Improving Public Health by Understanding Diversity in Metabolism, Body Composition & Calorie Requirements

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Learning Objectives

1. Use the NIH body weight planner to accurately estimate the calorie requirements of patients who would benefit from changing their body composition

2. Use calorie requirements to make practical recommendations for patients

See 1 citation found by title matching your search:

N Engl J Med. 1990 May 24;322(21):1477-82.

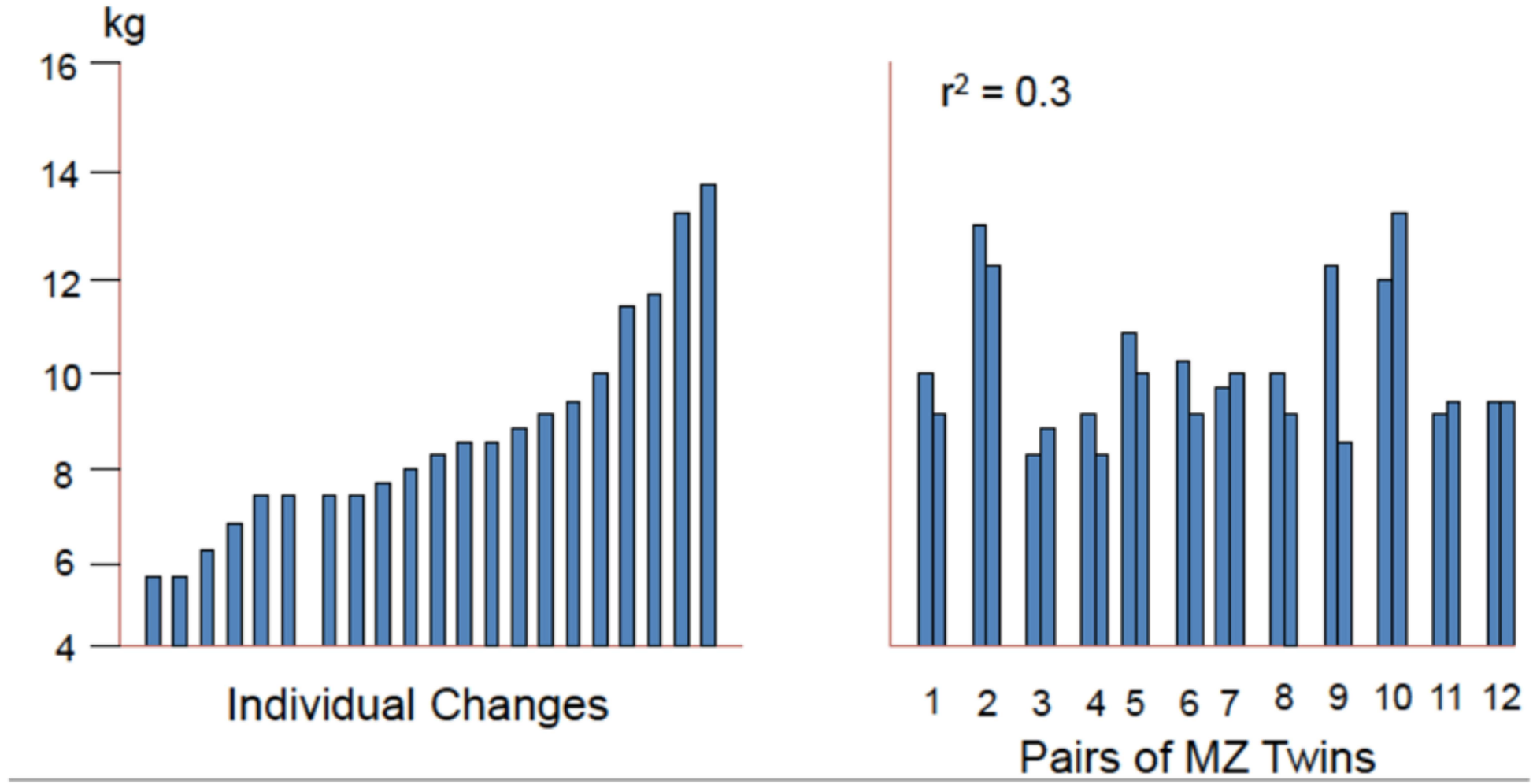
The response to long-term overfeeding in identical twins.

