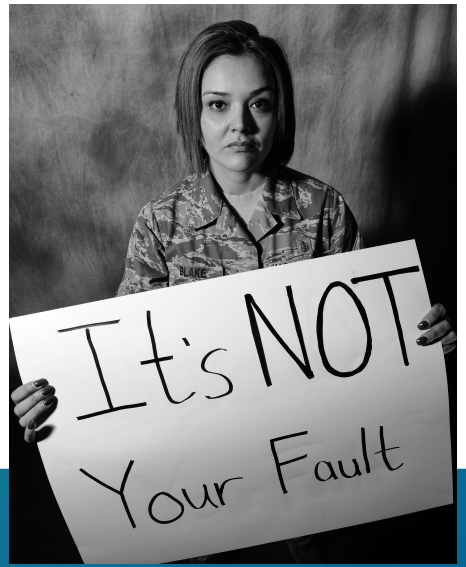
Not quite:

- **Starvation Mode** defined by the IG influencers is when your body can't lose weight or you gain weight when calories are too low
- Reality: Starvation Mode **DOES NOT EXIST**
  - Yes, your body will reduce your metabolic rate when you lose weight or are in a caloric deficit BUT your metabolic rate will never go to ZERO...until you die
  - SO your weight-loss has stalled not because of Starvation Mode BUT because you are unable to achieve a consistent calorie deficit

So its my fault?

NO it is not your Fault!

- Human physiology, metabolic rate, and appetite regulation is extremely complex
- So the slowing of your metabolism is not Starvation Mode instead it is…..



Metabolic Adaptation OR Adaptive Thermogenesis

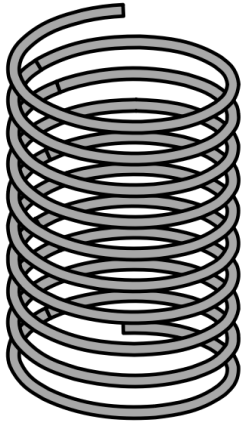
Definition:

- The change in energy expenditure following acute and/or long-term overfeeding and underfeeding.
  - Obviously in Obesity management we are more focused on underfeeding or a calorie deficit
    - Could be a barrier to weight maintenance and **cause of** **weight regain**
  - BUT if you overfeed or over eat your body can also increase its metabolic rate to compensate for the extra calories
    - For most of us this increase is miniscule
    - For a select few a*sholes in the world it can increase substantially limiting weight-gain

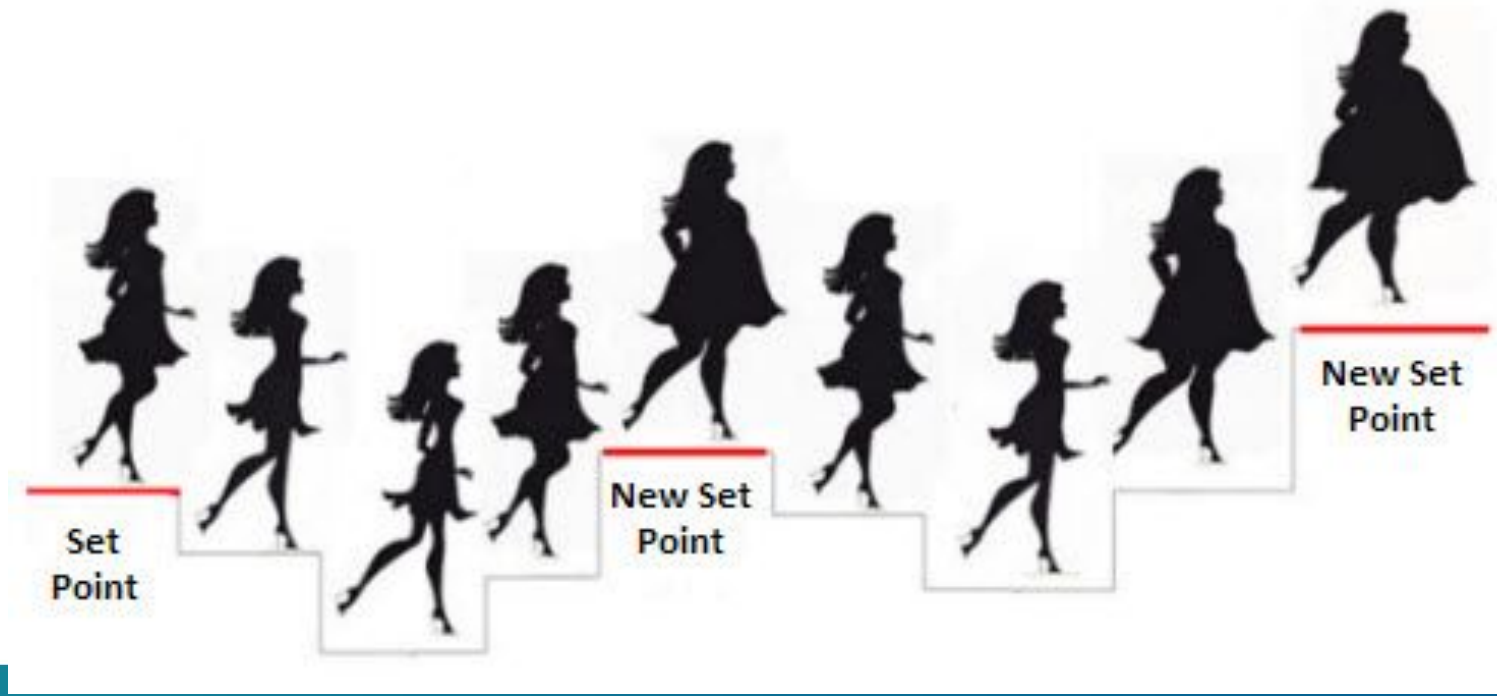
This leads us to the Set Point OR Compensation Theory

