Breezing metabolic rate tracker
Study Cases

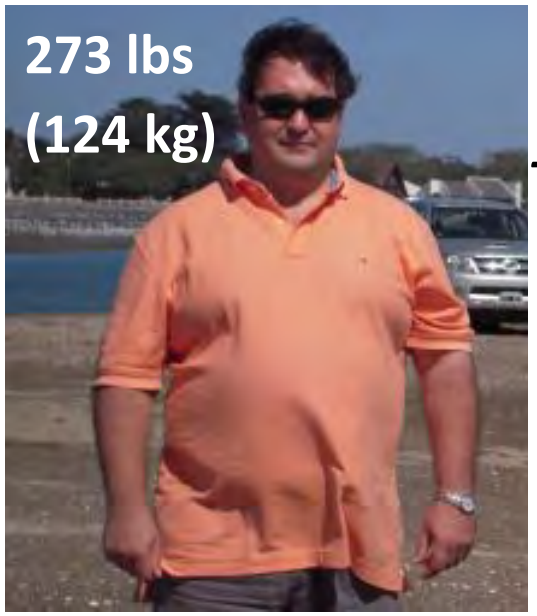
www.breezing.com

Case #1: Gabriel P.'s case

176 lbs
(80 kg)

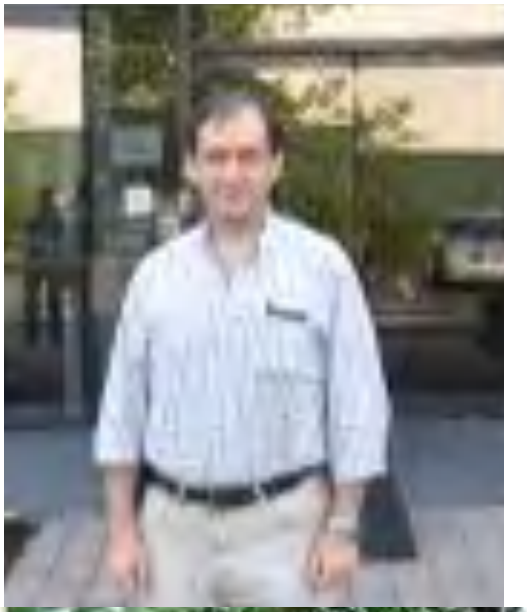
+5 years

+ 97 lbs
(+ 44 kg)



+ 2 years

- 88 lbs
(- 40 kg)

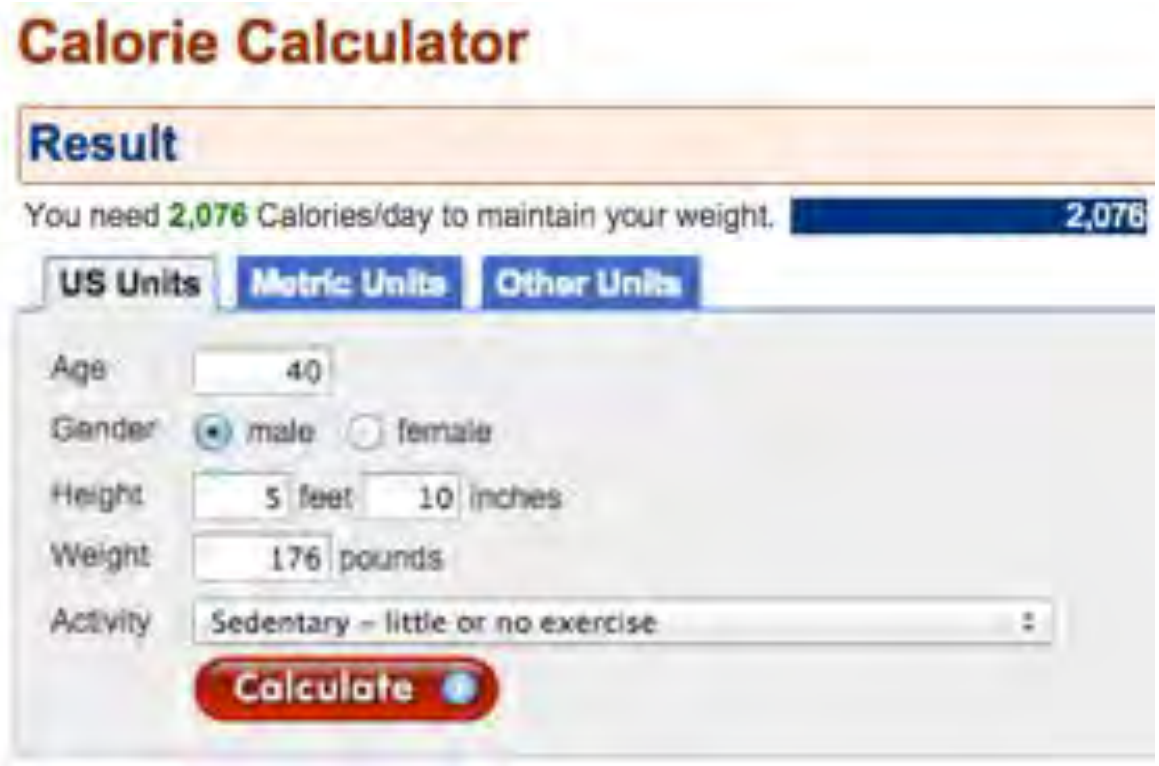


185 lbs
(84 kg)

#1 Why did Gabriel gain 97 lbs (44 kg)?

#2 How did Gabriel lose 88 lbs (40 kg)?

Why did Gabriel gain 97 lbs (44 kg) in years?



- **He used a calorie calculator to estimate Total Burn: 2100 kCal/day**

Mifflin - St Jeor equation: Man:

REE(M-StJ) = [10 * weight (kg)] + [6.25 * height (cm)] - [5 * age (y)] + 5

Why did Gabriel gain 97 lbs (44 kg) in years?

176 lbs

80 kg

+5 years

+ 97 lbs

+ 44 kg

Estimated Total Burn: 2100 kcal/day

First True Total Burn: 1900 kcal/day

Difference **Estimated - True Burn**: **200 kCal/day**

How does this difference translate to weight?

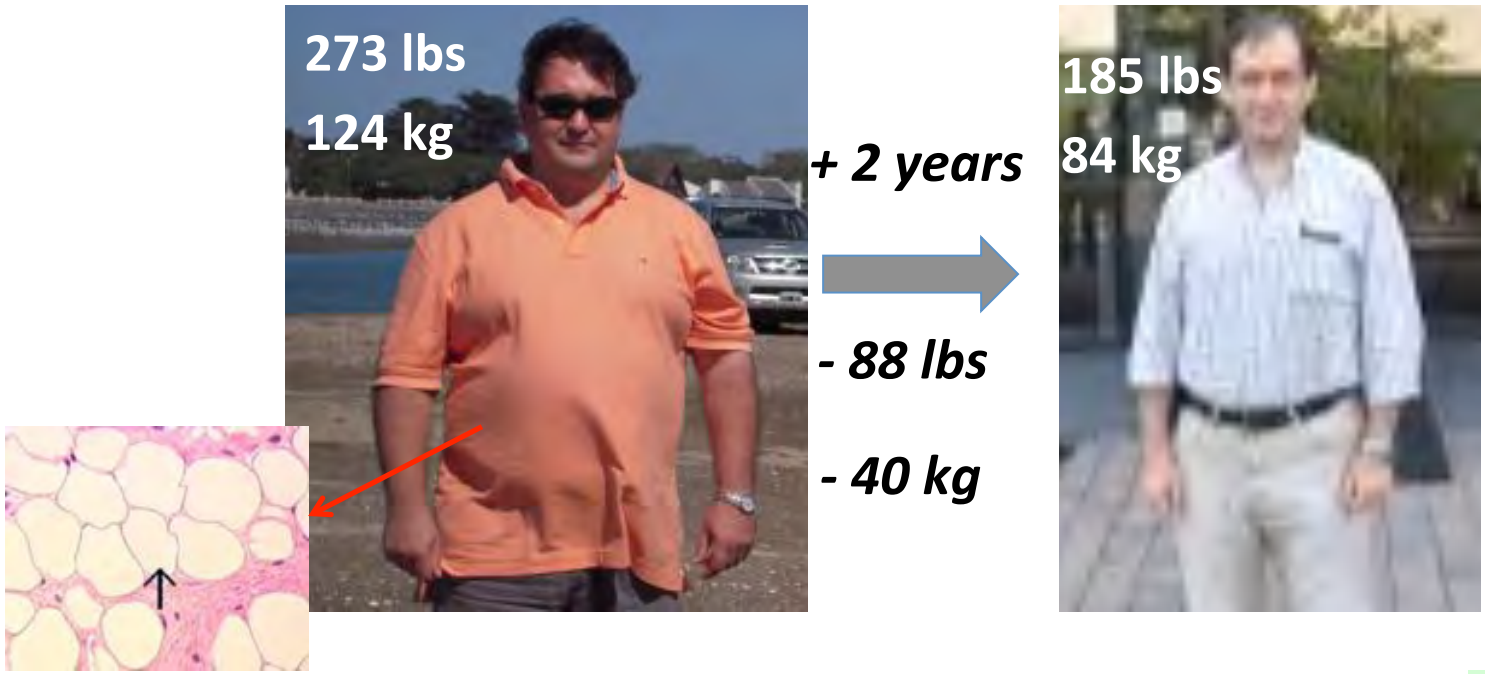
[(200(kCal/day)*7*52weeks/year)]/[3500kCal/lbs]=

+ 20 lbs/year

The knowledge of measuring Energy Expenditure was a key point for Gabriel to explained why he gained weight

5 yrs. → ~100 lbs Total ~ 45 kg

How did Gabriel lose 88 lbs (40 kg)?*



Energy Balance Equation

Initial approach

Energy Storage = Energy Intake - Total Energy Expenditure

- 500 kcal/day ~ 1400 kcal/day - 1900 kcal/day

Gabriel expected a deficit of 3500 kcal per week → equivalent to a loss of 1 lb per week (52 lbs/year). Gabriel actual weight loss was 44lbs/year, a total of 88 lbs in 2 years

*Dr. Pablo Pelegri (MD), Dr. Liliana Balsells (MD), Buenos Aires, Argentina; Breezing's user experience team.