Bouchard C[1], Tremblay A, Després JP, Nadeau A, Lupien PJ, Thériault G, Dussault J, Moorjani S, Pinault S, Fournier G.

Author information

Abstract

We undertook this study to determine whether there are differences in the responses of different persons to long-term overfeeding and to assess the possibility that genotypes are involved in such differences. After a two-week base-line period, 12 pairs of young adult male monozygotic twins were overfed by 4.2 MJ (1000 kcal) per day, 6 days a week, for a total of 84 days during a 100-day period. The total excess amount each man consumed was 353 MJ (84,000 kcal). During overfeeding, individual changes in body composition and topography of fat deposition varied considerably. The mean weight gain was 8.1 kg, but the range was 4.3 to 13.3 kg. The similarity within each pair in the response to overfeeding was significant (P less than 0.05) with respect to body weight, percentage of fat, fat mass, and estimated subcutaneous fat, with about three times more variance among pairs than within pairs (r approximately 0.5). After adjustment for the gains in fat mass, the within-pair similarity was particularly evident with respect to the changes in regional fat distribution and amount of abdominal visceral fat (P less than 0.01), with about six times as much variance among pairs as within pairs (r approximately 0.7). We conclude that the most likely explanation for the intrapair similarity in the adaptation to long-term overfeeding and for the variations in weight gain and fat distribution among the pairs of twins is that genetic factors are involved. These may govern the tendency to store energy as either fat or lean tissue and the various determinants of the resting expenditure of energy.



Bouchard et al. NEJM 1990:322;1477

Patient Example:

Gender: Women
Age: 45 years
Height: 5’6’’
Weight: 200 lbs
BMI: 32.3
Waist Circumference: 40 inches

Fasting blood sugar: 115 mg/dL
Hemoglobin A1c: 6.2%

Would this patient benefit from decreasing her body fat via TLC?

FROM THE ACADEMY
Position Paper

Position of the Academy of Nutrition and Dietetics: Interventions for the Treatment of Overweight and Obesity in Adults

ABSTRACT

It is the position of the Academy of Nutrition and Dietetics that successful treatment of overweight and obesity in adults requires adoption and maintenance of lifestyle behaviors contributing to both dietary intake and physical activity. These behaviors are influenced by many factors; therefore, interventions incorporating more than one level of the socioecological model and addressing several key factors in each level may be more successful than interventions targeting any one level and factor alone. Registered dietitian nutritionists, as part of a multidisciplinary team, need to be current and skilled in weight management to effectively assist and lead efforts that can reduce the obesity epidemic. Using the Academy of Nutrition and Dietetics' Evidence Analysis Process and Evidence Analysis Library, this position paper presents the current data and recommendations for the treatment of overweight and obesity in adults. Evidence on intrapersonal influences, such as dietary approaches, lifestyle intervention, pharmacotherapy, and surgery, is provided. Factors related to treatment, such as intensity of treatment and technology, are reviewed. Community-level interventions that strengthen existing community assets and capacity and public policy to create environments that support healthy energy balance behaviors are also discussed.
J Acad Nutr Diet. 2016;116:129-147.

POSITION STATEMENT

It is the position of the Academy of Nutrition and Dietetics that successful treatment of overweight and obesity in adults requires adoption and maintenance of lifestyle behaviors contributing to both dietary intake and physical activity. These behaviors are influenced by many factors; therefore, interventions incorporating more than one level of the socioecological model and addressing several key factors in each level may be more successful than interventions targeting any one level and factor alone.

How much weight loss should we recommend?