Definition:

- Each individual has a **predetermined** set weight based on genetics, environment, etc.
    - Body will actively regulate metabolism, appetite, and energy output in order to ‘defend’ that set point whether your weight goes up or down

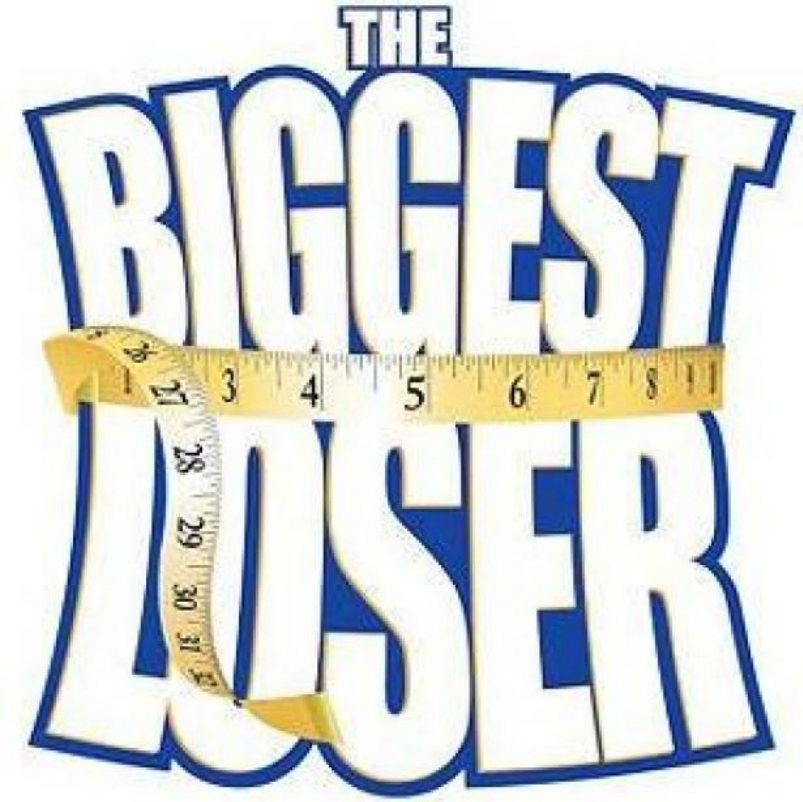


Predetermined? It seems like my ‘Set Point’ keeps going up?!



Question: Is metabolic adaptation due more to losing weight or being in a calorie deficit?

Evidence - Biggest Loser Study



Evidence - Biggest Loser Study

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Obesity (Silver Spring). Author manuscript; available in PMC 2017 August 01.

Published in final edited form as:

Obesity (Silver Spring). 2016 August ; 24(8): 1612–1619. doi:10.1002/oby.21538.

Persistent metabolic adaptation 6 years after The Biggest Loser competition

Erin Fothergill[1], **Juen Guo**[1], **Lilian Howard**[1], **Jennifer C. Kerns**[2], **Nicolas D. Knuth**[3], **Robert Brychta**[1], **Kong Y. Chen**[1], **Monica C. Skarulis**[1], **Mary Walter**[1], **Peter J. Walter**[1], and **Kevin D. Hall**[1,*]

[1]National Institute of Diabetes and Digestive and Kidney Diseases

[2]Washington DC Veterans Affairs Medical Center

[3]Towson University

What did they do?

