Benefits of whole room calorimetry for enhancing Weight loss and overall health

D & S

Room Calorimeter Experts Since 2001

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Introduction

Wish it was true!

Obesity begins in early childhood……

……and continues into adulthood…wonder why!

Measurement of caloric content of foods

What is a Calorie?

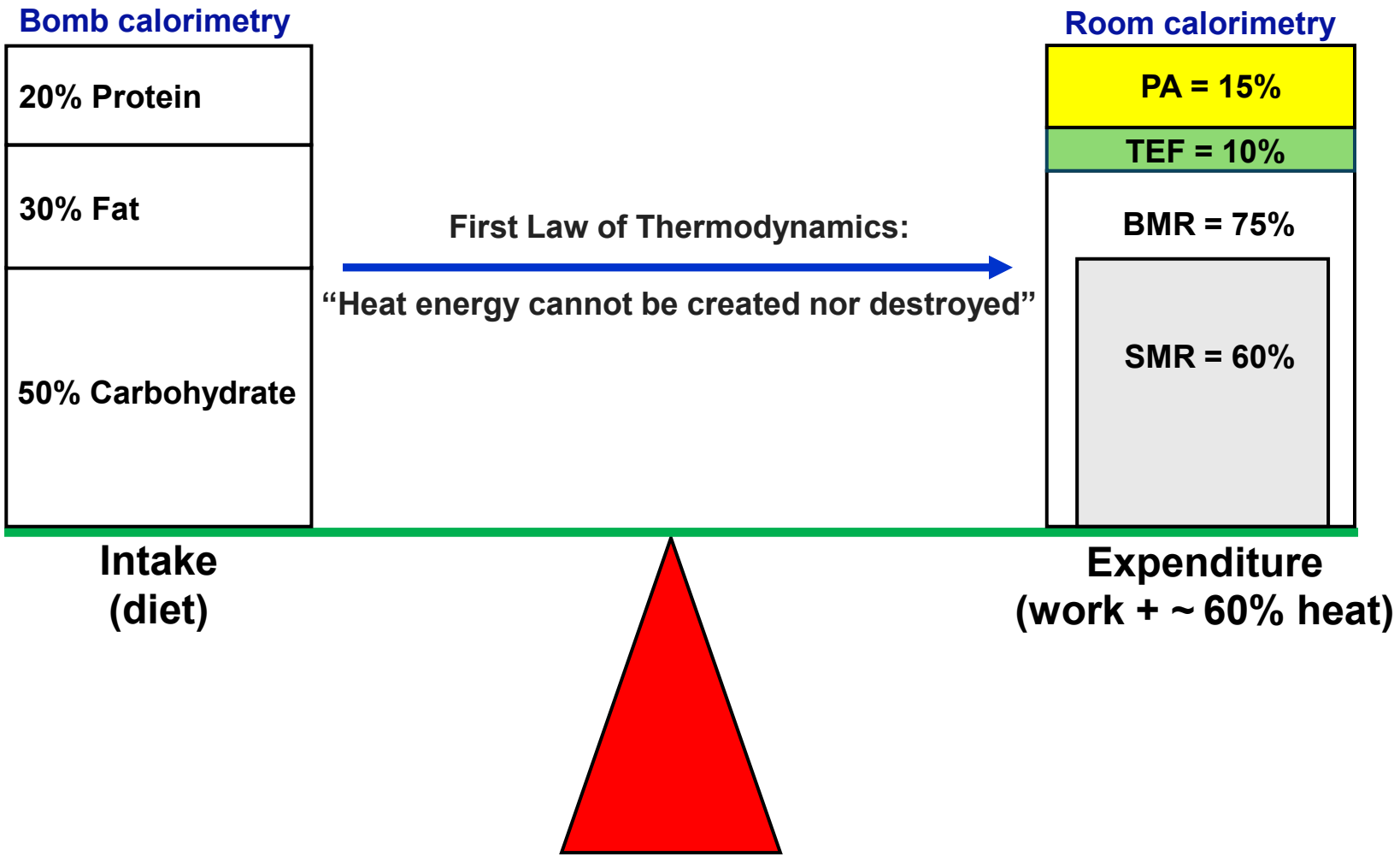
A unit of energy, often used to express the energy content of foods, equivalent to the heat energy needed to raise the temperature of 1 kilogram (2.2 lbs) of water by 1 °C (1.8 °F).