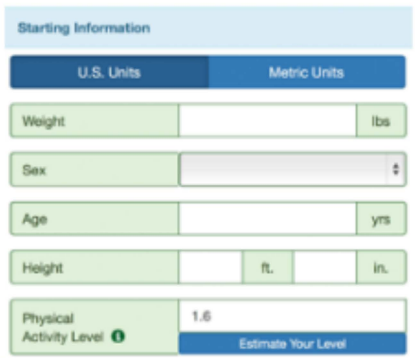
Weight loss of only 3% to 5% that is maintained has the ability to produce clinically relevant health improvements (eg, reductions in triglycerides, blood glucose, and risk of developing type 2 diabetes).[1] Larger weight loss reduces additional risk factors of CVD (eg, low-density and high-density lipoprotein cholesterol and blood pressure) and decreases the need for medication to control CVD and type 2 diabetes. Thus, a goal of weight loss of 5% to 10% within 6 months is recommended.[1]

EAL Recommendation: "The registered dietitian nutritionist (RDN) should collaborate with the individual regarding a realistic weight-loss goal such as one of the following: up to 2 lb per week, up to 10% of baseline body weight, or a total of 3% to 5% of baseline weight if cardiovascular risk factors (hypertension, hyperlipidemia, and hyperglycemia) are present." **(Rating: Strong, Imperative)**

Body Weight Planner

The Body Weight Planner allows users to make personalized calorie and physical activity plans to reach a goal weight within a specific time period and to maintain it afterwards.

Launch the Body Weight Planner



Watch a video to see how to use the Body Weight Planner

Use SuperTracker to get a personalized meal plan based on your calorie results from the Body Weight Planner. SuperTracker is a free food, physical activity, and weight tracking tool from ChooseMyPlate.gov.

Model of Human Metabolism

$$\rho_C \frac{dG}{dt} = CI - DNL + GNG_P + GNG_T - G3P - CarbOx$$

$$\rho_T \frac{dF}{dt} = 3M_{TRIG}FI/M_{TG} + e_d DNL - KU_{exer} - (1-e_k)KTG - FatOx$$

$$\rho_P \frac{dP}{dt} = PI - GNG_P - ProtOx$$

$$FFM = BM + ECF + ECP + LCM$$
$$= BM + ECF + ECP + ICW + P + G + ICS$$
$$= BM + ECF + ECP + \hat{I}CW + P(1+h_P) + G(1+h_G) + ICS$$

$$\frac{dECF}{dt} = \frac{1}{[Na]}\left(\Delta Na_{diet} - \xi_{ECa}(ECF - ECF_{init}) - \xi_{CI}(1 - CI/CI_b)\right) + \Delta ECF$$

$$\tau_{BW}\frac{d\Delta ECF}{dt} = \xi_{BW}(BW - BW_{init}) - \Delta ECF$$

$$TEE = TEF + PAE + RMR$$

$$RMR = E_c + \gamma_b M_b + \gamma_{FFM}\left[FFM - M_b - \Delta G(1+h_g) - (ECF - ECF_{init})\right] + \gamma_F F$$
$$+(1-e_d)DNL + (1-e_g)(GNG_T + GNG_P) + (1-e_K)KTG$$
$$+\eta_W N_{exer} + (\eta_P + e_P)D_P + \eta_P\frac{dP}{dt} + \eta_T D_T + \eta_T\frac{dF}{dt} + \eta_G D_G + \eta_G\frac{dG}{dt}$$

$$\tau_T\frac{dT}{dt} = \begin{cases} \lambda_1(\Delta EI/EI_b) - T, & \text{if } EI < EI_b \\ \lambda_2(\Delta EI/EI_b) - T, & \text{else} \end{cases}$$

$$\gamma_{FFM} = \sum_i \gamma_i \frac{dM_i}{dFFM}$$

$$\gamma_{FFM} = \hat{\gamma}_{FFM}\left[1 + (1-\sigma)T\right]$$

$$PAE = \delta(1+\sigma T)BW + \upsilon EW$$

$$TEF = \alpha_P PI + \alpha_T PI + \alpha_C CI$$

$$DNL = \frac{CI \times (G/G_{init})^4}{(G/G_{init})^4 + K_{DNL}^4} \qquad D_G = \hat{D}_G\left(\frac{G}{G_{init}}\right)$$