Energy Balance Equation Components

Energy Storage = Energy Intake - Total Energy Expenditure

- 500 kcal/day ~ 1400 kcal/day - 1900 kcal/day

The knowledge of Resting Energy Expenditure was a key point for Gabriel

=

-

[

+

]

Resting (89%) **Activity**

1700 kcal/day 200 kcal/day

Resting Energy Expenditure represents a large percentage (75-95%) of Total Energy Expenditure

History of Measuring Energy Expenditure

1770's

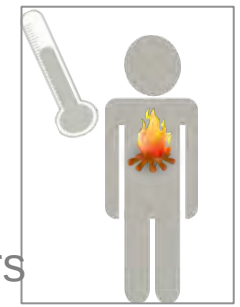
Lavoisier & Laplace

Law of the conservation of energy → First Human Calorimetry

1890's

Atwater & Rosa

Wesleyan Univ.: First important work of Direct Calorimetry



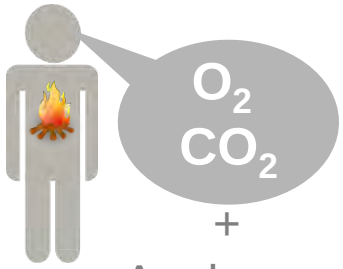
\+ Analyzers

1900's

Other Direct Calorimetry Efforts:

Airflow, water flow, water storage, and gradient layer calorimeter

Claude Douglas: Gold Standard Indirect Calorimetry Method



\+ Analyzers

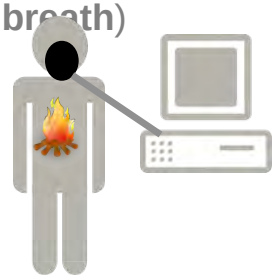
1940

Indirect Calorimetry: Open circuit spirometry

12 lbs

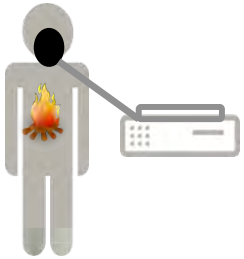
1980

Indirect calorimetry: Computer-based Instrumentation (**Breath-by-breath**)

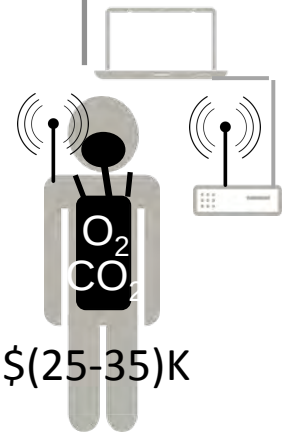


2000

Portable Breath-by-Breath Instrumentation



2010



$(25-35)K

2014

Breezing

$350

Resting Energy Expenditure or Resting Metabolic Rate

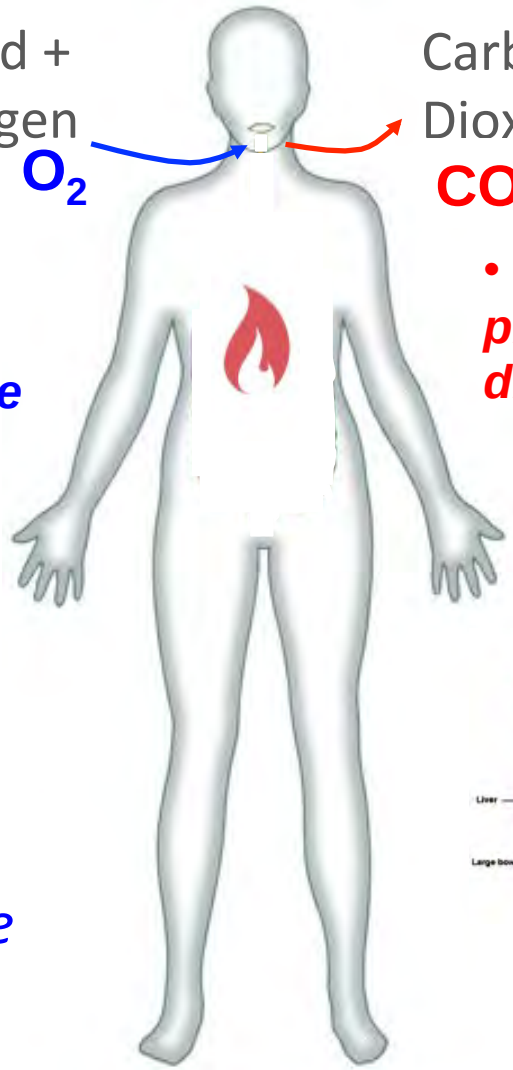
Food + Oxygen

O_2

Carbon Dioxide

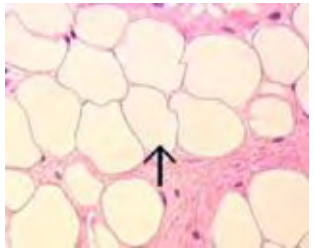
CO_2

+ ATP (heat), storage



- ***VO_2 consumed oxygen rate***

- ***VCO_2 produced carbon dioxide rate***



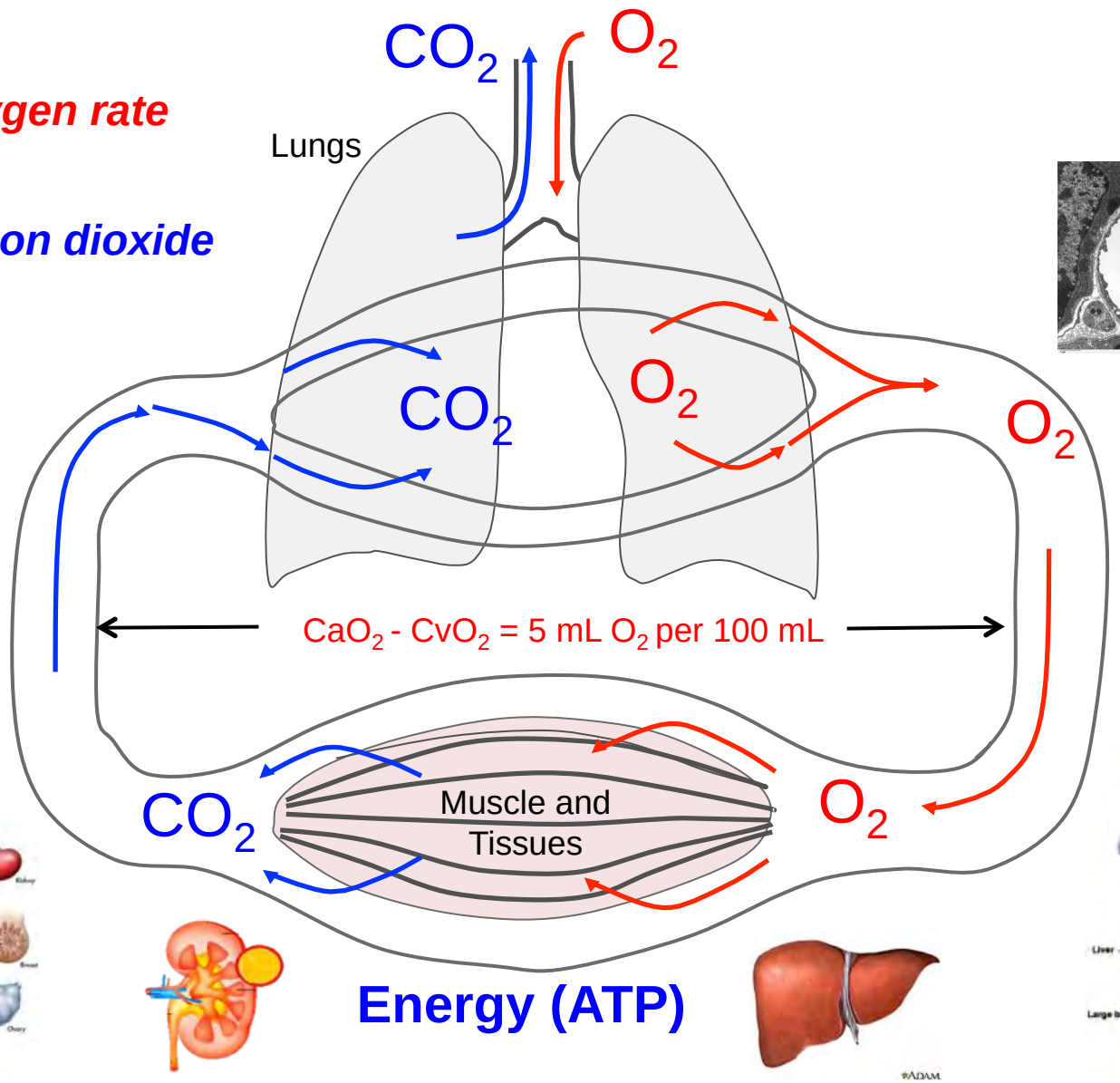
REE or RMR or Resting Metabolism or Resting Calories:

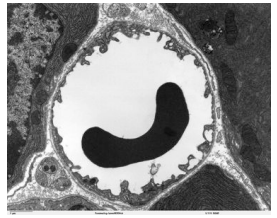
✓ *Sustain life*

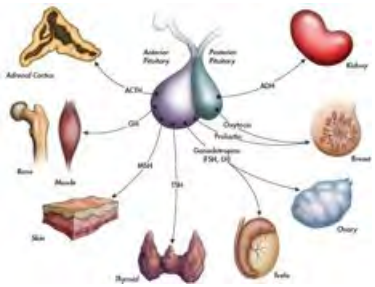
✓ *Our main expenditure from total energy expenditure in a day*

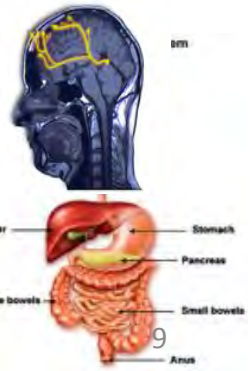
Energy management: Cardio-Pulmonary System

- ***VO_2***
consumed oxygen rate
- ***VCO_2***
produced carbon dioxide









Resting Energy Expenditure: Indirect Calorimetry Principle

Weir Equation:

$$REE\ (kCal/day) = [3.9\ (VO_2) + 1.1\ (VCO_2)] \times 1.44$$

VO_2: consumed oxygen rate (mL/min)
VCO_2: produced carbon dioxide rate (mL/min)

Weir, J. B. D. (**1949**). "New Methods For Calculating Metabolic Rate With Special Reference To Protein Metabolism." Journal Of Physiology-London **109**(1-2): 1-9.