- Looked at 14 individuals with Obesity that competed in the Biggest Loser TV Show
  - Time Points:
    - Immediately after the competition measured body composition (weight, fat-mass, etc.) and Resting Metabolic Rate (similar to BMR)
    - Follow-up 6-years later repeated the above
- Hypothesis: Metabolic adaptation would still be present many years after the competition and would correlate with amount of weight regain

Results

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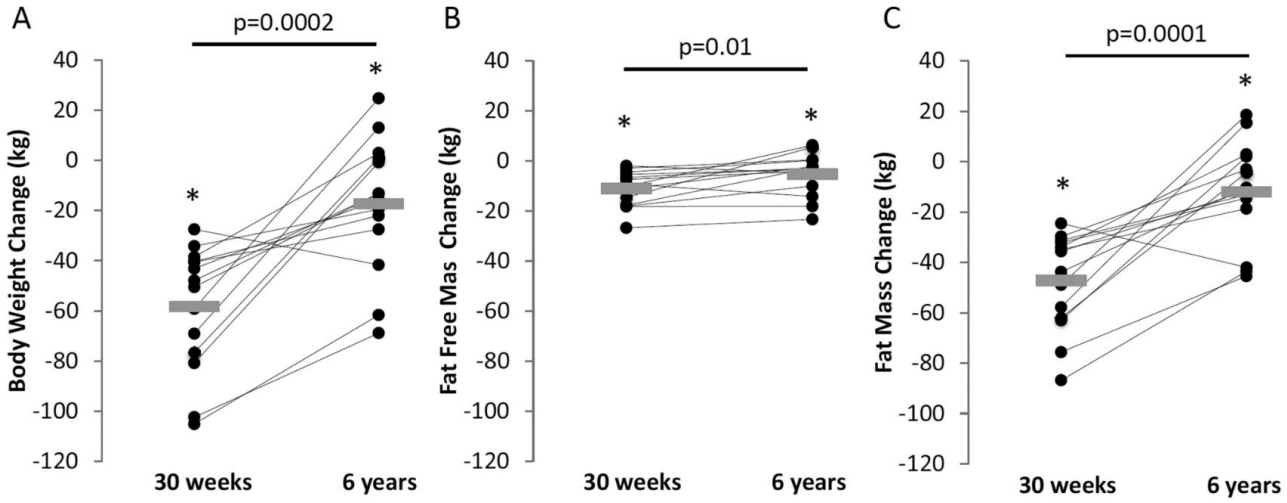

Figure 2.

Individual (●) and mean (gray rectangles) changes in body weight (A), fat-free mass (B), and fat mass (C) at the end of the 30 week Biggest Loser weight loss competition and after 6 years. Horizontal bars and corresponding p values indicate comparisons between 30 weeks and 6 years. * indicates $p<0.05$ compared to baseline.

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Results

- At the end of the 30 week competition:
  - All of the participants lost a significant amount of weight
    - Significant amount of Fat-Mass and some Fat-Free-Mass (Muscle)
- At 6-year follow-up:
  - Nearly all of the participants re-gained some amount of weight, with some gaining all or more compared to their pre-competition weight
    - Weight gained was primarily fat-mass

OK what about RMR or BMR?!

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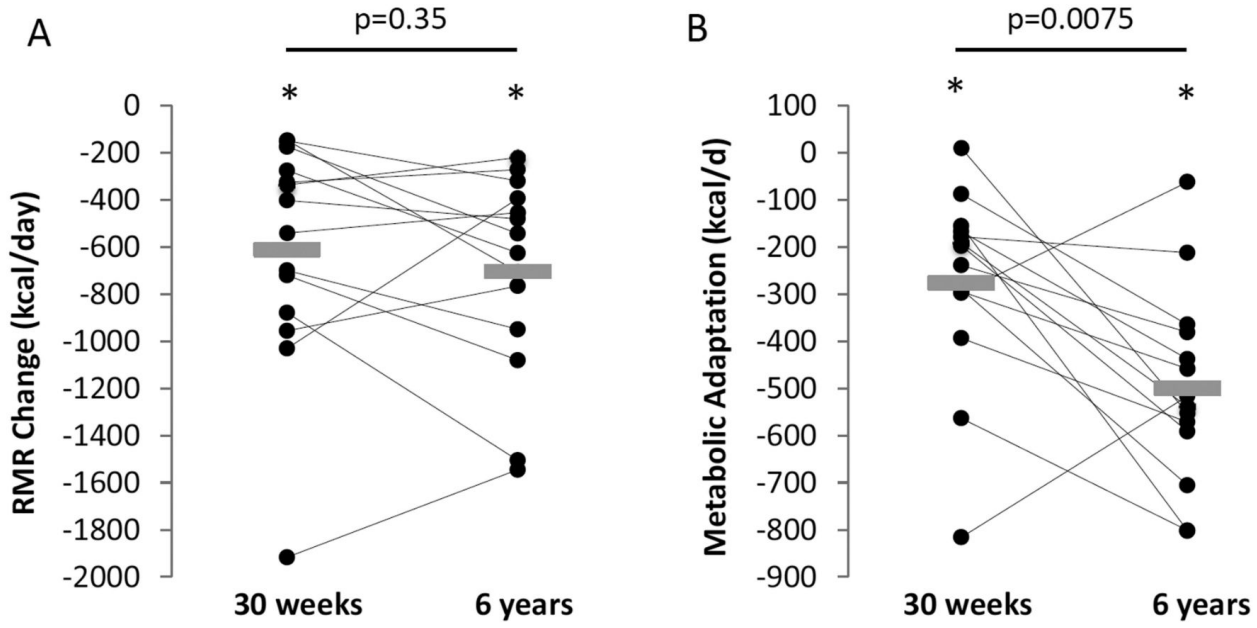


Figure 4.

