

ENERGY BALANCE ASSESSMENT

JUNK IN LEADS TO JUNK OUT

Although conceptually fairly straight forward, the use of energy balance is inherently dependent upon obtaining accurate information regarding caloric consumption and expenditure. We cannot expect to obtain usable information from energy balance if we feed it junk information. Without accurate information, the utility of the approach is compromised.

Topics: Resting Metabolic Rate — Basal Metabolic Rate — Accuracy vs Precision — Perceived Energy Balance — Scarcity Effect — Eating for Health

Measurements of **Basal Metabolic Rate (BMR)** require the individual to be resting quietly on their back, having not eaten for 8 to 12 hours, not exercised for at least several hours, with a body temperature between 96 and 99°F, in a room temperature between 70 and 75°F, and without feelings of stress or cognitive engagement. As such a list of requirements is often very difficult to realistically obtain, in practice **Resting Metabolic Rate (RMR)** is most commonly used as a measure since it only requires the individual to be resting quietly on back and not cognitively engaged — controlling the two largest contributors to metabolic rate.

Measurement of metabolic rate can be achieved using either direct (measurement of changes in the temperature of the room) or indirect (measurement of oxygen consumption and carbon dioxide production) means. **Direct calorimetry** is based upon physical properties of energy conservation that tell us that any energy processed will eventually be converted into heat. By measuring the heat that is produced, we can directly obtain an assessment of the caloric expenditure associated with metabolism. This approach is exceptionally accurate, but very time consuming and expensive as it requires specialized highly sensitive chambers. **Indirect calorimetry** is based upon aerobic and anaerobic energy cycles. If we measure the amount of oxygen that the body extracts from the air and the amount of carbon dioxide that is produced, we can obtain an indirect assessment of how much energy the body utilized. As this approach only requires a device capable of measuring oxygen and carbon dioxide, it is a much less expensive approach for assessing metabolic rate. As a result, indirect calorimetry is the most often utilized measurement approach with clinics and specialty centers usually charging \$50 to \$300 for metabolic

assessments.

Although measurement of metabolic rate is preferable, as fat-free mass accounts for the vast majority of metabolic rate it is possible to use a prediction equation to obtain an estimate of metabolic rate. However, the accuracy of the prediction will vary based upon the relevance of the prediction equation to the target population. The prediction equation below provides adequate estimates for most adult populations with body fat between 10 and 40%. But other prediction equations are more appropriate when working with individuals with excessively low or high body fat levels, as well as developing and geriatric populations.

METHOD TO ESTIMATE METABOLIC RATE

$$\text{Metabolic Rate} = 500 + (14 \times (\text{Weight (kg)} \times (1 - \text{Percent Body Fat})))$$

This formula has the advantage of being relatively easy to use as it only requires the assessment of body composition to determine percent body fat. The formula assumes that for a typical adult, a constant of 500 calories should be included to account for general energetic requirements. It then multiplies the individual's fat free mass (one minus percent body fat) by the energetic rate of skeletal muscle (13 kcal per kg per day) plus one extra kcal per kg per day. Thus, as the individual increases fat free mass, the estimate would assume their metabolic rate should also proportionately increase. This particular formula does adopt a conservative estimation approach in contrast to others that are often integrated into calorie counting applications on the web or your phone (i.e., metabolic rate estimates tend to be lower with this formula than with others; formula estimate might be 200-400 kcal less than the estimate on your calorie application).

CALORIC ACCURACY

Accuracy — How close a measurement is to the true or accepted value.

Precision — How close measurements of the same item are to each other.

If we focus on food consumption, what is the likelihood that the number we are using for energy intake reflects the actual caloric intake? For the energy balance equation to work properly, it is necessary to obtain accurate numbers. Unfortunately when it comes to caloric reporting of dietary practices there are considerable issues both at the systemic level and the individual level.

Systemically, how can food manufacturers perfectly ensure that

the food label on packaging accurately reflects the caloric content of food inside while at the same time having the food labels be identical on every single package? The benefit of the Atwater indirect system of food labeling is that as long as we know the mass and general composition of food that we can assign a caloric value to it. So it should provide a very precise method of assigning caloric value to packaging. But not only is there variation in exact weight of the food within packaging (within tolerances) but there is considerable variation (error) in the composition of food, particularly the less processed it is. So variations in underlying composition will impact not only the caloric content of the energy intake but also on the thermic effects of processing that food internally. Therefore, in practice the approach is neither particularly accurate or precise.

Similarly, food labels provide the caloric information based upon recommended serving sizes. But those serving sizes do not necessarily align with actual food intake practices. If the food label says that there are 100 calories (actually kilocalories) in large print, but in small print indicates that there are 5 servings within the package it is likely that an individual will report that they consumed 100 kilocalories rather than the 500 kilocalories they actually consumed.