Weir, J. B. D. (**1990**). "Nutrition Metabolism Classic - New Methods For Calculating Metabolic-Rate With Special Reference To Protein-Metabolism." Nutrition **6**(3): 213-221.

Tracker for Resting Energy Expenditure (REE) or Resting Metabolic Rate

Global Journal of Obesity, Diabetes and Metabolic Syndrome

Peertechz

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Research Article

Personalized Indirect Calorimeterfor Energy Expenditure (EE) Measurement

Abstract

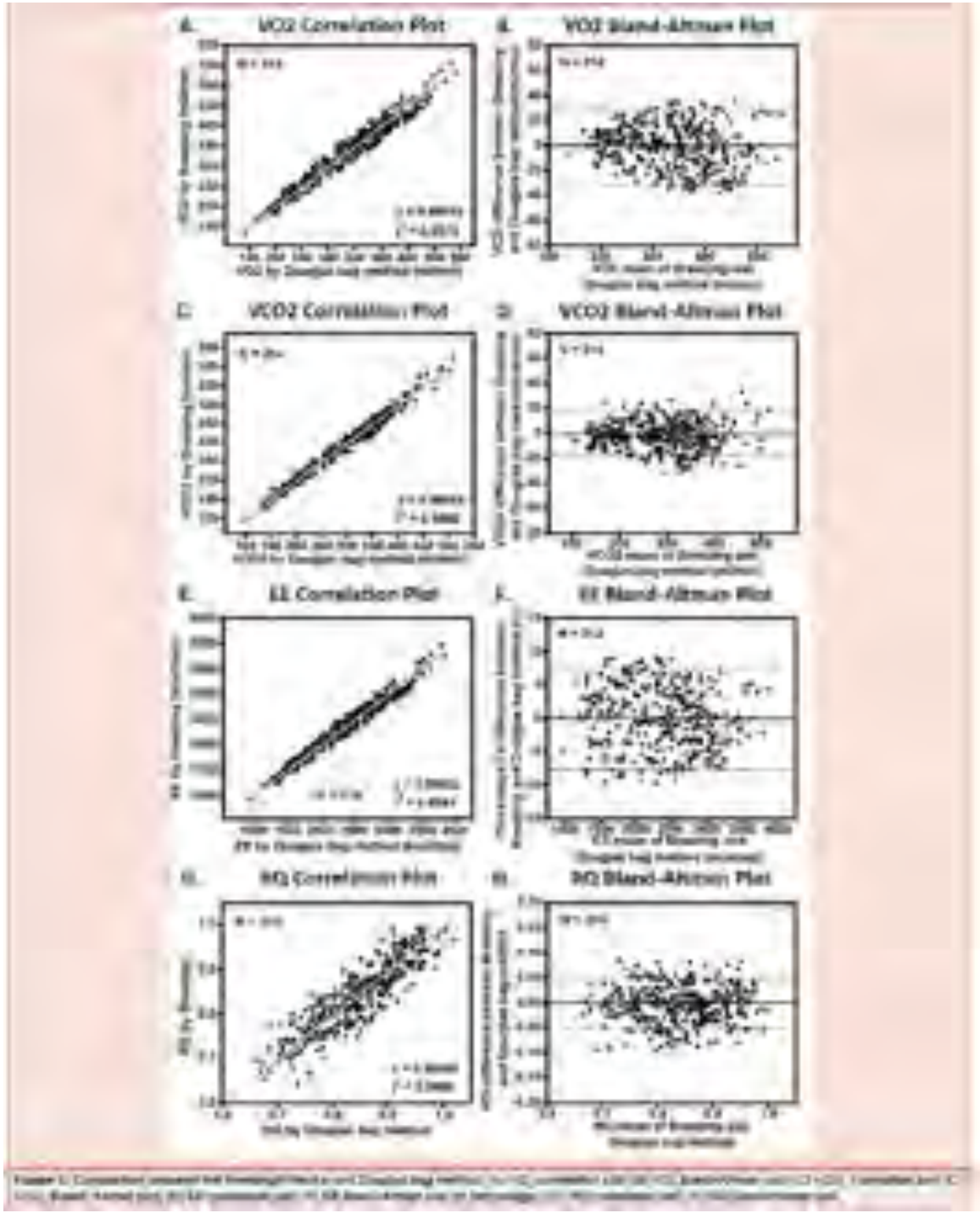
Background and aims: A personal indirect calorimeter allows everyone to assess resting and non-resting energy expenditure, thus enabling accurate determination of a person's total calorie need for weight management and fitness. The aim of this study is to compare the performance of a new personal metabolic rate tracker based on indirect calorimetry, Breezing®, with the Douglas bag method, the gold standard method for energy expenditure (EE) measurement.

Methods: Energy expenditures (EE) at rest and during activities, and respiratory quotient (RQ) were measured for 12 healthy subjects, including 7 males and 5 females under different living conditions. A total of 314 measurements were performed with Breezing®, and the results were compared with those by the Douglas bag method.

Results: R-squared correlation coefficients (R^2) between the data obtained with Breezing® and the Douglas bag method were 0.9976, 0.9986, 0.9981, and 0.9980, for VO_2, VCO_2, EE, and RQ respectively.

Conclusions: The EE and RQ values determined by Breezing® are in good agreement with those by the Douglas bag method.

GJODMS, March, 2015

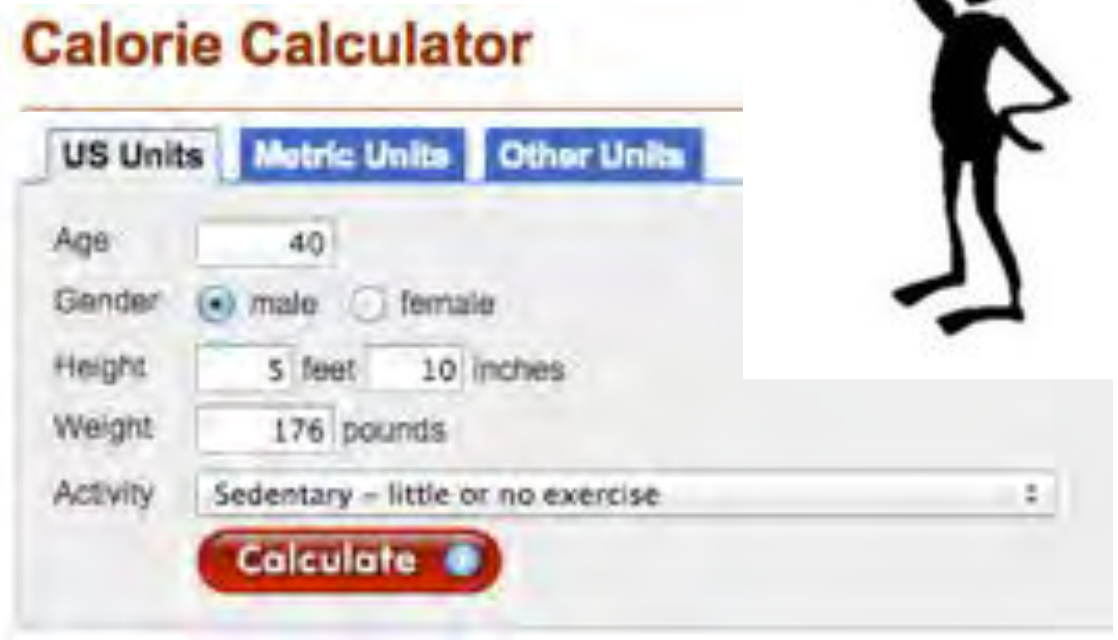


Breezing

✓ *The Tracker for Energy Expenditure (EE) demonstrated ~100% accuracy*

GJODMS, March, 2015

How many cases like Gabriel are out there?



Study Case #2 – Pilot study with overweight/obese population

THE UNIVERSITY OF ARIZONA COLLEGE OF MEDICINE

FLINN FOUNDATION

Dr. Craig Stump, MD

Table 1. Physical characteristics of recruited study participants. Means +/- (SD)

Physical Parameters	Age	Weight (kg)	Height (m)	BMI (kg/m²)	W/H	Fat%	Sys BP	Dias BP
CG (n=20) F:14, M:6	54 (7)	102 (20)	1.68 (0.08)	36 (6)	0.88 (0.10)	44 (8)	127 (14)	81 (7)
IG (n=20) F:17, M:3	57 (13)	92 (14)	1.64 (0.10)	34 (6)	0.85 (0.06)	44 (6)	132 (20)	85 (14)
Normal range	N/A	N/A	N/A	18.5-24.9	N/A	N/A	N/A	N/A