$$CarbOx = GNG_T + GNG_P - G3P + f_C \times \hat{TEE}$$

$$FatOx = KetOx + f_T \times \hat{TEE}$$

$$ProtOx = f_P \times \hat{TEE}$$

$$D_T = \hat{D}_T\left[\left(\frac{P}{P_{Keyn}}\right) + \chi\left(\frac{\Delta PI}{PI_b}\right)\right]$$

$$D_P = \hat{D}_P\left(\frac{P}{P_{Keyn}}\right)^{\frac{3}{4}}\left[L_{diet} + L_{PA}\right]$$

$$\tau_L\frac{dL_{diet}}{dt} = \frac{K_L^{S_L}\left[1 + (A_L - B_L)\times\exp\left(-k_L CI/CI_b\right) + B_L\right]}{K_L^{S_L} + MAX\left\{0,\left(F/F_{Keyn} - 1\right)^{S_L}\right\}} - L_{diet}$$

$$GNG_T = FI\left(\frac{\rho_C M_G}{\rho_T M_{TG}}\right) + D_T\rho_C\left(\frac{M_G}{M_{TG}}\right) \qquad L_{PA} = \varphi\left(\frac{\delta + \upsilon}{\delta_{init} + \upsilon_{init}} - 1\right)$$

$$GNG_P = G\hat{N}G_P\left[\left(\frac{P}{P_{Keyn}}\right) - \Gamma_C\left(\frac{\Delta CI}{CI_b}\right) + (\Gamma_P + \chi)\left(\frac{\Delta PI}{PI_b}\right)\right]$$

$$KTG = \rho_K D_T\left[A_K\left(\frac{D_T/\hat{D}_T}{K_K + D_T/\hat{D}_T}\right)\exp\left(-k_T\frac{PI}{PI_b}\right)\exp\left(-k_G\frac{G}{G_{init}}\right)\right]$$

$$KU_{exer} = \begin{cases} 0, & \text{if } KTG/\rho_K < KTG_{thresh} \\ \dfrac{\rho_K KU_{max}(KTG/\rho_K - KTG_{thresh})}{(KTG_{max} - KTG_{thresh})}, & \text{else} \end{cases}$$

$$f_C = \frac{w_G(D_G/\hat{D}_G) + w_C MAX\left\{0,(1 + S_C\Delta CI/CI_b)\right\}G/(G_{min} + G)}{Z}$$

$$f_T = \frac{w_T\left(D_T/\hat{D}_T\right)}{Z}$$

$$f_P = \frac{w_P MAX\left(0,\left(1 + P_{sig}\right)\right) + \left(D_P/\hat{D}_P\right)S_A\exp\left(-k_A(\delta+\upsilon)/(\delta_b + \upsilon_b)\right)}{Z}$$

$$\tau_{sig}\frac{dP_{sig}}{dt} = S_I\,\Delta PI/PI_b - P_{sig}$$

Body Weight Planner | *Balancing Your Food and Activity*

Step 1 of 4 - Enter your starting information

Switch to Expert Mode

Starting Information

U.S. Units | Metric Units

Weight	200			lbs
Sex	Female			
Age	45			yrs
Height	5	ft.	6	in.
Physical Activity Level	1.6			

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.

Body Weight Planner | *Balancing Your Food and Activity*

Step 1 of 4 - Enter your starting information

Starting Information

U.S. Units | Metric Units

Weight	200			lbs
Sex	Female			
Age	45			yrs
Height	5	ft.	6	in.
Physical Activity Level	1.6	Estimate Your Level		

Next Step

Starting Information

Enter your starting information, in
physical activity level.

Physical Activity Level

Click the "Estimate Your Level" bu

Typical physical activity level num
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.

Estimate Your Physical Activity Level

Describe your physical activity at work or school:

Very Light

Sitting at the computer most of the day, or sitting at a desk.

Describe your physical activity at leisure time:

Moderate

Regular activity at least once a week, e.g., walking, bicycling (including to work) or gardening.