How is the caloric content of foods is measured?

Bomb calorimetry (shown below) is the technique utilized to measure caloric content of just about any food or beverage. This involves combusting 1 gram of a sample, in a pressurized stainless-steel vessel, filled with 100% oxygen. Based on an international gold standard, the temperature difference from baseline is recorded and related to caloric content.

Dr. Russell Rising using a bomb Calorimeter (HBO; 2013)

Maintenance of energy balance based on accurate metabolic measurements

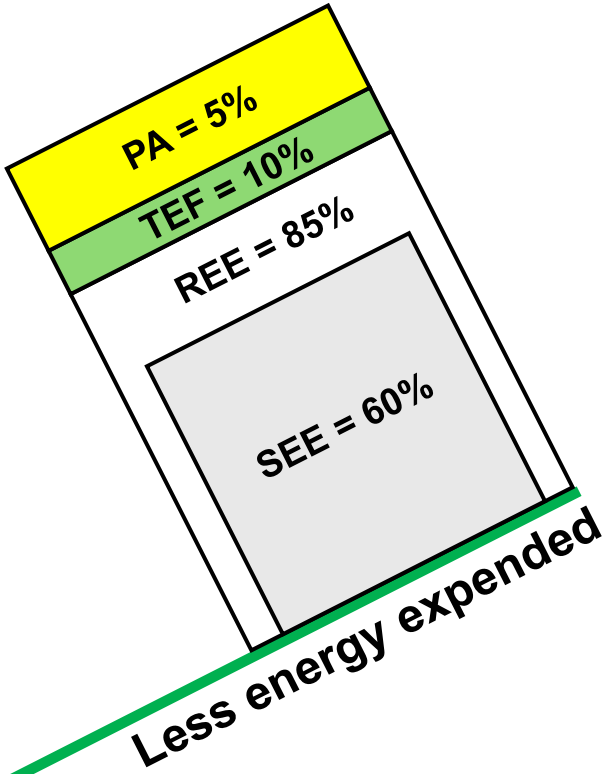


"Each of us is a unique"

Weight gain occurs when…

Greater energy intake

Equals



Less energy expended

"Each of us gains weight differently"

Common weight loss myths

- Carbs make you gain weight
- The faster you lose weight, the better
- You need to track every calorie and macro nutrient
- You have to cut out entire food groups to lose weight
- The scale is the only indicator of health
- You must avoid all processed foods

Calorie intake

Calorie content misrepresentation

2013:
Listed as 39 calories per cup.
(Rising measured it at 69 calories/cup).

Current:
Listed at 50 calories per cup.
How was this measured?

Caloric analysis results for restaurant food samples

Date	Sample #	Name of food	Measured calories (Kcal/item)	Posted calories (Kcal/item)	% Difference (measured - posted)
4/18/16	1	Pizza Hut personal pepperoni pizza	864.9	640.0	26.0 Over
04/16/16	2	KFC famous bowl	723.2	730.0	6.8 Under
04/16/16	3	McDonald's large fries	594.4	510.0	14.2 Over
04/16/16	4	McDonald's big mac	701.6	540.0	23.0 Over
04/16/16	5	Olive Garden	1439.8	1480.0	2.7 Under
04/16/16	6	Starbucks Carmel frap venti/whip	476.2	510.0	6.6 Under
04/18/16	7	Chipotle chick burrito w/everything	1670.1	1315.0	21.3 Over
04/18/16	8	TGI Friday's pecan-crusted salad w/ one container balsamic dressing	816.6	1080.0	24.0 Under
04/12/16	9	Shake Shack Smokeshack double burger	1027.9	925.0	10.0 Over

Notes:

- All samples run in triplicate
- Variation within each food sample run must Coefficient of variation of 3% or less
- Tests run on 4/16/16

(Tech Insider, 2018)

Caloric analysis results for restaurant food samples (Cont.)