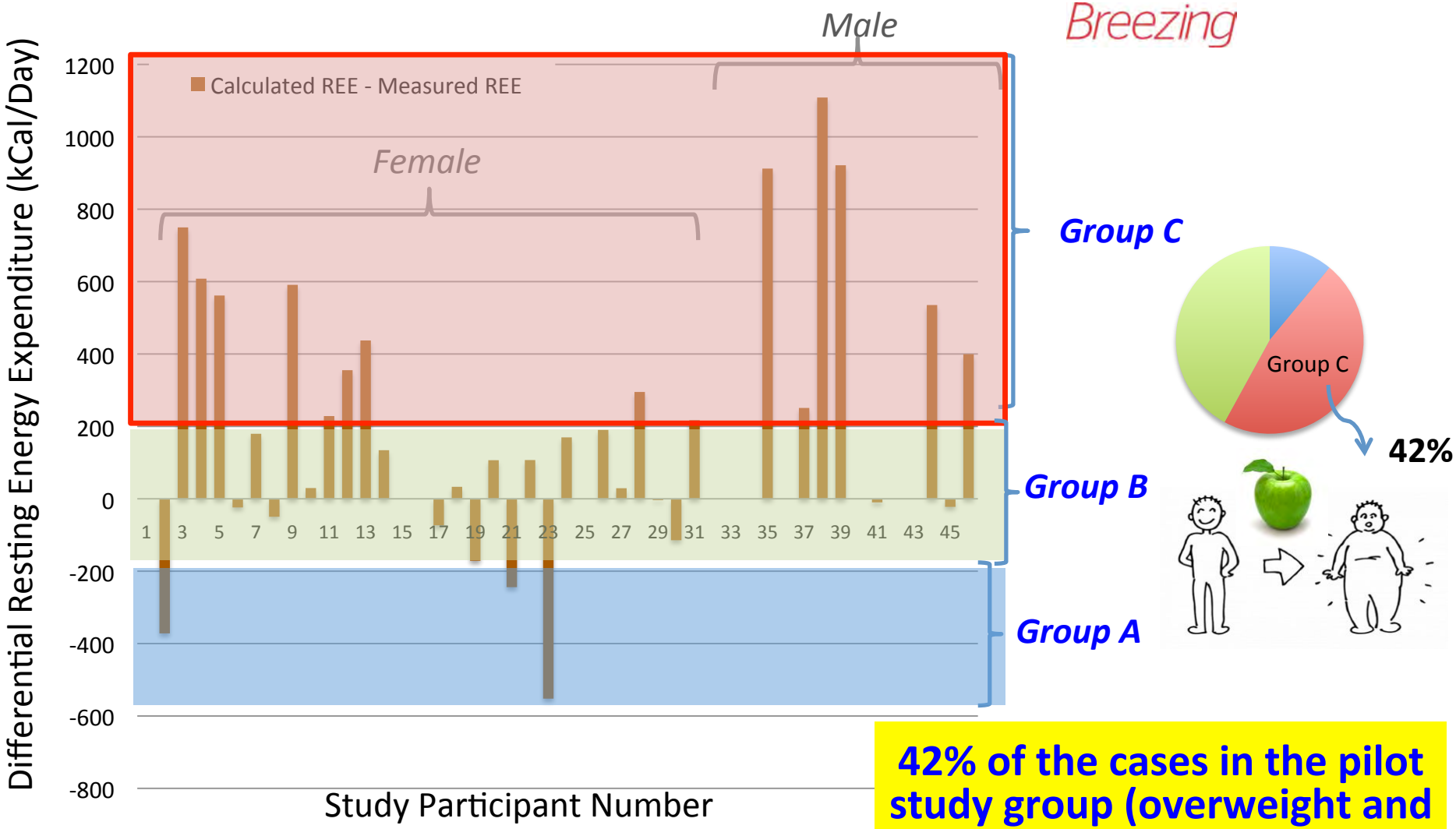
BMI: body mass index., Waist to hip ratio: W/H ratio, Body fat percentage: Fat%, Blood pressure: BP, Sys BP: systolic BP, Dias BP: diastolic BP.

Table 2. Metabolic and blood parameters of recruited study participants. Means +/- (SD)

Parameter	REE (kCal/d)	Gluc. (mg/dL)	Glyc. Hb (%)	Trigly. (mg/dL)	Chol. (mg/dL)	LDL (mg/dL)	HDL (mg/dL)	LDL/HDL	DHRI
CG (n=20) F:14, M:6	1420 (300)	109 (33)	6.6 (1.1)	148 (65)	208 (33)	130 (37)	52 (11)	2.8 (1.3)	6/11= 54%
IG (n=20) F:17, M:3	1570 (280)	111 (27)	6.7 (1.5)	120 (42)	200 (36)	130 (37)	51 (9)	2.7 (1.0)	7/12= 58%
Normal range	N/A	70-105	<6.0	0-169	0-200	0-99	>38	1.3-4.7	

REE: resting energy expenditure, Gluc.: glucose, Glyc Hb: glycosylated Hemoglobin, Trigly : trygliceride, Chol: cholesterol., DHRI: Diabetes High Risk Index, percentage a new cases discovered with Glyc Hb levels higher than 6.0%.

Difference of Calculated REE* – True (measured) REE



42% of the cases in the pilot study group (overweight and T2 diabetes) had slow metabolic rates like Gabriel

* Predictive Equation

Dr. Craig Stump, MD

THE UNIVERSITY OF ARIZONA | COLLEGE OF MEDICINE | FLINN FOUNDATION

What about pregnancy?

To learn more watch:
https://www.youtube.com/watch?v=tHS-pegE_gQ

Study case #3: Resting Energy Expenditure during pregnancy*

How does the profile connect to other body parameters?

*Dr. Corrie Whisner, American Society of Nutrition's Public Information Committee

* D. Jackemeyer, BSW, Application Scientist, Arizona State University

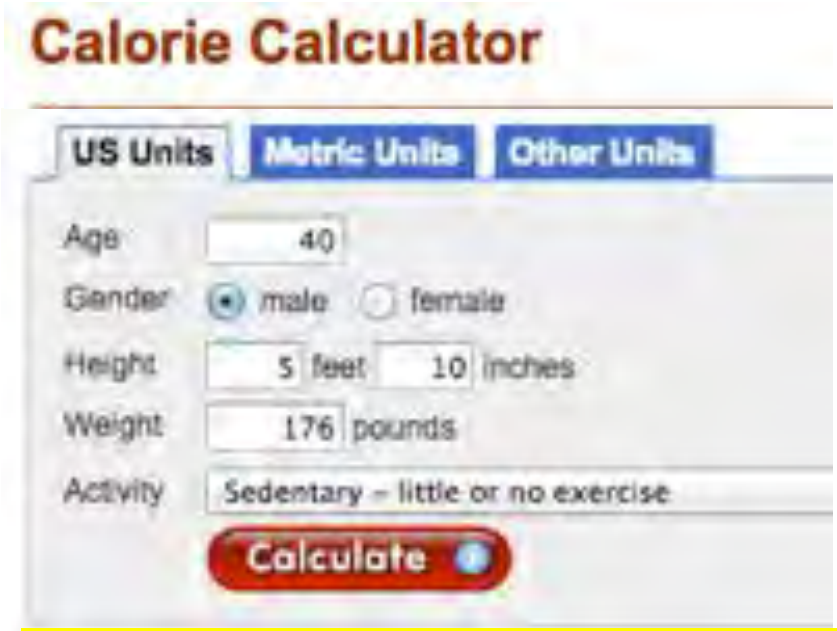
Comparison of REE with Weight

Mifflin - St Jeor equation:

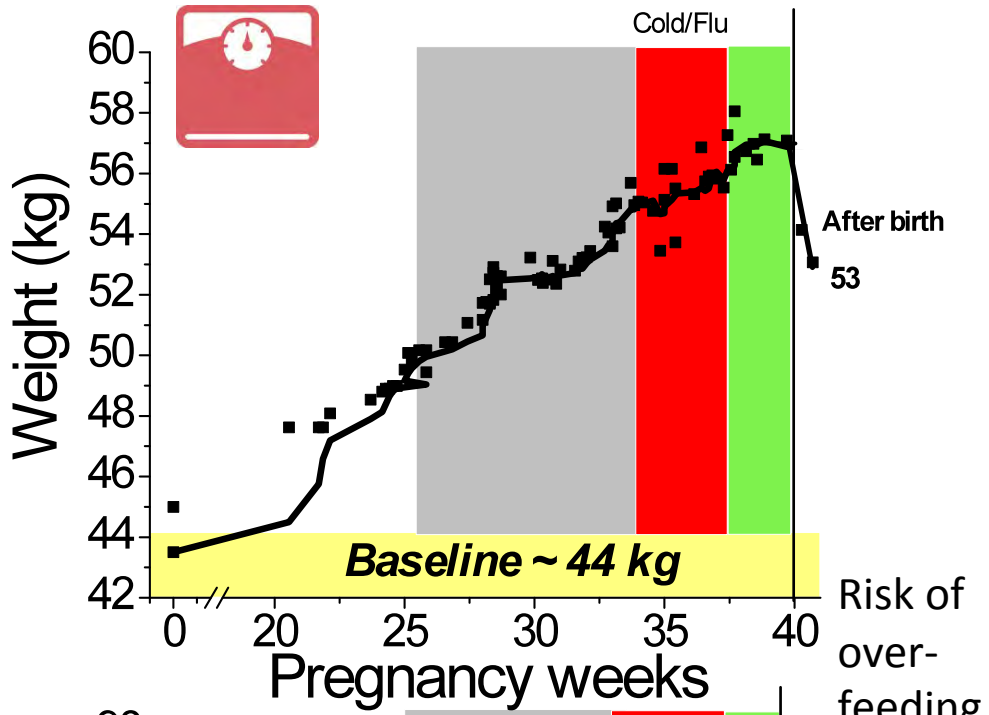
✗

Woman:

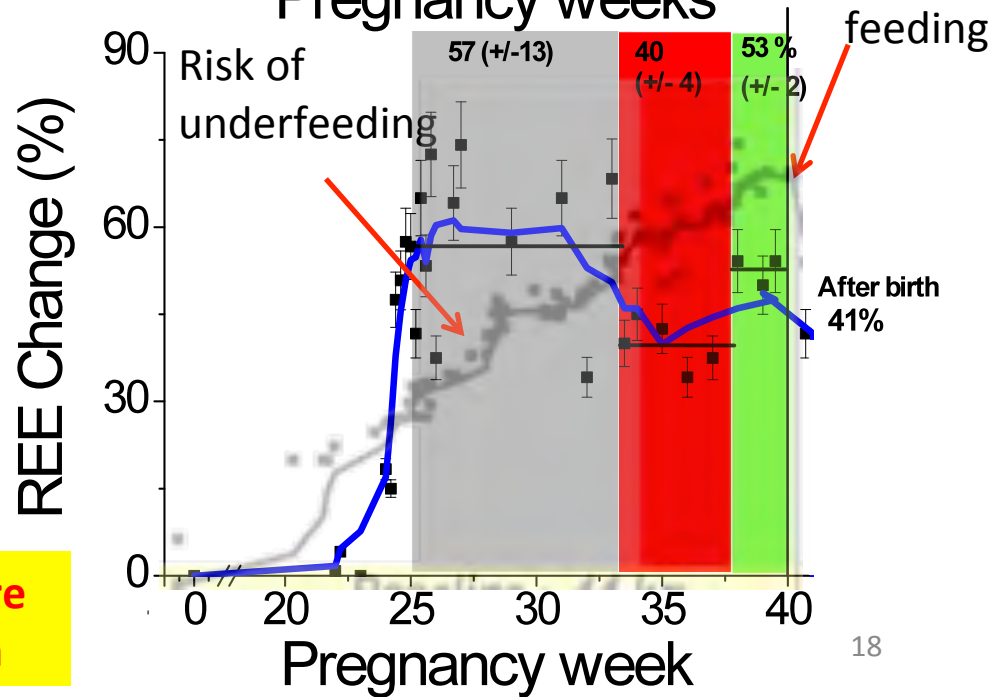
REE(M-StJ) = [10 * weight (kg)] + [6.25 * height (cm)] - [5 * age (y)] - 161