Some of these problems could be solved by utilizing food scales and accurately measuring the mass of each food or through the use of phone and image based tracking applications. The general guidance to avoid counting calories, however, incorporates perspectives that when people do this, they tend to gravitate to more highly processed foods as the nutritional information is provided or more readily available – unlike less processed or natural foods where the calorie content is more ambiguous. There is also substantial data to suggest that when individuals at risk for use-disorders do this they often develop concerning obsessive behaviors and mental health related issues.

Rarely do individuals get out a food scale and measure their food to obtain accurate measures or even utilize phone applications that can make estimations based upon pictures of food. Instead they generalize the caloric content in a more consistent fashion often by making assumptions that the food was about a portion size or adjusting the portion size to match the calories they want to see. In practice this would not actually be such a bad thing as very precise measures (highly consistent) simply reflect an offset from the true value. So even if it is not accurate, a very precise measure can still be effectively utilized. But individuals also exhibit patterns of food tracking that omit calories consumed (such as beverages, second portions, pre-meal snacks, etc.). If the calories that individuals are reporting consuming do not actually reflect their dietary practices, the utility of energy balance starts to suffer.

Such practices unfortunately also apply to sources of energy expenditure. Clearly, whatever inaccuracies of caloric intake reporting that do occur will also effect the thermic effect of food measures. But this also extends to metabolic rate and physical activity. Metabolic rate is not actually a static (constant) measure and not only changes throughout the day but also in response to changes in the underlying composition of the body. As muscle mass increases or decreases, so to will metabolic rate. So energy balance approaches that do not regularly revise metabolic contributions will suffer in their predictive capacity. At the same time, if an individual is using an estimate of their metabolic rate it may be that the formula being used is a poor fit for them.

Although tracking of physical activity through smartphone and smartwatch technologies has greatly improved estimates of physical activity related energy expenditure compared to self-reporting practices; they are not perfect. A large number of both scientific and popular press articles have come out regarding this, noting that smart watches/phones do not always correctly identify the activity engaged in therefore apply the wrong energetic cost factor and misreport caloric expenditure. Similarly, GPS technologies intentionally build in error to prevent misuse resulting in variation in caloric expenditure.

There are also interesting patterns of human behaviors where individuals will intentionally not wear smart watches for caloric tracking on days when they are relatively inactive, only using it for active days. When reporting their physical activity energy expenditure they will 'forget' about those inactive days and indicate similar patterns of behavior even when they did not wear the device. Research has also indicated patterns of compensatory/reward eating whereby individuals will consume additional food sources following physical activity that will often be omitted from food tracking.

Perceived Energy Balance — Estimates of calories consumed and calories expended through physical activity are used to estimate metabolic rate. Those numbers are then reused for prescription of caloric alterations. Misreporting of calories in and calories out is expected.

If the values used for tracking caloric intake are flawed, the values used for thermic effect of food are flawed, metabolic rate is poorly estimated or not updated, and physical activity is not appropriately tracked, the use of the energy balance framework becomes problematic. However, it can still be helpful in guiding recommendations regarding physical activity practices. One approach that has been effectively used anticipates misreporting of caloric values but assumes that those values reflect individual perceptions of

behavior. If the caloric values are systematically misreported in this way, they can still provide valuable information.

The key to this approach is in applying the general perspective that the caloric information that you are provided is skewed. We know that people have the tendency to under report caloric consumption (i.e., say they ate less than they did) and over report caloric expenditure (i.e., say they were more active than they actually were). Because we know the information we are getting is flawed, there is not a good reason to assume that the level of precision of the data is meaningful. So we **take the calories they report consuming and round up to the nearest 50** (e.g., they report consuming 2006 calories, so we round that to be 2050 calories). We **take the calories they report expending and round down to the nearest 50** (e.g., they report having expended 410 calories, so we round that to be 400 calories).

Ideally we would have multiple weeks worth of tracking data that we could use to be able to get at habitual energy balance. In that case **we would apply this rounding principle to each days data and then we could compute the mean (i.e., average) of the last 3 weeks of caloric consumption data and the last 8 weeks of physical activity expenditure data**. But in principle, perceived energy balance also can be used with less data by having the individual report what they typically consume and their typical level of physical activity.

Your client reports that they typically consume 1988 calories per day, expend 340 calories per day in physical activity, and have a stable weight (not losing or gaining weight).

We would round consumed calories up to the nearest 50 and say they consumed 2000 calories per day.