Date	Sample #	Name of food	Measured calories (Kcal/item)	Posted calories (Kcal/item)	% Difference (measured - posted)
10/23/13	1	Yogurt Muffin	734.7	640.0	12.8 Over
10/23/13	2	Starbucks Grande Frappuccino	392.9	370.0	5.8 Over
10/23/13	3	Chipotle Burrito	1295.0	1175.0	9.2 Over
10/23/13	4	Vegetarian sandwich	548.4	228.0	58.4 Over
10/23/13	5	Subway sandwich	350.8	360.0	2.8 Under

Notes:

- All samples run in triplicate
- Variation within each food sample run must Coefficient of variation of 3% or less
- Tests run on 10/13/2013

(HBO, 2013)

Caloric expenditure

Resting or basal metabolic rate (RMR or BMR)

Background:

- Can equal up to 70% of total daily energy expenditure
- Must be measured in the morning due to the metabolic circadian rhythm
- Most common parameter utilized for weight loss treatment

Definition:

- RMR = resting metabolic rate for 24-hours (can be nonfasted)
- BMR = basal metabolic rate for 24-hours (fasted for at least 12-hours)

Methods of determination:

- Mifflin prediction equation
  (based on weight/height/age/gender, ok for normal weight individuals)
- Wearable devices such as the Apple Watch or Fitbit
  (inaccurate)
- Handheld devices such as the Medgem for RMR
  (measures only oxygen and inaccurate)
- Metabolic cart connected to a ventilated hood
  (inaccurate and uncomfortable for individuals being measured)
- Whole room indirect calorimetry
  (accurate and comfortable for individuals being measured)

Calculating or determining energy expenditure in adults

Formulas for calculating RMR

Equation	Gender	Math and units
Harris-Benedict[1]	Men	BMR (kcal/d) = (10 × weight, kg) + (6.25 × height, cm) - (5 × age, years) + 5
	Women	BMR (kcal/d) = (10 × weight, kg) + (6.25 × height, cm) - (5 × age, years) - 161
Mifflin[2]	Men/women	RMR (kcal/d) = ((9.99 × weight, kg) + (6.25 × height, cm) - (4.92 × age, years) + (166 * sex, males = 1, females = 0) -161)
Owen[3]	Men	RMR (kcal/d) = 879 + 10.2 * weight (kg)
	Women	RMR (kcal/d) = 795 + 7.2 * weight (kg)

Consumer electronics for calculating both energy expenditure and nutrient oxidation

Apple watch (EE)


Fitbit (EE)

Fitbit (RMR)

Lumen (nutrient oxidation)

([1]Harris JA and Benedict FG , 1919; [2]Mifflin et al, 1990; [3]Owen et al, 1986)

Article regarding wearable device accuracy for energy expenditure measurements

Wrist-worn devices for the measurement of heart rate and energy expenditure: A validation study for the Apple Watch 6, Polar Vantage V and Fitbit Sense

Guy Hajj-Boutros, Marie-Anne Landry-Duval, Alain Steve Comtois, Gilles Gouspillou, Antony D. Karelis

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ABSTRACT

The purpose of this study was to investigate the accuracy of 3 recently released wrist-worn devices (Apple Watch 6, Polar Vantage V and Fitbit Sense) for heart rate and energy expenditure during various activities. The study population consisted of 60 young healthy individuals (30 men and 30 women; age: 24.9 ± 3.0 years, BMI: 23.1 ± 2.7 kg/m2). Heart rate and energy expenditure were measured using the Polar H10 and Metamax 3B, respectively (reference measures) as well as with the 3 wrist-worn devices during 5 different activities (sitting, walking, running, resistance exercises and cycling). The Apple Watch 6 displayed the highest level of accuracy for heart rate measurement with a coefficient of variation (CV) (%) of less than 5% for all 5 activities, whereas the Polar Vantage V and the Fitbit Sense presented various degrees of accuracy (from high to poor accuracy) dependent on the activity (CVs between 2.44-8.80% and 4.14-10.76%, respectively). As for energy expenditure, all 3 devices displayed poor accuracy for all 5 physical activities (CVs between 14.68-24.85% for Apple Watch 6, 16.54-25.78% for Polar Vantage V and 13.44-29.66% for Fitbit Sense). Results of the present study indicate that the Apple Watch 6 was the most accurate for measuring heart rate across all 5 activities, whereas variable levels of accuracy for heart rate measurement for the Polar Vantage V and the Fitbit Sense were observed depending on the activity. As for energy expenditure, all 3 devices showed poor accuracy during all activities.