REE does not follow the simple math of more mass more metabolic rate from an Equation



Risk of over-feeding

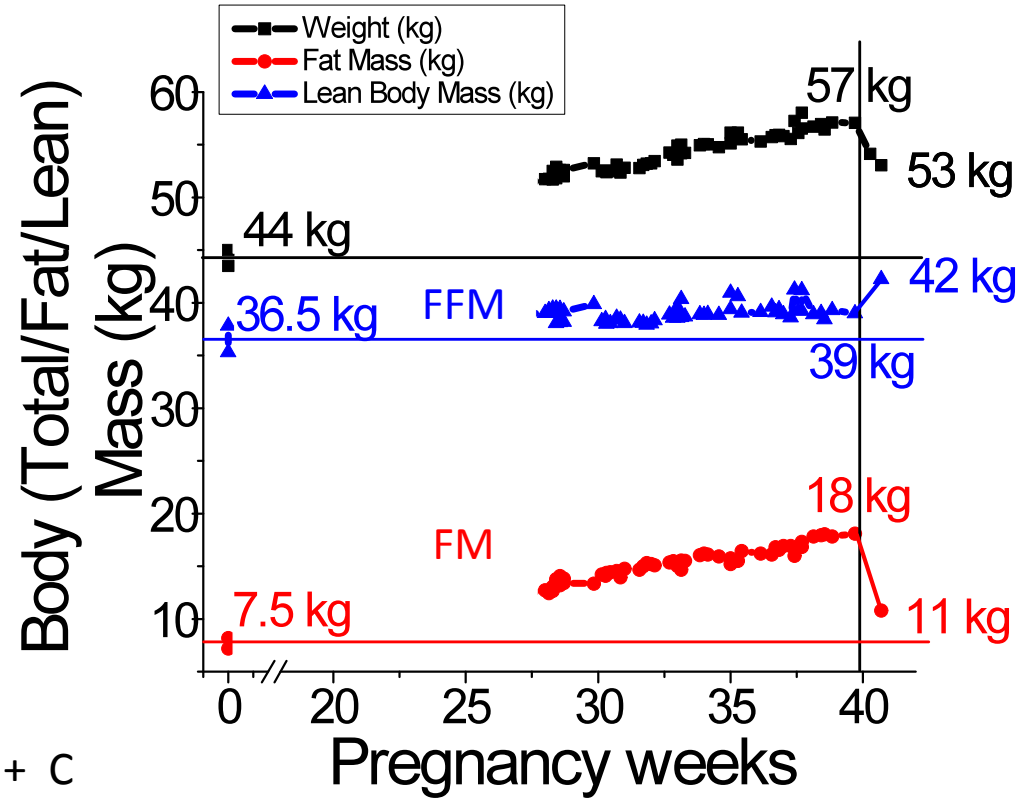


Comparison of REE with Body Composition

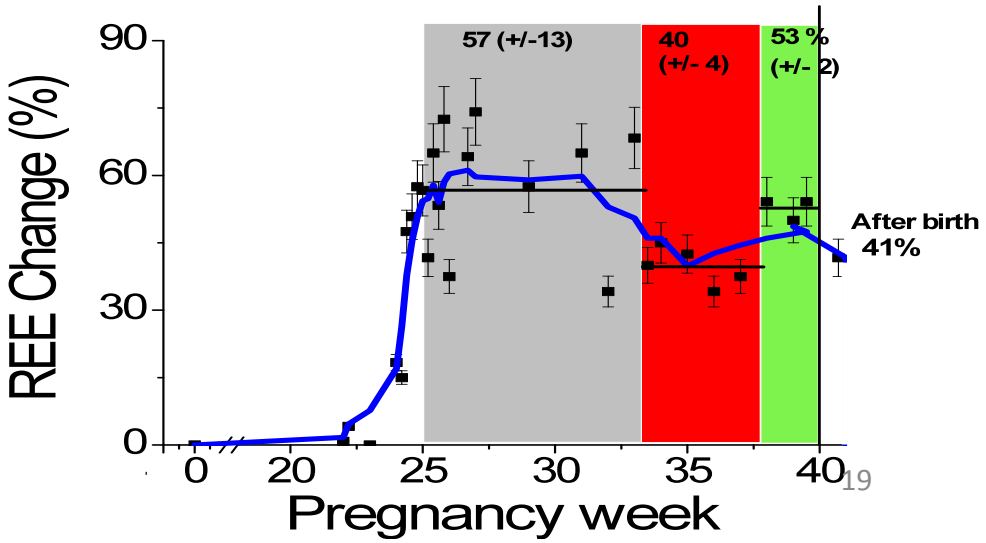
Mifflin - St Jeor equation: ✗

Woman:

REE(M-StJ) = [A * FFM (kg)] + [B * FM (kg)] + C



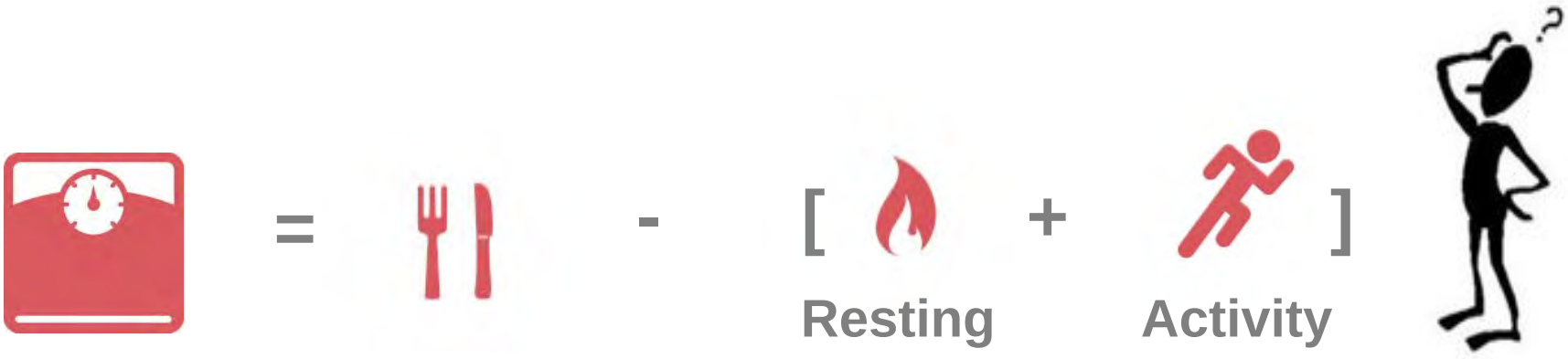
REE does not follow the simple math of more mass the more Free Fat Mass (FFM) or more Fat Mass (FM), the more metabolic rate from an equation.



“ The use of predicative equations for estimating REE are only ESTIMATIONS”

“We are much more complex as individuals and the complexity is addressed only with a breath-based REE measurement”

Can we bring other cases to show the energy equation really works?



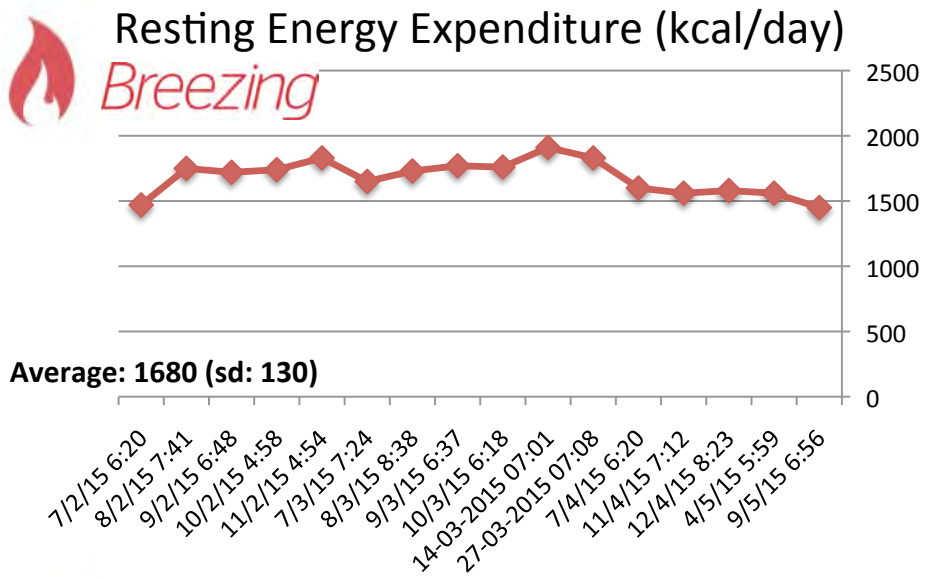
Study Case #4 – Weight management in sports*