Individual (●) and mean (gray rectangles) changes in resting metabolic rate (A), and metabolic adaptation (B) at the end of the 30 week Biggest Loser weight loss competition and after 6 years. Horizontal bars and corresponding p values indicate comparisons between 30 weeks and 6 years. * indicates $p<0.001$ compared to baseline.

OK what about RMR or BMR?!

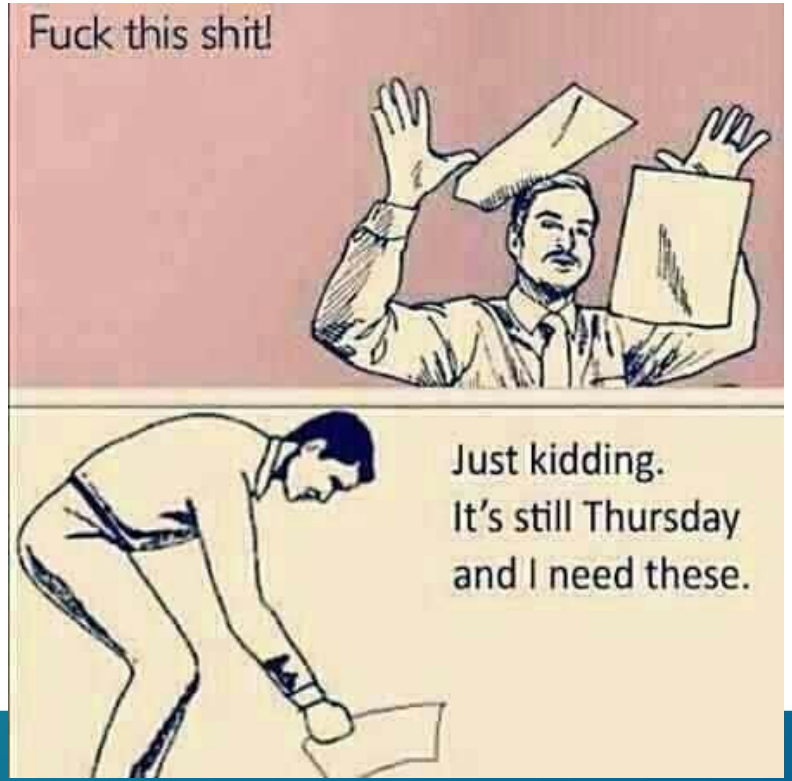
Conclusions:

- Despite weight regain in the 6 years following the competition, RMR remained suppressed at the same average levels as at the end of the weight-loss competition
- **Mean RMR after 6 years was ~500cal/day lower than EXPECTED**
- So even after 6 years with weight regain (all and then some for a few individuals) individuals were still burning fewer calories than expected….

So metabolic adaptation must be due to the weight-loss?! And is permanent?!!!!

.

So ‘Set Point’ can only go up and if I lose weight my metabolism is forever broken?!



Maybe not….

Metabolic adaptation is an illusion, only present when participants are in negative energy balance

Catia Martins,[1,2,3] Jessica Roekenes,[1] Saideh Salamati,[2] Barbara A Gower,[3] and Gary R Hunter[3]

[1]Obesity Research Group, Department of Clinical and Molecular Medicine, Faculty of Medicine and Health Sciences, Norwegian University of Science and Technology (NTNU), Trondheim, Norway; [2]Centre for Obesity and Innovation (ObeCe), Clinic of Surgery, St. Olav University Hospital, Trondheim, Norway; and [3]Department of Nutrition Sciences, University of Alabama, Birmingham, AL, USA

ABSTRACT

Background: The existence of metabolic adaptation, following weight loss, remains a controversial issue. To our knowledge, no study has evaluated the role of energy balance (EB) in modulating metabolic adaptation.

Objectives: The aim of this study was to determine if metabolic adaptation, at the level of resting metabolic rate (RMR), is modulated by participants' EB status. A secondary aim was to investigate if metabolic adaptation was associated with weight regain.

Methods: Seventy-one individuals with obesity (BMI: 34.6 ± 3.4 kg/m^2; age: 45.4 ± 8.2 y; 33 men) enrolled in a 1000-kcal/d diet for 8 wk, followed by 4 wk of weight stabilization and a 9-mo weight loss maintenance program. Body weight/composition and RMR were measured at baseline, week 9 (W9), week 13 (W13), and 1 y (1Y). Metabolic adaptation was defined as a significantly different (lower or higher) measured compared with predicted RMR.