Highlights

- The Apple Watch 6 was the most accurate for measuring heart rate, whereas the Polar Vantage V and Fitbit Sense showed variable results dependent on the activity
- The Apple Watch 6, Polar Vantage V and Fitbit Sense showed poor accuracy for energy expenditure during 5 different physical activities

RMR measurements with a metabolic cart and whole room indirect calorimetry (WRIC)

Metabolic Cart for RMR

RMR WRIC – Columbia University

Face mask setup for RMR

RMR WRIC – Mount Sinai

Energy expended for physical activities

Measurement of the energetics of physical activities (PA)

Metabolic cart

VS.

Exercise whole room indirect calorimeter

[1]non-anaerobic energetics (kcal/min) = 3.941 * VO_2 (l) + 1.106 * VCO_2 (l)

[2,3]Glucose Ox (g) = - 3.226 * VO_2 (l) + 4.585 * VCO_2 (l) - 0.461 * 0.066

[2,3]Lipid Ox (g) = 1.695 * VO_2 (l) - 1.701 * VCO_2 (l) - 0.319 * 0.066

1) Subject attachment to instrumentation
2) Anxiety due to head gear
3) Utilizes breath x breath configuration
4) Lack of macro-nutrient oxidation data
5) Desiccants required
6) Software preparatory thus un-editable
7) Errors up to 30% for energetics of PA

1) No subject connection to instrumentation
2) The energetics of any PA can be measured
3) Single mass air flow rate settings
4) No desiccants required during tests
5) Data includes macro-nutrient oxidation
6) Equations can be modified in software
7) < 1% error in PA energetics

([1]Weir V, 1949; [2]Kelly LP and Basset FA, 2017; [3]Protein oxidation assumed to be 66 mg/min)

Measuring the energetic costs of various physical activities utilizing whole room indirect calorimetry[1]

Physical Activity	Duration (min)	Subject gender	Body Weight (kg)	BMI (kg/m^2)	EXEE (kcal)	RQ (VCO_2/VO_2)	Glucose Oxidation (g)	Lipid Oxidation (g)
Jazz drumming	25	M	84.1	24.6	125.0	0.73	0.3	12.8
Trumpet playing	40	M	98.2	34.0	100.8	0.85	1.6	3.1
Guitar playing	30	F	64.9	23.8	81.8	0.78	3.0	6.0
Opera singing	40	F	52.7	21.4	66.0	0.85	8.0	2.0
One-man band	107	M	69.9	25.1	327.4	0.83	-----	-----
Yoga practice	30	F	59.6	22.8	243.1	0.93	55.2	2.1
Shadow boxing	30	F	66.8	25.2	267.0	0.88	43.2	6.9
Aerobic dancing	40	M	78.2	24.1	400.0	0.80	32.0	27.6
Irish Step Dancing	40	F	59.0	21.8	238.8	0.90	28.8	12.4
Step exercise	40	F	58.2	20.6	320.8	0.93	73.6	2.9
Half-marathon	77	M	61.9	21.9	1100.0	0.85	144.8	54.7
Tennis (forehand)	20	M	79.1	27.4	146.0	0.84	18.0	7.6
Tennis (backhand)	20	--	-----	-----	135.4	0.86	19.6	5.8
Online training	60	M	72.7	25.2	292.2	0.88	47.1	10.2
Trampoline exercise	30	F	120.6	40.0	219.5	0.83	-----	-----

Energetics of physical activity measured via wrist band[2]

Sexual activity	30	M	------	24.2	100.0	----	-----	-----
Sexual activity	30	F	------	19.5	76.2	----	-----	-----

([1]Rising et al, 2016; [2]Frappier et al, 2013)

Potential future use for whole room indirect calorimetry?

Cross country skiing simulator

Another potential future use for whole room indirect calorimetry?

Ice hockey simulator





THANK YOU

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