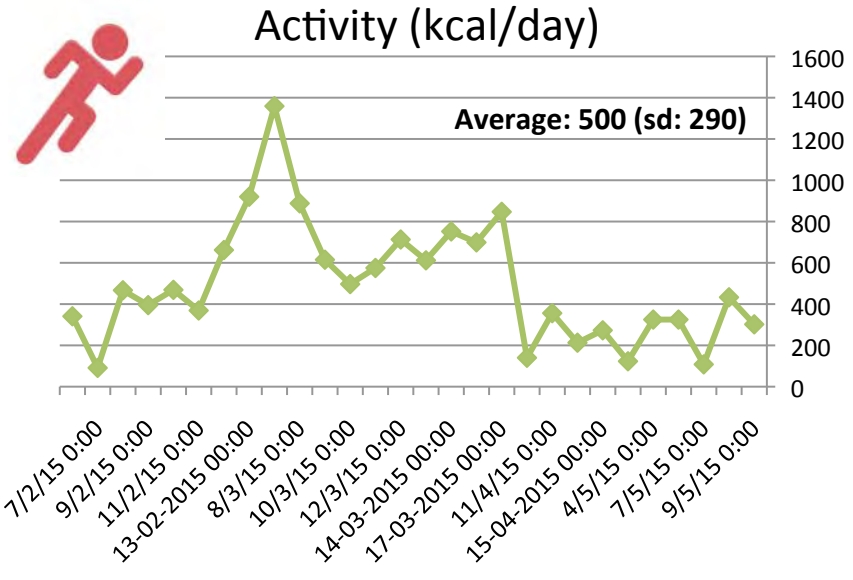
Emily's goal:

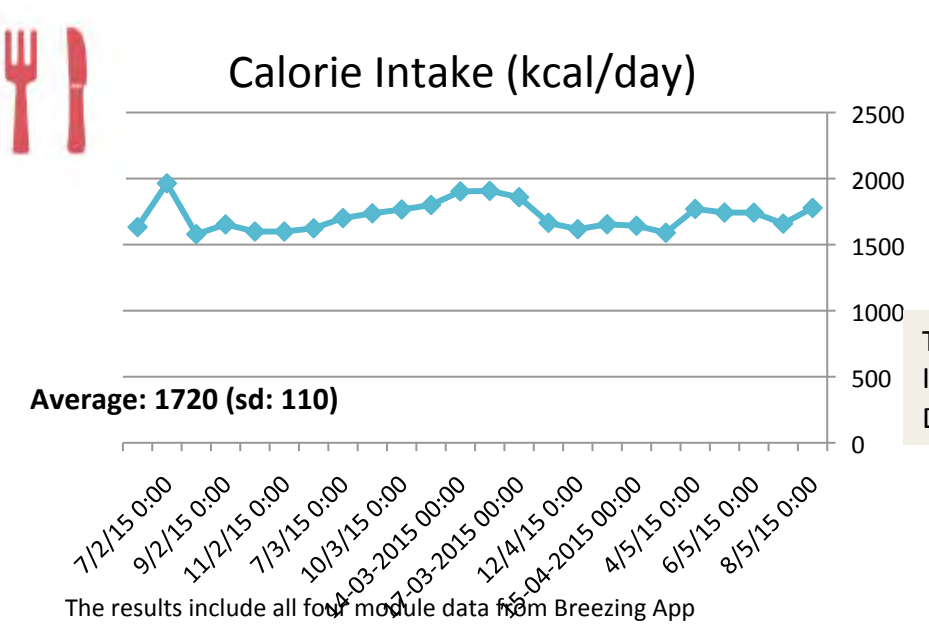
- **Needed to lose 10 lbs** to reach 160 lbs by the competition day on April 16th (**2 months**)

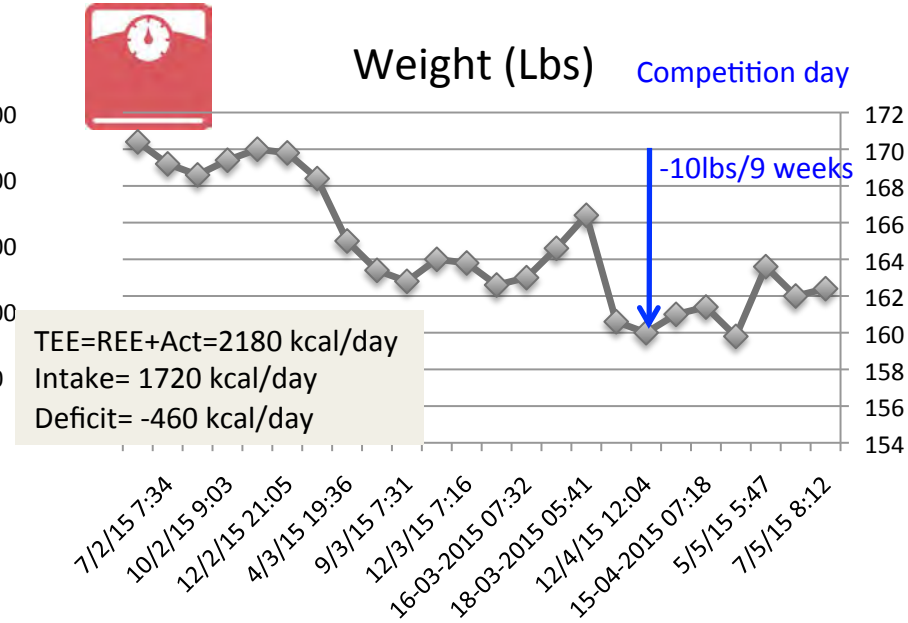
* Rich Wenner, athletes' coach & Amber Yudell, nutritionist, Arizona State University

Study Case #4 – Weight management in sports









The results include all four module data from Breezing App
Resting Energy Expenditure (REE) (indirect calorimetry)
Diet (manually entered), and assessed with MyFitnessPal

Activity (manually entered), and assessed with HR monitor (PulseONE)
Weight (manually entered)

Study Case #4 – Weight management in sports

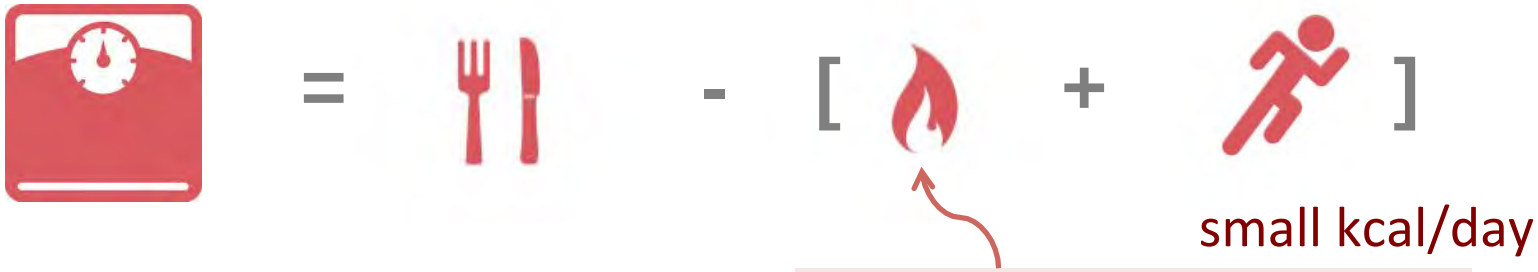
Emily J achieved her weight goal of 160 lbs in 2 months, and her life's weightlifting record (70 kg, 5Kg over previous personal record)!

She can rescue someone with her own weight now!

http://instagify.com/media/980460235926117550_1581604454

Study Case #5 – Weight management in Hypothyroidism

Case with Cytomel (Thyroid T3) - 25mcg/day



~ - 600 kcal/day

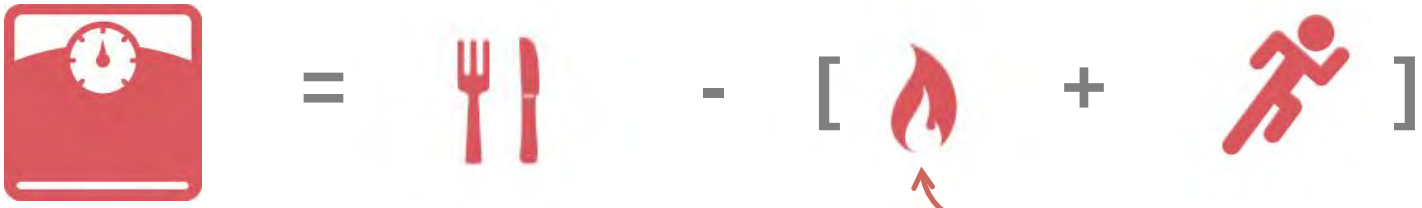
2050 kcal/day

REE measure from before:
2600 kcal/day

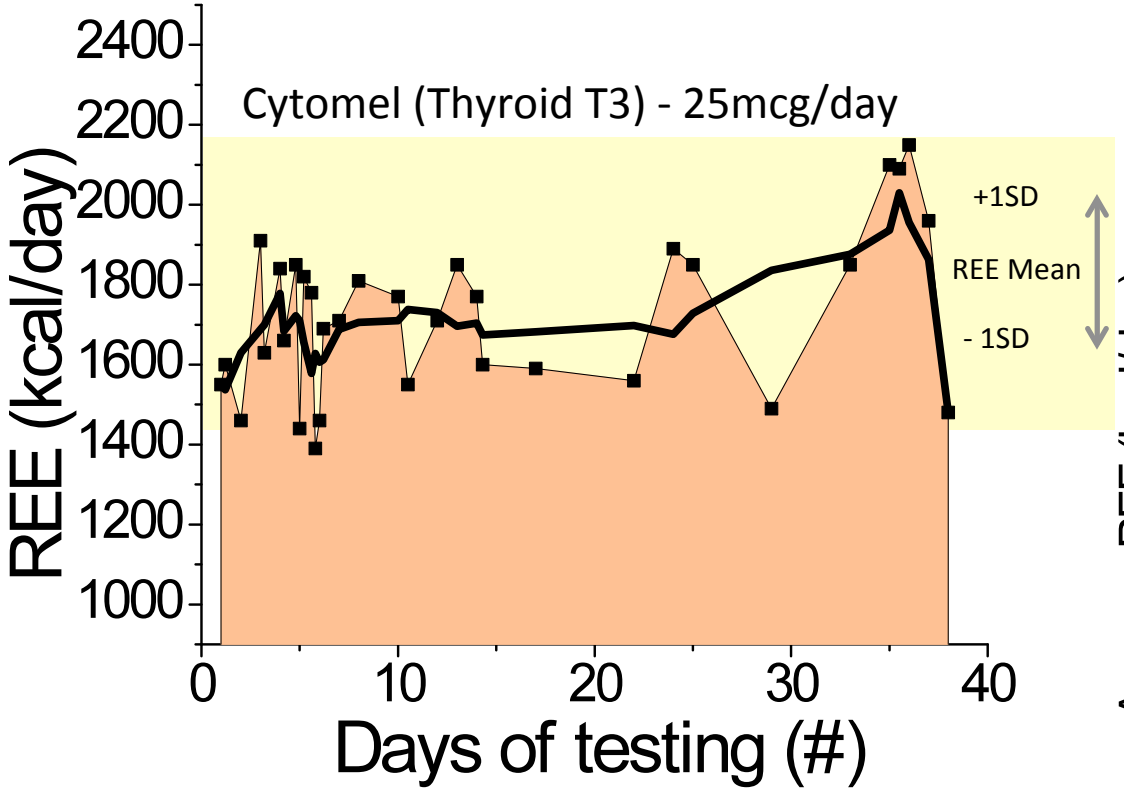
✓ The user thought that he should be losing weight!