Keywords: metabolic adaptation, adaptive thermogenesis, weight regain, resting metabolic rate, weight loss

Introduction

Weight loss is accompanied by a significant reduction in total energy expenditure due to a decrease in both resting and nonresting energy expenditure (EE) (1). Some have argued that this reduction is greater than predicted, given the measured losses in both fat mass (FM) and fat-free mass (FFM) (1–6), a mechanism known as metabolic adaptation or adaptive thermogenesis. Metabolic adaptation would then correspond to an exaggerated reduction in EE, below predicted levels, and could be a barrier to successful weight loss maintenance. However, others have reported no evidence of metabolic adaptation when weight-stable individuals who had obesity and lost weight were compared with BMI-matched controls (7–12), and to our

What did they do?!

- Recruited participants from the ASKED - Ketosis and Appetite Suppression study
  - Participants
    - 18-65 years old healthy men and women with obesity BMI >30.0
    - Weight stable, not dieting, nor using medications or other supplements to help with weight-loss
  - **Weight-loss Study (Calories IN < Calories OUT)**
    - Participants were randomized into 3 groups each following a 1000 cal/day diet for 8 weeks and each group consuming different amounts of carbs
  - **Weight Maintenance Study (Calories IN = Calories OUT)**
    - After 8 weeks they were switched to a maintenance diet for 4 weeks
      - Calorie intake was based on calculated RMR and activity levels
    - Next 9-months participants continued consuming maintenance calories

Martins, et al.

- Measured body composition, weight and RMR
  - Done at baseline, the end of week 8 of weight-loss diet, the end of week on maintenance diet, and at 1 year

SO what did they find?

Martins et al. Results

TABLE 3 Anthropometrics and RMR data at all time points (baseline, week 9, week 13, and 1 y) in a subgroup of participants ($n = 45$)

					P value				
Characteristic	Baseline	Week 9	Week 13	1 y	Baseline vs. week 9	Baseline vs. week 13	Baseline vs. 1 y	Week 9 vs. week 13	Week 13 vs. 1 y
Weight, kg	105.1 ± 14.0	90.7 ± 11.4	90.7 ± 11.5	94.8 ± 15.5	<0.001	<0.001	<0.001	0.999	0.005
FM, kg	42.6 ± 9.1	31.4 ± 8.6	30.6 ± 8.3	35.4 ± 10.6	<0.001	<0.001	<0.001	0.006	<0.001
FFM, kg	62.7 ± 10.8	59.2 ± 9.8	60.1 ± 10.1	59.4 ± 11.5	<0.001	<0.001	<0.001	0.001	0.999
RMRm, kcal/d	1884 ± 253	1665 ± 211	1732 ± 242	1790 ± 228	<0.001	<0.001	<0.001	<0.001	0.037
RMRp, kcal/d	1888 ± 216	1773 ± 190	1781 ± 195	1798 ± 224	<0.001	<0.001	<0.001	0.088	0.999
RMRm−p, kcal/d	−4 ± 122	−107 ± 102***	−49 ± 128*	−7 ± 129					

Data presented as means ± SDs. Changes over time assessed with repeated-measures ANOVA, followed by post hoc comparisons between time points with Bonferroni adjustment. Asterisks denote significant differences between measured and predicted RMR at specific timepoints by paired sample *t* tests: $^{*}P = 0.013$ and $^{***}P < 0.001$. FM, fat mass; FFM, fat-free mass; ICW, intracellular water; RMR, resting metabolic rate; RMRm, resting metabolic rate measured; RMRm−p, RMR measured minus RMR predicted; RMRp, resting metabolic rate predicted.

RMRp = Calculated RMR
RMRm = Measured RMR
RMRm - p = Difference between Calculated and Measured RMR

Martins et al. Results

- Weight-loss:
  - Average weight-loss after 8 weeks = ~14.4kg - **~1.8kg or ~4lbs/week**
  - After 4 weeks at maintenance calorie intake - **NO WEIGHT WAS GAINED**
    - Fat-Mass even declined by 0.8kg and Fat-Free-Mass increased
  - After 1-year there was ~4kg or ~9lbs weight regain
- RMR
  - Baseline: Calculated and Measured were equal
  - End of 8 week weight-loss: Measured was ~100 cals less than calculated = Metabolic Adaptation
  - End of 4 week maintenance: Measured was ~50 cals less than calculated = Still Metabolic Adaptation but improved
    - Note: Participants may have still been in small calorie deficit
  - After 1-year: Calculated and Measured were equal

