

Why is it So Hard to Lose Weight and Keep it off?

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Erroneous Weight Loss Projections



Calories In & Out are NOT Independent



Feedback Regulation of Body Weight



Feedback Regulation of Body Weight



Mathematical Modeling of Metabolism



KD Hall. *Am J Physiol* 298: E449–66 (2010) KD Hall et al. *The Lancet* 378:826-37 (2011)

Switch to Expert Mode

Step 1 of 4 - Enter your starting information

Starting Information				
U.S. Units		Met	ric Units	
Weight	190			lbs
Sex	Female			•
Age	30			yrs
Height	5	ft.	7	in.
Physical	1.6			
Activity Level	Estimate Your Level			
Next Step 😁				

Starting Information

Enter your starting information, including your weight, sex, age, height, and physical activity level.

Physical Activity Level

Click the "Estimate Your Level" button to find your physical activity level.

Typical physical activity level numbers range from 1.4 (sedentary) to 2.5 (very active).

The default value of 1.6 describes someone who does very light activity at school or work (mostly sitting) and moderate physical activity (such as walking or cycling) at least once a week.

BWplanner.niddk.nih.gov

Disclaimer: This information is for use in adults defined as individuals 18 years of age or older and not by younger people, or pregnant or breastfeeding women. This information is not intended to provide medical advice. A health care provider who has examined you and knows your medical history is the best

KD Hall et al. The Lancet 378:826-37 (2011)



Biggest Loser Body Weight and Fat Loss



KD Hall. *Obesity* 21(5):957-9 (2013)



KD Hall. Obesity 21(5):957-9 (2013)

11



Mean ± SD

KD Hall. Obesity 21(5):957-9 (2013)





KD Hall. Obesity 21(5):957-9 (2013)

13





KD Hall. *Obesity* 21(5):957-9 (2013)

14

Metabolic Rate before the Biggest Loser



DL Johannsen et al. JCEM 97(7):2489–2496 (2012)

Metabolic Rate after the Biggest Loser



DL Johannsen et al. JCEM 97(7):2489–2496 (2012)

ENCE OF FAT

After 'The Biggest Loser,' Their Bodies Fought to Regain Weight

Contestants lost hundreds of pounds during Season 8, but gained them back. A study of their struggles helps explain why so many people fail to keep off the weight they lose.

By GINA KOLATA MAY 2, 2016

















Two Thirds of the Lost Weight was Regained 6 Years Later



E Fothergill et al. Obesity 24:1612-1619 (2016)

Weight Regain was <u>Unrelated</u> to Metabolic Slowing at the End of the Competition



E Fothergill et al. Obesity 24:1612-1619 (2016)

Resting Metabolic Rate Remained Low 6 Years Later



*p <0.05 vs. baseline

E Fothergill et al. Obesity 24:1612-1619 (2016)

<u>Less</u> Weight was Regained in those with the <u>Greatest</u> Metabolic Slowing



E Fothergill et al. Obesity 24:1612-1619 (2016)

What Explains the Weight Regain?



J Kerns et al. Obesity 25(11):1838-1843 (2017)

Those with the Greatest Increase in Physical Activity Regained Less Weight



Spring Model of Metabolic Slowing



Spring Model of Metabolic Slowing



Spring Model of Metabolic Slowing



Feedback Regulation of Body Weight



D. Polidori, A. Sanghvi, R. Seeley, K.D. Hall. Obesity, 24:2289 (2016)

Intensive Calorie Restriction Intervention



J Guo et al. Am J Clin Nutr 107:558–65 (2018).

Corresponding Energy Balance Dynamics



J Guo et al. Am J Clin Nutr 107:558–65 (2018).

Interpreting Lifestyle Weight Loss



J Guo et al. Am J Clin Nutr 107:558-65 (2018).

Large & Persistent Perceived Effort



J Guo et al. Am J Clin Nutr 107:558–65 (2018).

New Rule: 55 kcal/d per lb (120 kcal/d per kg)

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The physiological adaptations to weight loss that decrease calorie expenditure and increase appetite require a new rule of thumb relating diet calories to weight loss: 55 kcal/d per pound or 120 kcal/d per kg

New Rule: 55 kcal/d per lb (120 kcal/d per kg)

For example, a patient who initially cuts 500 kcal per day from their diet and sustains a constant effort to adhere to the intervention would be expected to lose only about 9 lbs in total (500 kcal/d divided by 55 kcal/d/lb) with no further weight losses after the ~1 year plateau.

The Promise of Low Carb Diets



Carbohydrate-Insulin Model of Obesity

Excessive anabolic drive in adipose tissue



"a high-carbohydrate diet ... produces postprandial hyperinsulinemia, promotes deposition of calories in fat cells instead of oxidation in lean tissues, and thereby predisposes to weight gain through increased hunger, slowing metabolic rate, or both."

DS Ludwig & CB Ebbeling JAMA Intern Med 178:1098-1103 (2018).

Energy Expenditure: Isocaloric Carb vs. Fat



Weighted Mean Difference in Energy Expenditure (kcal/d)

Testing the Calorie Intake Predictions of the Carbohydrate Insulin Model





ClinicalTrials.gov NCT03878108

Insulin Levels were Much Higher After Low Fat Meals



Mean ± SE

NutriXiv Preprint: https://osf.io/preprints/nutrixiv/rdjfb/

Less Calorie Intake on the Low Fat Diet



NutriXiv Preprint: https://osf.io/preprints/nutrixiv/rdjfb/

<u>More</u> Body Fat Loss on the Low Fat Diet



Mean ± SE

NutriXiv Preprint: https://osf.io/preprints/nutrixiv/rdjfb/

No Differences in Self-Reported Appetite



Mean ± SE

NutriXiv Preprint: <u>https://osf.io/preprints/nutrixiv/rdjfb/</u>

No Differences in Pleasantness or Familiarity



Mean ± SE

NutriXiv Preprint: <u>https://osf.io/preprints/nutrixiv/rdjfb/</u>

Carb Carb Fat

Can We Transcend the Diet Wars?



Dietary Quality of Food Purchases



Moubarac et al. Can J Diet Pract Res. 75:15-21 (2014)

Diet Quality & Ultra-processed Food



Unprocessed or minimally processed foods include fresh, dried, or frozen vegetables, grains, legumes, fruits, meats, fish, eggs, and milk. They are the basis of healthy dishes and meals.

Ultra-processed foods include fast food, sugary drinks, snacks, chips, candies, cookies, sweetened milk products, sweetened cereals, and sauce and dressings. They are nutritionally poor.

Ultra-processed vs Unprocessed Diets





The meals had similar amounts of: Calories, Carbs, Fat, Protein, Sugar, Sodium, Fiber

20 Adults were instructed to eat as much or as little as desired

Primary Outcome: Energy Intake Differences

Ultra-processed Diets Cause Increased Intake

 $\Delta EI = 508 \pm 106 \text{ kcal/d}; P=0.0001$



KD Hall et al. Cell Metabolism 30:1-11 (2019).

Ultra-processed Diets Cause Body Fat Gain



KD Hall et al. Cell Metabolism 30:1-11 (2019).

More Carbs & Fat with Ultra-processed Diets



∆EI = 508 ± 106 kcal/d; P=0.0001

No Differences in Self-Reported Appetite



No Differences in Pleasantness or Familiarity



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- Reengineering your food environment may help facilitate maintenance of lost weight
- Less ultra-processed foods with lower energy density

Intramural NIH

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