We would round expended calories down to the nearest 50 and say they expended 300 calories per day in physical activity.

Calculate their metabolic rate

$$\begin{array}{rclclcl}
 \text{Energy Balance} & = & \text{Energy In} & - & \text{RMR} & - & \text{TEF} & - & \text{PA} \\
 0 & = & 2000 & - & \text{RMR} & - & \text{TEF} & - & 300 \\
 0 & = & 2000 & - & \text{RMR} & - & (2000 \times 0.1) & - & 300 \\
 0 & = & 2000 & - & \text{RMR} & - & 200 & - & 300 \\
 0 + \text{RMR} & = & 2000 & & & - & 200 & - & 300 \\
 \text{RMR} & = & 1500 & & & & & &
 \end{array}$$

The benefit of this approach is that their estimated metabolic rate does not actually have to align with their real metabolic rate. Rather, the perceived energy balance approach enables this metabolic rate to compensate for the incorrect values given for calories consumed and physical activity. If we used the individuals actual metabolic rate, the energy balance equation would not work because of the other incorrect values. So using the perceived approach, we can create prescriptions for caloric alterations or model out what changes in body composition should be expected based upon potential caloric alterations all based upon the individual's perceived behaviors.

The nature of the energy balance concept which considers both food consumption and energy expenditure has necessarily resulted in debate as to if it is more effective to try to combat such threats to health and wellness through addressing excess food consumption or increased physical activity. Unsurprisingly, given a biological imperative to be as inactive as possible, **the general societal tendency has been to target food over consumption.** Within the US, Americans spend over \$60 billion US dollars annually on weight loss products and services; and globally this retail market is valued at \$132 billion. Over 53% of Americans between 18 and 50 years of age have reported trying to diet at least once in the last year. Yet only 5% manage to maintain any weight loss for longer than 6 months; and there is very little data on how underlying body composition has changed as a result.

Scarcity Effect — Cognitive bias that assigns value based upon availability. Items that are abundantly available are perceived to be of lower value and are therefore less desirable. Items that are rare are perceived to be of higher value and are therefore more desirable.

The failure of such dietary changes to substantively impact upon diseases such as cardiovascular disease and obesity is most commonly attributed to the controversy, conflict, and stigma surrounding diet and nutrition. When done appropriately, with the proper guidance of professionals in food science and human nutrition; such dietary changes can absolutely be effective. But in practice, very few people seek such guidance and instead follow social trends and fad diets. Fundamentally, when you tell yourself that you can no longer eat the foods that you typically eat; it creates a desire to seek out those foods. This is commonly attributed to the scarcity effect, as restricting the availability of the food unintentionally increases its perceived desirability.

The other issue with trying to target food over consumption is that large food industries would stand to lose substantial profits. Food manufacturers spent \$9 million US dollars in the first three months of

lobbying against changes in food labeling requirements and cited losses of \$2 billion US dollars in response to the changes that were eventually approved. The opposition to sugar taxes are often used as a prime example of the power of food industry. Such taxes assess additional fees based upon the sugar added to food/beverages, costing the manufacturer more to create the food/beverage, who then charges the consumer more for it. When implemented outside of the US, such approaches have been found to be effective at reducing consumption of sugarsweetened beverages by over 25%, forcing formula changes to food/beverages to reduce added sugars, and reducing rates of obesity by around 5% over a two year period. Yet within the US, food industry has lobbied against such taxes, citing evidence from city level programs where community members choose to drive to a different town to avoid having to pay the excess tax and expressing concern over the economic impacts of such programs that could cause them to lay off employees if demand for their product deteriorates. When considered in the context that many of these companies have already implemented formula changes in their non-US arms and reductions of consumption of sugar-sweetened beverages are typically offset by growing segments of other aspects of their product lines; such opposition does not always appear to make sense.

Finally, there is mounting evidence noting the difficulty of changing dietary patterns of individuals without substantial other changes in their environment. Food preferences are established early, with dietary patterns of nutritional quality in infancy predicting food consumption during middle to late childhood. Unfortunately, those same foods appear to become so called 'comfort foods' that individuals turn to in their adulthood during times of stress, discomfort, and sadness. So when you go through such periods, you tend to turn to the same foods you preferred when you were eight to twelve years old.

Dietary Restriction — Approach that advocates for the limiting of caloric intake or the restriction of intake of specific types/classes of foods.

Eating for Health — Approach that advocates for altering the foods that are taken in to specifically benefit health or performance.