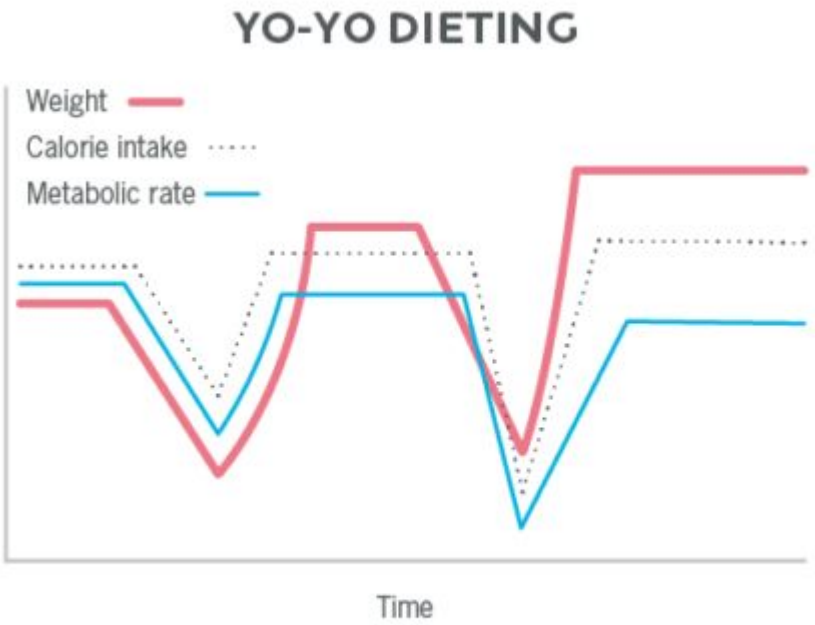
What does this mean?!

- Metabolic adaptation:
  - Not permanent
  - Has more to do with being in a calorie deficit vs. weight-loss itself
  - Does not have as much influence on weight regain as we thought

How do we explain the Biggest Loser results?!

Possible Explanation

- Yo-yo Dieting
  - Restrict-Binge Cycle
  - Metabolic rate never recovers
- Biggest Loser Competitors
  - Likely had a huge binge post competition
  - No supports post-competition
  - Back to old methods



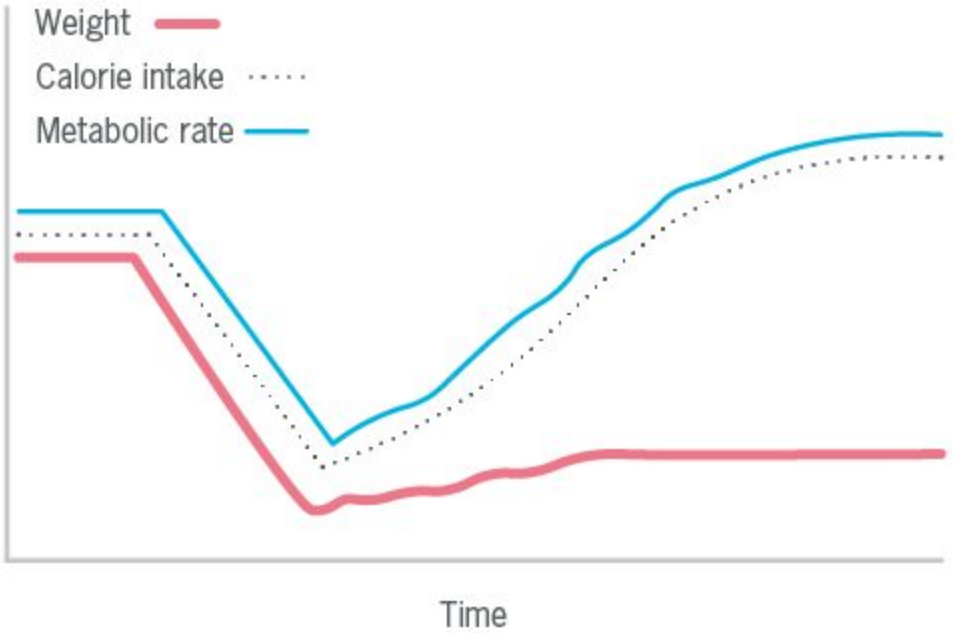
So how might we approach this issue?!

Diet Break or Reverse Dieting?!

- Reverse Dieting
  - Diet for a period of time then slowly increase your calorie intake over a period of weeks to increase metabolic rate
  - Prevent weight regain
- Diet Break
  - Period of 2-14 days where you increase your calorie intake to maintenance level
  - Goal is not gain or lose weight during this period

Caution: These are quickly becoming the next Keto/IF fad….

REVERSE DIETING



Reverse dieting helps to maintain weight loss and metabolic rate over time.

OPEN

International Journal of Obesity (2018) **42**, 129–138

www.nature.com/ijo

ORIGINAL ARTICLE

Intermittent energy restriction improves weight loss efficiency in obese men: the MATADOR study

NM Byrne[1,2], A Sainsbury[3], NA King[2], AP Hills[1,2] and RE Wood[1,2]

BACKGROUND/OBJECTIVES: The MATADOR (Minimising Adaptive Thermogenesis And Deactivating Obesity Rebound) study examined whether intermittent energy restriction (ER) improved weight loss efficiency compared with continuous ER and, if so, whether intermittent ER attenuated compensatory responses associated with ER.