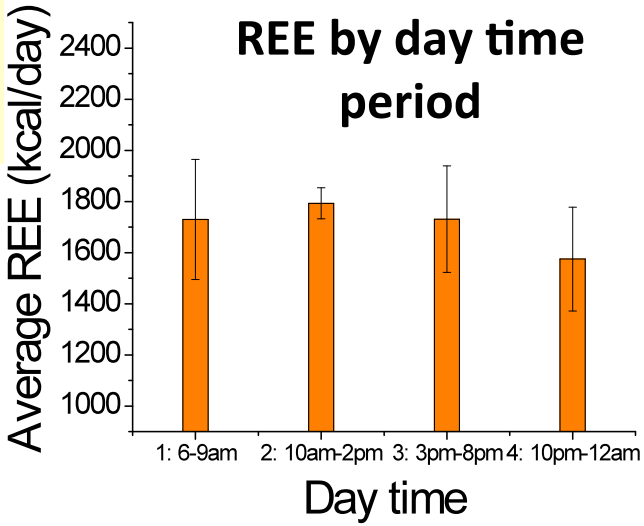
Study Case #5 – Weight management in Hypothyroidism*

Resting Metabolic Rate (kcal/day) from Feb. 2nd to March 26th 2015 – Total: 52 days



REE Mean: 1730 kcal/day (SD: 200)
Relative Variability (68prob., = +/-1SD): +/- 11.5%



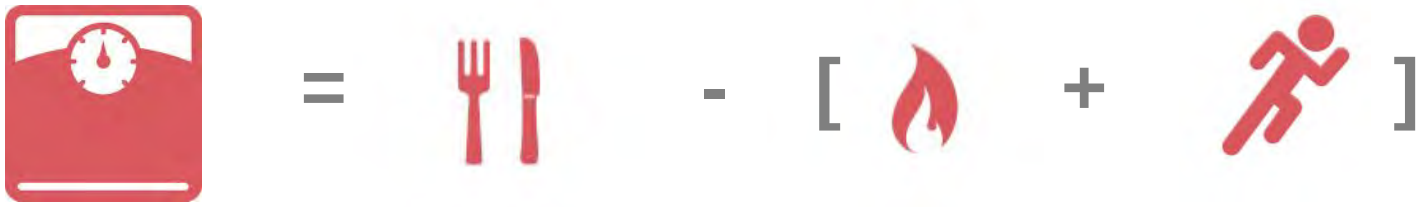


✓ High variability was observed due to the use of fast release of T3 hormone

✓ Despite this variability (caused by T3 hormone), an average REE value could still be defined

* Breezing's user experience team. Advise from Dr. John Henried, MD, Sacramento, CA

Applying REE measure to Energy Balance

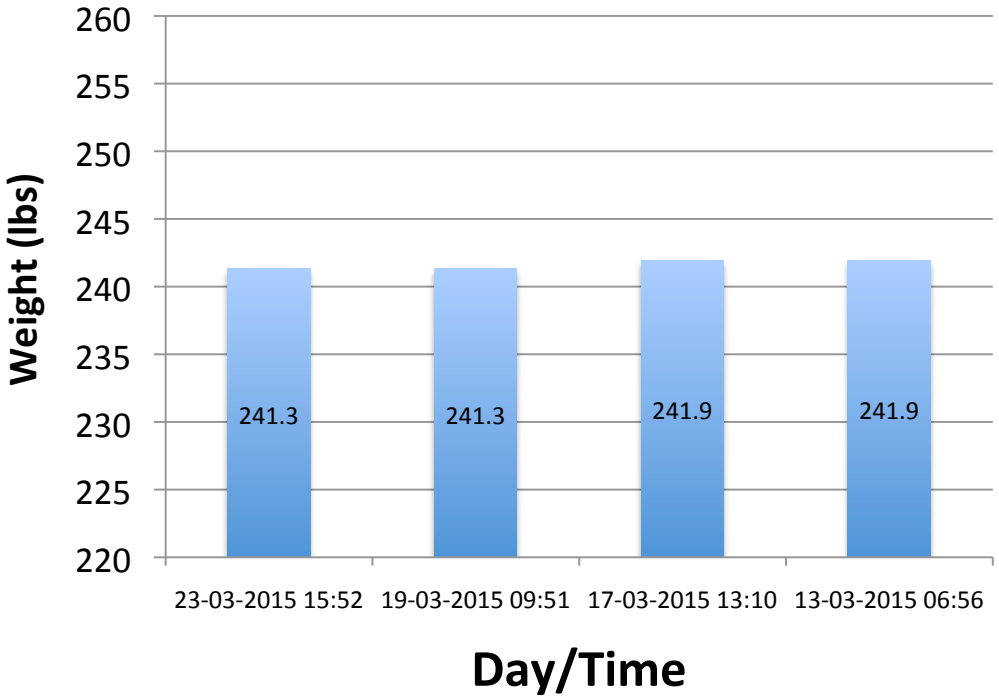


1730 kcal/day 100 kcal/day

0 kcal/day ~ 2050 kcal/day - 1830 kcal/day (+/- 200 kCal/day)

Expected weight maintenance

Weight Profile



✓ Weight profile showed less than 2% change → Energy balance corroboration

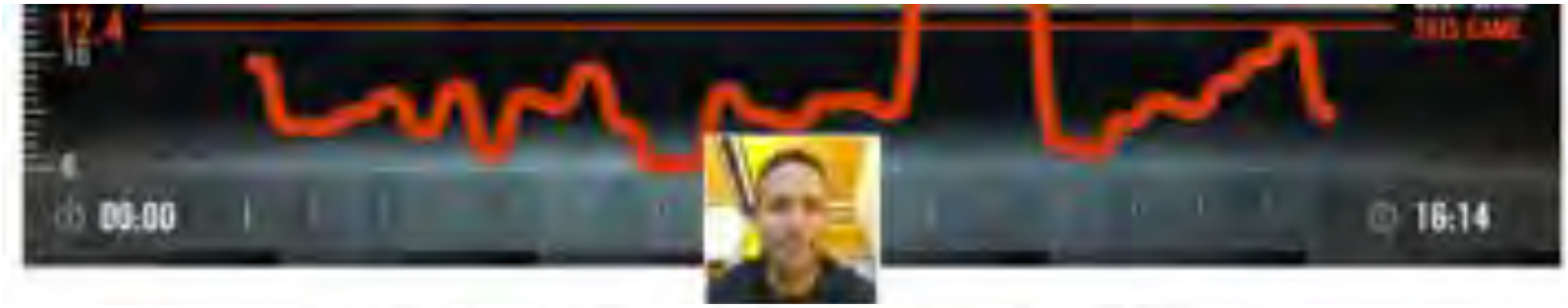
✓ The REE average values adjusted the energy balance equation, despite the potential hormonal variability.

Action: the user was switched to a slow release thyroid hormone to control the T3 levels in blood to avoid spikes due to fast release

How the use of equations to estimate REE is affecting users of activity trackers or calorie counters?

- **Reference to read:**

Check: Linkedin/David Jackemeyer



Calorie-calculator models (Mifflin by MyfitnessPal e.g.) should not be used for Weight Management

https://www.linkedin.com/pulse/calorie-calculator-models-mifflin-myfitnesspal-eg-used-jackemeyer?trk=prof-post

Good news

- **You can breathe and measure REE with** Breezing

- **Once you know your actual REE, you will be able to recalibrate your activity trackers, and adjust your calorie intake apps to better achieve your goals**

Study case #6: Long-Term Resting Energy Expenditure monitoring on Ketogenic Diets

Diet A: Ketogenic diet- higher fat:

Intake: 1800 cal/day,
Fat: 1250 cal (140g),
Protein: 360 cal (90g),
Carb: 180 cal (45g).