Accordingly, over the past several decades there has been a gradual shift to begin placing greater emphasis on increasing physical activity behaviors. This shift has not attempted to negate or downweight the influence of diet/nutrition, but rather has attempted to reframe dietary practices to better align with wellbeing campaigns. The fundamental basis reflects a shift from dietary restriction approaches to eating for

health approaches. Dietary restriction approaches reflect the common way many attempt to regulate their energy balance. They attempt to restrict calories consumed or remove poor quality foods from their diet, or make up for dietary failures by promising to 'exercise it off'. The eating for health approach reframes the food choice towards what foods will best allow the body to function in the demands that are being placed upon it. An important part of this approach is that weight-loss or adipose reduction is not a focus. The specific foods that are consumed can have a substantial impact upon how people feel while they are engaged in physical activity, so by eating to support the activities that they do, dietary practices can begin to be altered in a more sustainable way. If long-term dietary practices are changed in a way that enables people to be more active or feel better when they are active while also making smarter food choices, changes in body composition are likely to occur as a by product.

The other contributor to this shift is the reality that physical activity industries stand to benefit from increasing physical activity. Consider that when people adopt new years resolutions to begin to be more active, lose weight, or start exercising; what do they tend to do? Research on consumer behaviors indicates that such desires typically proceed purchases of expensive workout attire, new shoes, headphones/earbuds and in some demographics the purchase of exercise equipment that can cost thousands of dollars. As a result, such industries have continued to lobby legislative bodies to help promote physical activity opportunities.

Assessing Metabolic Rate

Metabolic Rate: The amount of energy required to sustain the body's vital functions in the waking state.

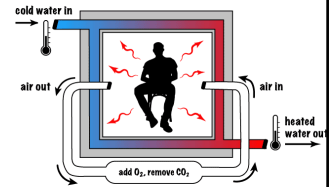
- Technically this refers to **Basal Metabolic Rate (BMR)**
 - Resting quietly on the back
 - Not eaten for 8 to 12 hours
 - No exercise for at least 4 hours
 - Body temperature between 96 and 99°F
 - Room temperature between 70 and 75°F
 - Without feelings of stress or cognitive engagement

Assessing Metabolic Rate

Direct Calorimetry

Uses heat production to measure metabolic rate.

- As the body burns energy, heat is produced.
- Exceptionally accurate.
- Very time consuming and expensive.



Assessing Metabolic Rate



Indirect Calorimetry

Uses measurement of oxygen consumption and carbon dioxide production to measure metabolic rate.

- Relies upon aerobic and anaerobic energy cycles.

Assessing Metabolic Rate



Indirect Calorimetry

Much more cost-effective approach as it only requires a device capable of measuring oxygen and carbon dioxide.

- In practice this approach is the most utilized.
- \$50 to \$300 cost at clinics and specialty centers.

Predicting Metabolic Rate

If measurement is possible, then measurements should be obtained.

Since fat-free mass accounts for the majority of metabolic rate, it is possible to use a prediction equation to make an estimation.

- The accuracy of the estimate will always vary based upon the relevance of the prediction equation to the target population.
 - If you use a prediction equation made for college athletes to estimate the metabolic rate of a 50 year old, you end up with a junk estimate.
 - If you use a prediction equation made for elderly adults to estimate the metabolic rate of a college student, you end up with a junk estimate.

80 kg, 25% Fat

Predicting Metabolic Rate

There are a wide assortment of estimation formulas that vary based upon the target population and what additional information you have.

- The formula below provides adequate estimates for most adult populations with body fat levels between 10 and 40%.

$$\text{Metabolic Rate} = 500 + (14 \times (\text{Weight [kg]} \times (1 - \% \text{ Body Fat})))$$

$$\text{Metabolic Rate} = 500 + (14 \times (80 \times (1 - 25\%)))$$

$$\text{Metabolic Rate} = 500 + (14 \times (80 \times (75\%)))$$

$$\text{Metabolic Rate} = 500 + 840 = 1340 \text{ kcal}$$

Predicting Metabolic Rate

80 kg, 25% Fat
Height: 175 cm
Male, 25 yrs

This formula tends to be more conservative (results in a lower metabolic rate estimate) than other formulas often used by calorie tracking apps.

$$\text{Metabolic Rate} = 500 + (14 \times (\text{Weight [kg]} \times (1 - \% \text{ Body Fat})))$$