SUBJECTS/METHODS: Fifty-one men with obesity were randomised to 16 weeks of either: (1) continuous (CON), or (2) intermittent (INT) ER completed as 8 × 2-week blocks of ER alternating with 7 × 2-week blocks of energy balance (30 weeks total). Forty-seven participants completed a 4-week baseline phase and commenced the intervention (CON: $N = 23$, 39.4 ± 6.8 years, 111.1 ± 9.1 kg, 34.3 ± 3.0 kg m^{-2}; INT: $N = 24$, 39.8 ± 9.5 years, 110.2 ± 13.8 kg, 34.1 ± 4.0 kg m^{-2}). During ER, energy intake was equivalent to 67% of weight maintenance requirements in both groups. Body weight, fat mass (FM), fat-free mass (FFM) and resting energy expenditure (REE) were measured throughout the study.

RESULTS: For the $N = 19$ CON and $N = 17$ INT who completed the intervention *per protocol*, weight loss was greater for INT (14.1 ± 5.6 vs 9.1 ± 2.9 kg; $P < 0.001$). INT had greater FM loss (12.3 ± 4.8 vs 8.0 ± 4.2 kg; $P < 0.01$), but FFM loss was similar (INT: 1.8 ± 1.6 vs CON: 1.2 ± 2.5 kg; $P = 0.4$). Mean weight change during the 7 × 2-week INT energy balance blocks was minimal (0.0 ± 0.3 kg). While reduction in absolute REE did not differ between groups (INT: -502 ± 481 vs CON: − 624 ± 557 kJ d^{-1}; $P = 0.5$), after adjusting for changes in body composition, it was significantly lower in INT (INT: − 360 ± 502 vs CON: − 749 ± 498 kJ d^{-1}; $P < 0.05$).

CONCLUSIONS: Greater weight and fat loss was achieved with intermittent ER. Interrupting ER with energy balance 'rest periods' may reduce compensatory metabolic responses and, in turn, improve weight loss efficiency.

International Journal of Obesity (2018) **42,** 129–138; doi:10.1038/ijo.2017.206

MATADOR Study

- 51 males who had Obesity BMI >30.0 were randomized to 2 groups
  - Group 1:
    - Continuous Energy Restriction daily for 16 weeks
  - Group 2:
    - Intermittent Energy Restriction for 16 weeks as 8 x 2-week blocks with 7 x 2-week blocks at maintenance calories - total of 30 weeks
      - Example: 2 weeks of energy restriction THEN 2 weeks of maintenance…..
- Both groups then completed a post weight-loss energy balance phase for 8 weeks and another follow-up was done 6-months later
- Notes:
  - Calorie deficit was 33% below TDEE
  - All food was provided

Byrne et al., Results

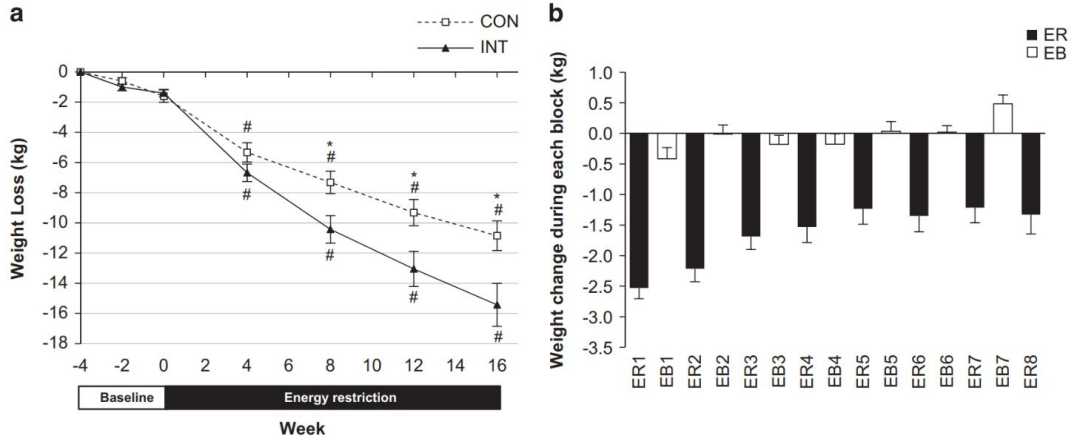
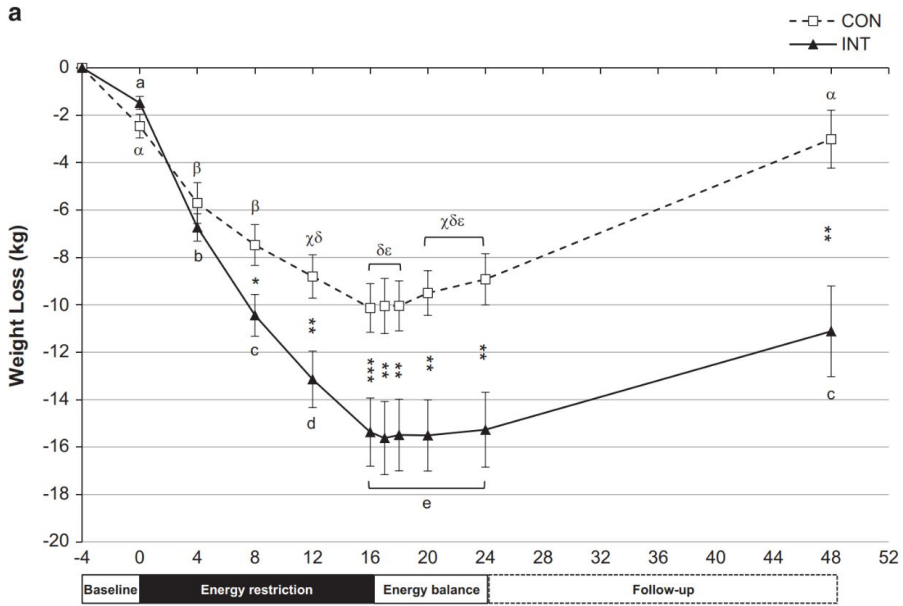