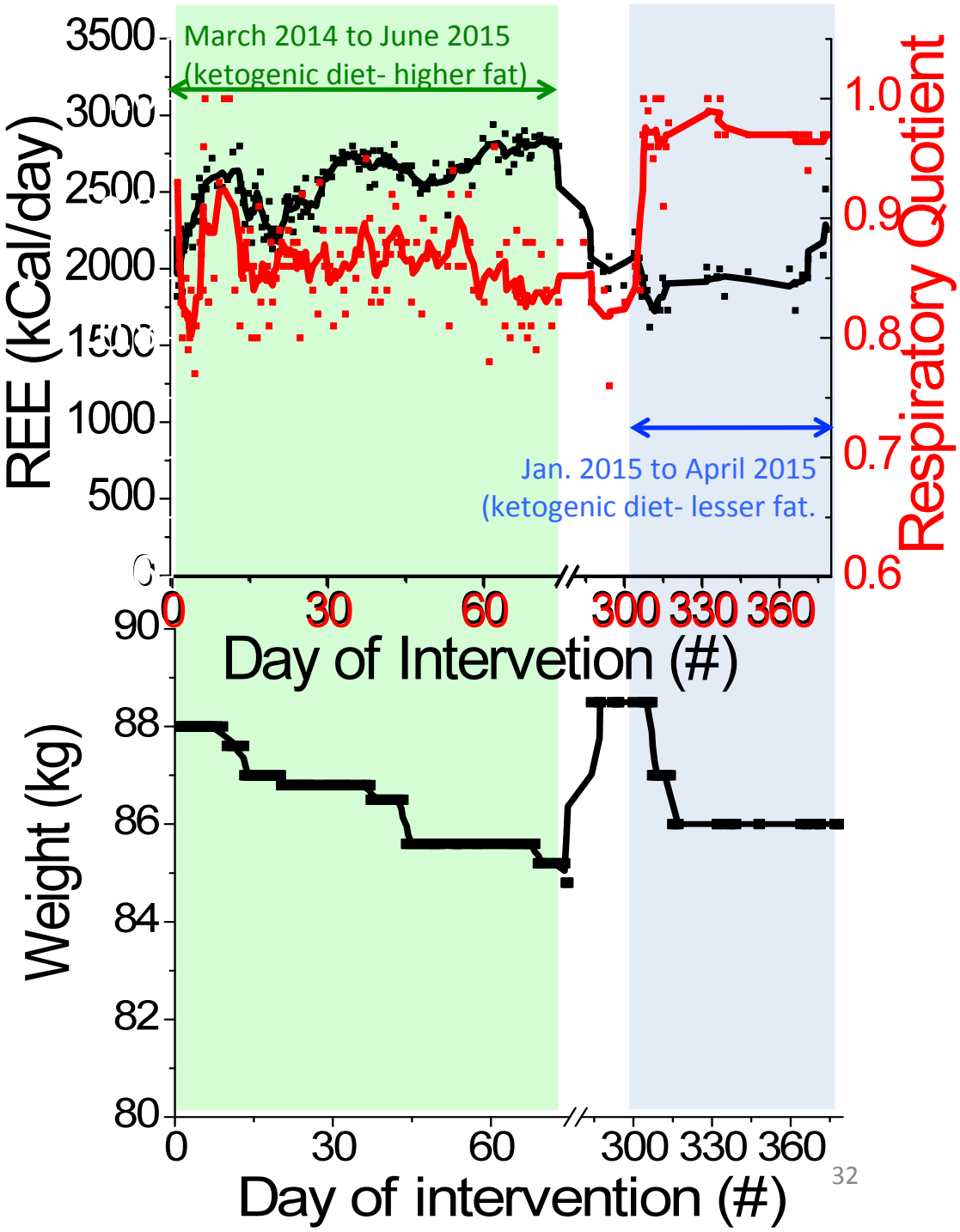
Diet B: Ketogenic diet- lesser fat:

Intake: 1200 – 1400 cal/day
Fat: 75 g,
Protein: 80g,
Carb: 5 days 50 g, 2 days 100g.

Diet A increased metabolic rate above 2,000 kcal/day level, and Respiratory Quotient (RQ) reflected diet composition.

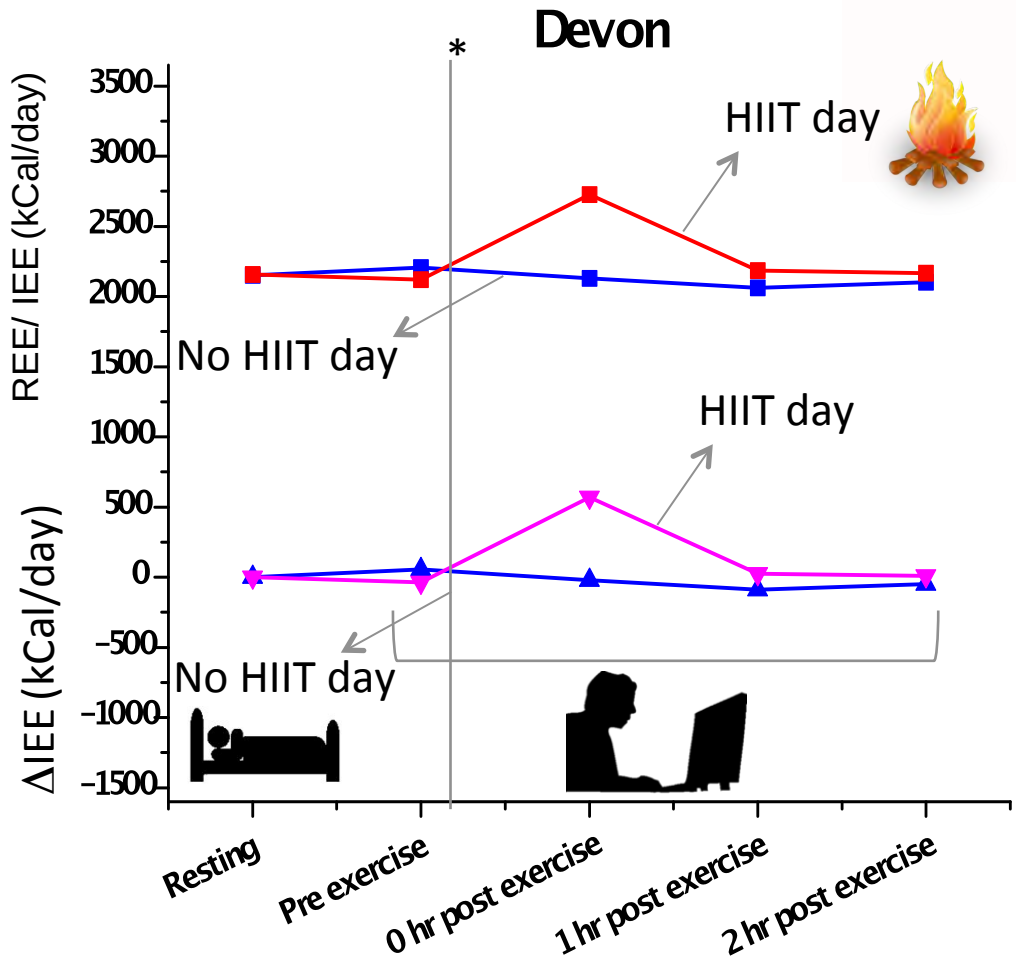
Diet B did not change metabolic rate, it increased RQ → 1, indicating only carbohydrate oxidation source.

Refs. for RQ values:
0.60 to 0.80: mostly fat oxidation
0.80 to 0.90: mixed source, fat and carb oxidation
0.90 to 1.00: mostly carbohydrate oxidation or anaerobic metabolism increased.



Study case #7: Momentary Energy Expenditure after exercising*

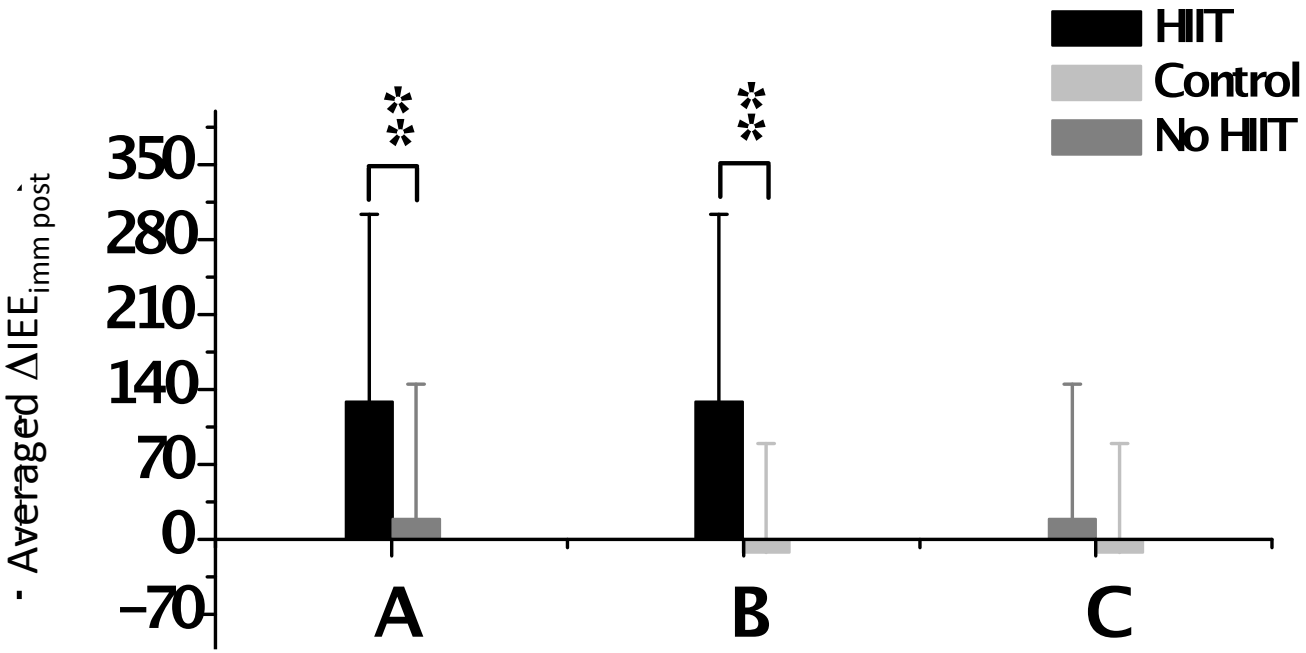
Can we detect a difference in metabolism between a High Intensity Interval Training (HIIT) day vs a No-HIIT day ?



* Squatting work of 36-55 lbs and 0.53 m with up & down

* In collaboration with Barb Ainsworth (Former ACSM President), Troy Anderson (CPT), and D. Jackemeyer (ASU)

Effect of HIIT on individual's energy expenditure throughout training sessions



Averaged change of pre- and post- energy expenditure ($\Delta iEE = EE_{post} - EE_{pre}$) was significantly different:

- ✓ **HIIT day vs. NO HIIT day (HIIT group)**
- ✓ **HIIT day (HIIT group) vs. CONTROL (Control group)**

Conclusions

- The breath measurement of Resting Energy Expenditure (REE) is important to manage weight in a variety of different health-related situations, including hormonal problems, obesity, type 2 diabetes, pregnancy as well as in fitness training.
- The importance on breath analysis for REE is similar to a blood pressure measurement for management of blood pressure.
- Calorie intake based on Resting Energy Expenditure measurement can be accurately prescribed to manage weight successfully, in a similar manner a medicine is prescribed to manage blood pressure.
- Attempts to use an equation, instead of a measurement for Resting Energy Expenditure, is merely a guess that can irresponsibly produce undesired effects.