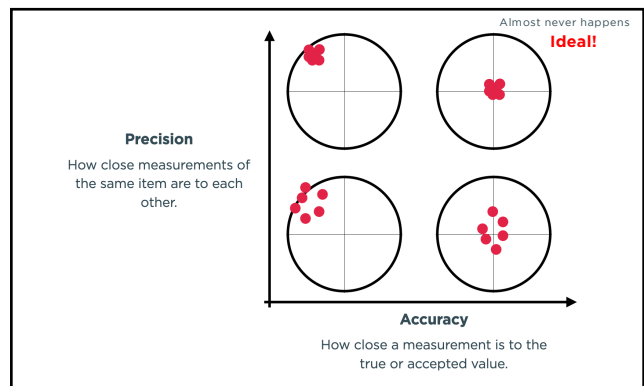
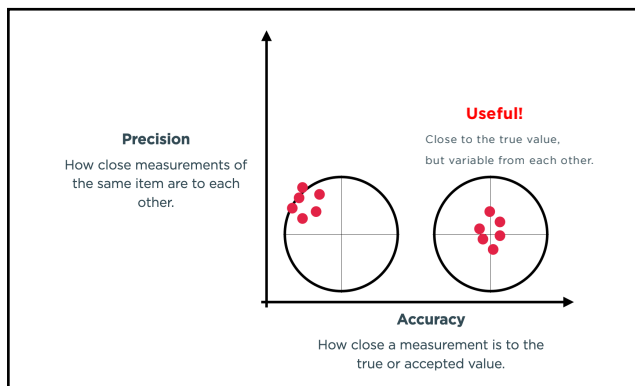
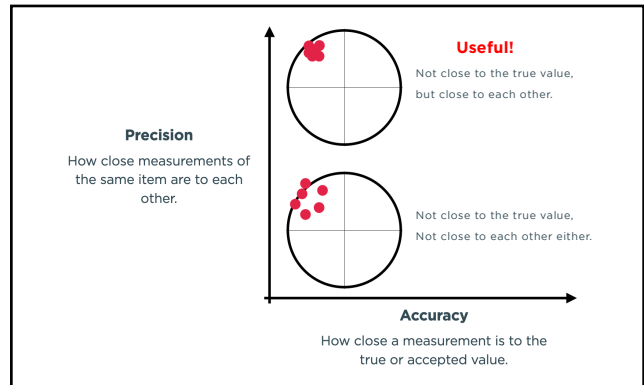

$$\text{Metabolic Rate} = 500 + 840 = 1340 \text{ kcal}$$

Mifflin-St Jeor equation

$$\text{Metabolic Rate} = (10 \times \text{Weight [kg]}) + (6.25 \times \text{Height [cm]}) - (5 \times \text{age [yrs]}) + 5$$

$$\text{Metabolic Rate} = (10 \times 80) + (6.25 \times 175) - (5 \times 25) + 5$$

$$\text{Metabolic Rate} = (800) + (1094) - (125) + 5$$

$$\text{Metabolic Rate} = 1774 \text{ kcal}$$



How can food manufacturers perfectly ensure that the food label on packaging accurately (close to the true value) reflects the caloric content of food inside while at the same time having the food labels be identical on every single package.

Variation in exact weight of the food within packaging (within tolerances)

Variation in the composition of food.

Nutrition Facts	
4 servings per container	
Serving size 1 1/2 cup (200g)	
Amount per serving	
Calories	240
<small>% Daily Value*</small>	
Total Fat 5g	10%
Saturated Fat 1.5g	3%
Trans Fat 0g	0%
Cholesterol 50mg	10%
Sodium 450mg	18%
Total Carbohydrate 45g	17%
Dietary Fiber 5g	20%
Total Sugars 0g	0%
Includes 2g Added Sugars	4%
Protein 11g	22%
Vitamin D 200µg	10%
Calcium 200mg	20%
Iron 10mg	20%
Potassium 240mg	6%

Tracking Food Calories

Couldn't we just use a food scale or app?

- The general guidance to avoid counting calories stems from two issues that occur when people adopt this approach:
 - Gravitate towards more highly processed foods where nutrition information is more available.
 - Individuals at risk for "use disorders" have a tendency to develop obsessive behaviors regarding the use of calorie counting and food scales.

Tracking Food Calories

- **Even with food tracking phone apps, most people just "guess"**
 - They generalize to assume portion sizes or approximate number of calories.
 - If it was done consistently and systematically, then even if the numbers were not accurate at least they would be precise...
 - Rarely is this the case.
- **Individuals omit calories**
 - Fail to count drinks.
 - Fail to count second portions or a few extra bites.
 - Fail to include pre-meal snacks.

Updating Metabolic Rate

- **Metabolic rate is not a static measure**
 - Changes throughout the day.
 - Changes with the underlying composition of the body.
- **Energy balance approaches must regularly update metabolic contributions or their predictive capacity will suffer!**

Are smartphones/smartwatches good at Tracking Physical Activity?

- Despite the popular press surrounding the accuracy of smartphones/smartwatches in tracking physical activity, they are far superior to self-reporting practices.
- Accuracy improves when you tell the device what you are doing.
 - It can then select the correct energetic cost algorithm.
- GPS intentionally has built in and variable error.
 - i.e., running the same path every day will show different distances.