Figure 1. Changes in body weight (kg; mean ± s.e.m.) during baseline and 16 weeks of energy restriction (ER) in the continuous (CON; $N = 19$) and intermittent (INT; $N = 17$) groups. (**a**) Cumulative weight change (kg) over baseline (−4, − 2, 0 weeks) and after 4, 8, 12 and 16 weeks of ER for the CON and INT groups. *Significant difference between groups; $P < 0.05$. #Significant difference from baseline within-group; $P < 0.01$. (**b**) Weight change (kg; mean ± s.e.m.) in the intermittent energy restriction (INT) group during each of the 8 × 2-week energy restriction (ER) and 7 × 2-week energy balance (EB) blocks that comprised the 30-week intervention. Data are from participant-reported weights measured at home ($N = 20$ except $N = 19$ for ER5, EB5, EB6, ER7 and EB7, and $N = 17$ for ER8). Weight change is calculated as the difference in weight measured from Day 1 of one block (for example, ER1) to Day 1 of the subsequent block (for example, EB1). Participants were instructed to record weight daily throughout the study. The majority (80% or 256/312) of measurements were taken on Day 1 of the block (as instructed), and 93% (299/312) of measurements were taken within ± 1 day of Day 1.

Byrne et al., Results



Byrne et al., Results

- Intermittent Energy Restriction vs. Continuous Energy Restriction
  - Weight-loss: **-14.1kg vs. 9.1kg**
  - Fat-mass loss: **-12.3kg vs. -8.0kg**
  - Fat-free-mass loss: **-1.8kg vs. 1.2kg**
  - Reduction in RMR: **-360cals vs. -749cals**
  - Weight-loss maintained at 6-months: **-13.9kg vs. 7.7kg**

Conclusion:

- Greater weight-loss and attenuation of Metabolic Adaptation?

MATADOR Limitations

- High drop-out rate?
- Intermittent energy group did see greater weight-loss than expected in the first 4-weeks indicating possible calculation/measurement errors
- No activity was included
- Protein intake was on the lower side 15-20% of macros

Overall, there are a few things that could be optimized and given the study more power!

Conclusions

- Metabolic Adaptation:
  - Due to a calorie deficit vs. weight-loss
  - Not an illusion but has a smaller role than originally thought in weight regain
  - No starvation mode or broken metabolism
- Eat more to lose more?!
  - 1200 calorie/day diets still don’t work
  - Diet breaks and reverse dieting the future of obesity management
- Debunking Set Point Theory?

How can you use this information?!

References

1. Fothergill, E. *et al.* Persistent metabolic adaptation 6 years after The Biggest Loser competition. doi:10.1002/oby.21538.

2. Martins, C., Roekenes, J., Salamati, S., Gower, B. A. & Hunter, G. R. Metabolic adaptation is an illusion, only present when participants are in negative energy balance. *Am. J. Clin. Nutr.* **112**, 1212–1218 (2020).

3. NM, B., A, S., NA, K., AP, H. & RE, W. Intermittent energy restriction improves weight loss efficiency in obese men: the MATADOR study. *Int. J. Obes. (Lond).* **42**, 129–138 (2018).

4. Martins, C., Dutton, G. R., Hunter, G. R. & Gower, B. A. Revisiting the Compensatory Theory as an explanatory model for relapse in obesity management. *Am. J. Clin. Nutr.* **112**, 1170–1179 (2020).

Future Events

How much am I supposed to eat for weight-loss?! Calories, and Protein the King of the Macronutrients! - Exclusive Event $5/ticket

Are my medications causing me to gain weight?

Exercise the NOT so holy grail of weight-loss?!

Let's connect!
Where to find me: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