Are smartphones/smartwatches good at Tracking Physical Activity?

- Intentional misreporting of physical activity.
 - Choosing not to wear device on inactive days.
- Compensatory behaviors:
 - Electing to not engage in additional activities because they have already 'achieved' daily goal.
 - Reward eating patterns.



Perceived Energy Balance

- Estimates of calories consumed and calories expended through physical activity are used to estimate metabolic rate.
- Those numbers are then reused for prescription of caloric alterations.
- Misreporting of calories in and out is EXPECTED!

Perceived Energy Balance

- Recognize that the data people give you is skewed!
 - People tend to under report caloric consumption.
 - Say they ate less than they actually did.
 - So take the number and round UP to the nearest 50 (e.g., 2006 calories becomes 2050 calories)
 - People tend to over report caloric expenditure.
 - Say they were more active than they actually were.
 - So take the number and round DOWN to the nearest 50 (e.g., 410 calories becomes 400 calories)

Perceived Energy Balance

- Ideally this would use Habitual Data
 - Apply rounding to each days reported caloric consumption.
 - Compute average of last 3 weeks of caloric consumption.
- Apply rounding to each days reported physical activity.
 - Compute average of last 8 weeks of physical activity expenditure.
- Can also just have person report what they typically consume and their typical levels of physical activity.

Perceived Energy Balance

$$\begin{aligned} \text{Energy Balance} &= \text{Calories In} - \text{Metabolic Rate} - \text{TEF} - \text{PA} \\ 0 &= 2000 - \text{Metabolic Rate} - \text{TEF} - \text{PA} \\ 0 &= 2000 - \text{Metabolic Rate} - 200 - \text{PA} \\ 0 &= 2000 - \text{Metabolic Rate} - 200 - 300 \\ 0 + \text{Metabolic Rate} &= 2000 - 200 - 300 \\ \text{Metabolic Rate} &= 1500 \text{ kcal} \end{aligned}$$

- Consumes 1988 calories per day.
- Expends 340 calories per day in physical activity.
- Stable weight (not losing or gaining weight).

Perceived Energy Balance

- Estimates of calories consumed and calories expended through physical activity are used to estimate metabolic rate.
- Those numbers are then reused for prescription of caloric alterations.
- Misreporting of calories in and out is EXPECTED!

Across many prominent threats to health and wellbeing Energy Balance Appears as a Critical Concept

Excess food consumption increases the risk.
Physical activity decreases the risk.

Targeting Food Consumption

The general societal tendency has been to target food over consumption.

- There is a biological imperative to be as inactive as possible.
- Americans spend over \$60 billion USD each year on weight loss products and services.
- Globally weight loss products and services are valued at \$132 billion USD.
- Over 53% of Americans (18 to 50) have attempted a diet in the last year.
- Only 5% maintain any weight loss for longer than 6 months.

Targeting Food Consumption

The current approach to combating food overconsumption has largely been ineffective.

- Most behavioral interventions targeting food consumption fail.
- When done appropriately, with proper guidance of professionals they can be effective.
- Very few people seek out professional support, instead following social trends and fad diets.
- There is controversy, conflict, and stigma surrounding diet and nutrition.

Targeting
Food Consumption

Dietary Restriction:
Approach that advocates for the limiting of caloric intake or the restriction of intake of specific types/classes of food.

- The most common approach for targeting food overconsumption is a dietary restriction approach.
- South Beach Diet
- Keto Diet
- Whole 30 Diet
- Paleo Diet
- Elimination Diet (pick one thing and no longer eat it)



Scarcity Effect

Cognitive bias that assigns value based upon availability. Items that are abundantly available are perceived to be of lower value and are therefore less desirable. Items that are rare are perceived to be of higher value and are therefore more desirable.

Targeting
Food Consumption

- Food industry within the US actively lobbies against the introduction of sugar taxes.
- Taxes would place additional fees based upon the sugar added to food/beverages.
- Would cost the manufacturer more to create, the additional cost is then passed on to the consumer.
- Food industry funds advertising 'news' to highlight negative effects of the taxes and failures.
- Residents in cities with sugar taxes will choose to drive to a different city to avoid paying more.

Targeting
Food Consumption

- Food industries claim that economic impacts of taxes may cause them to lay off employees if the demand for their product deteriorates and due to the additional cost of creating new formulas.
- Most multinational food manufacturers already have implemented formula changes in their non-US arms.
- Reduction of consumption of sugar-sweetened beverages are usually offset by consumption of other beverages in their product lines.

Targeting
Food Consumption

Food preferences are established early in life.

- Dietary patterns of nutritional quality in infancy predict food consumption during middle to late childhood.
- Foods consumed during middle to late childhood appear to become so called 'comfort foods' that individuals turn to in their adulthood.
- Stress, Discomfort, and Sadness all increase consumption of these 'comfort foods'.

Shifting Focus Towards
Physical Activity

Shift from dietary restriction approaches to eating for health approaches.

- Dietary restriction does not typically work, has negative associations, encourages problematic behaviors.
- Over the past several decades efforts have tried to reframe dietary practices to better align with wellbeing campaigns.
- The impact of dietary practices have not been negated or down weighted, just reframed.

Shifting Focus Towards
Physical Activity

Eating for Health:
Approach that advocates for altering the foods that are consumed to specifically benefit health or performance.

- Approach reframes the food choice towards what foods will best allow the body to function in the demands that are being placed upon it.
- Weight-loss or adipose reduction is not a focus.
- The specific foods that are consumed can have a substantial impact upon how people feel while they are engaged in physical activity, so by eating to support the activities that they do, dietary practices can begin to be altered in a more sustainable way.

Shifting Focus Towards
Physical Activity

Eating for Health:
Approach that advocates for altering the foods that are consumed to specifically benefit health or performance.

- Changes in body composition can still occur, but do so as a byproduct.
- If long-term dietary practices are changed in a way that enables people to be more active or feel better when they are active while also making smarter food choices, changes in body composition are likely to occur.
- Food choices are in support of the activity behaviors.

Energy Balance Assessment Worksheet

1. To assess food calories, what is the name of the method that places food in an oxygen rich container and ignites it to measure heat production? What is the name of the method that uses established energetic values based upon food nutrients?

2. Using the method that uses established energetic values based upon food nutrients, calculate calories (rounded to nearest whole number / integer) for the following foods:

	Carbs (grams)	Fat (grams)	Protein (grams)	Calories (kcal)
Cinnamon Roll	47	10	4	
Peanut butter	4	8	4	
Grilled Chicken	1	2	22	
Blueberries	11	0	1	
Ice Cream	32	15	5	
Protein Bar	16	6	20	
White Rice	27	0	2	
Chick Fil A Fries	48	21	6	
3 Eggs	3	15	18	

3. Using the formulas provided below, estimate metabolic rate (rounded to nearest whole number / integer) for the following cases:

Class Formula: $Metabolic\ Rate = 500 + (14 \times (Weight\ [kg] \times (1 - \% Body\ Fat)))$

Mifflin-St. Jeor for males:

$Metabolic\ Rate = (10 \times Weight\ [kg]) + (6.25 \times Height\ [cm]) - (5 \times age\ [yrs]) + 5$

Mifflin-St. Jeor for females:

$Metabolic\ Rate = (10 \times Weight\ [kg]) + (6.25 \times Height\ [cm]) - (5 \times age\ [yrs]) - 161$

	Biological Sex	Age (years)	Height (centimeters)	Weight (kg)	Body Fat (%)	Metabolic Rate (kcal)
Case 1	Male	27	169	91	14	
Class Formula:						
Mifflin-St. Jeor:						
Case 2	Female	42	159	60	33	
Class Formula:						
Mifflin-St. Jeor:						
Case 3	Female	34	172	63	27	
Class Formula:						
Mifflin-St. Jeor:						
Case 4	Male	55	185	110	35	
Class Formula:						
Mifflin-St. Jeor:						
Case 5	Female	64	153	55	22	
Class Formula:						
Mifflin-St. Jeor:						

4. Calculate the thermic effect of food (TEF, rounded to nearest whole number / integer) for the following cases:

	Calories (kcal)	TEF (kcal)
Case 1	1639	
Case 2	2414	
Case 3	1101	
Case 4	3401	
Case 5	4421	

5. Calculate the thermic effect of food (TEF, rounded to nearest whole number / integer) for the following cases:

	Carbs (grams)	Fat (grams)	Protein (grams)	TEF (kcal)
Case 1	171	72	87	
Case 2	264	45	143	
Case 3	204	100	97	
Case 4	345	70	240	
Case 5	219	172	210	

6. Calculate the physical activity energy expenditure (PA, rounded to nearest whole number / integer) for the following cases:

	Energetic Cost (kcal/kg/min)	Weight (kg)	Time (min)	PA (kcal)
Walking	0.066	60	10	
Stairmaster	0.155	53	8	
Pilates	0.047	68	30	
Cleaning the kitchen	0.058	45	5	
Yardwork	0.05	72	60	

7. Your mom has been really into getting more fit since you went away to college and is interested in purchasing a weight vest to wear while she is active. Calculate the physical activity energy expenditure (PA, rounded to nearest whole number / integer) for the following cases:

	Energetic Cost (kcal/kg/min)	Weight (kg)	Time (min)	PA (kcal)	PA (kcal) with 9 kg vest	PA (kcal) with 18 kg vest
Walking	0.066	60	30			
Stairmaster	0.155	60	15			
Pilates	0.047	60	60			
Watching TV	0.016	60	240			
Yardwork	0.05	60	60			

8. Your mom decided against purchasing the 9 kg (approximately 20 lb) weight vest. How many more minutes (rounded up to the next whole number / integer) would she have to engage in the following activities (without a weighted vest) to expend a similar amount of energy (as if she was wearing the 9 kg vest)?

	Difference in PA (vest - no vest; kcal)	Energetic Cost (kcal/kg/min)	Weight (kg)	Extra Time (min)
Walking		0.066	60	
Stairmaster		0.155	60	
Pilates		0.047	60	
Watching TV		0.016	60	
Yardwork		0.05	60	

9. Your mom decided against purchasing the 18 kg (approximately 40 lb) weight vest. How many more minutes (rounded up to the next whole number / integer) would she have to engage in the following activities (without a weighted vest) to expend a similar amount of energy (as if she was wearing the 18 kg vest)?

	Difference in PA (vest - no vest; kcal)	Energetic Cost (kcal/kg/min)	Weight (kg)	Extra Time (min)
Walking		0.066	60	
Stairmaster		0.155	60	
Pilates		0.047	60	
Watching TV		0.016	60	
Yardwork		0.05	60	

10. Modern evidence indicates that the starvation response begins to be initiated when?

11. Complete the table below (rounded to nearest whole number / integer) for the following cases:

	Metabolic Rate (kcal)	Calories Consumed (kcal)	Exercise Expenditure (kcal)	Non-Exercise Expenditure (kcal)	TEF (kcal)	Caloric Deficit (kcal)
Case 1	1750	2100	800	200		
Case 2	2560	3500	250	225		
Case 3	1624	2200	410	100		

12. Using the data above, which case has likely activated a starvation response?

13. Calculate the energy availability (rounded to nearest whole number / integer) for the following cases:

	Calories Consumed (kcal)	Exercise Expenditure (kcal)	Weight (kg)	Body Fat (%)	Energy Availability (kcal/kg FFM)
Case 1	2100	800	72	14	
Case 2	3250	350	86	21	
Case 3	5312	400	105	10	
Case 4	1180	100	68	26	
Case 5	1740	250	59	31	

14. Based upon the table above, what case(s) would be considered to have Optimal Energy Availability?

15. Based upon the table above, what case(s) would be considered to have Clinically Low Energy Availability?

16. Complete the table below (rounded to nearest whole number / integer) for the following cases to determine the caloric difference between calories consumed and exercise expended that would be associated with each level of energy availability:

	FFM Weight (kg)	Optimal Energy Availability (45 kcal/kg FFM)	Clinically Low Energy Availability (29 kcal/kg FFM)
Case 1	30		
Case 2	40		
Case 3	50		
Case 4	60		
Case 5	70		
Case 6	80		

Data: Your friend has been trying to lose weight by tracking their calorie balance for the past several weeks, but their weight and body composition have stayed the same at 70 kg and 23% fat.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Average Daily Calories Consumed (kcal)								
	2100	2681	3190	4431	1820	2231	2319	2671
Average Daily Physical Activity Expenditure (kcal)								
	800	650	791	412	761	655	900	541

17. Using their data above, calculate their habitual caloric consumption using the perceived energy balance approach (rounded to nearest whole number / integer).

18. Using their data above, calculate their habitual physical activity expenditure using the perceived energy balance approach (rounded to nearest whole number / integer).

19. Using their data above, calculate their perceived energy balance (rounded to nearest whole number / integer).

20. Using their data above and the information that one pound of fat is equivalent to 3,500 kcals, complete the table below (rounded to nearest whole number / integer) to see what effects different scenarios for altering food consumption and physical activity would have. For weeks to lose one lb of fat round up to the nearest whole number / integer.

	Metabolic Rate (kcal)	Calories Consumed (kcal)	PA Expenditure (kcal)	TEF (kcal)	Avg Daily Caloric Deficit (kcal)	Total Weekly Caloric Deficit (kcal)	Weeks to lose 1 lb of Fat
Case 1		2433 - 200	675				
Case 2		2433	675 + 100				
Case 3		2433 - 200	675 + 200				
Case 4		2433 - 100	675 + 100				