Cancel | Save

Body Weight Planner | *Balancing Your Food and Activity*

Step 2 of 4 - Enter your goal weight

Switch to Expert Mode

Weight Goal

Goal Weight	180	lbs
I want to reach my goal in	140	days

OR select a date

I want to reach my goal by	9/24/2018	

Previous Step

Next Step

Goal Weight

Enter your goal weight and when you would like to reach it.

You can enter a number of days OR choose a specific date using the calendar.

National Institute of Diabetes and Digestive and Kidney Diseases

Body Weight Planner | *Balancing Your Food and Ac*

Step 3 of 4 - Enter your physical activity change (optional)

Physical Activity Change

To reach my goal, I will change my physical activity by 9 % Calculate

Physical Activity C

Click the "Calculate

Changing your phys

The physical activity
reach your goal and

If you don't want to change your physical activity, click the "Next Step" button to skip this step.

Previous Step | Next Step

Estimate Percent Change in Physical Activity Level

I will make the following changes to my physical activity:

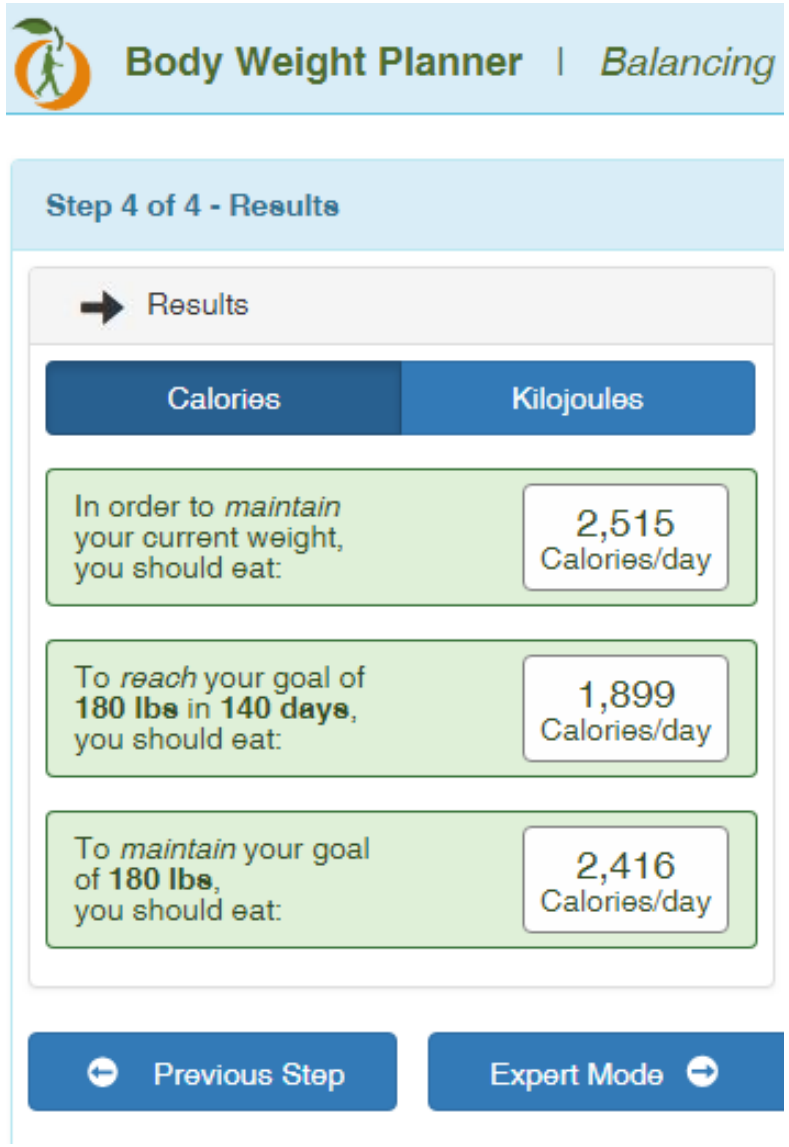
I plan to Add **Medium Walking** **for** 30 **minutes,** 3 **times per** week Delete

This represents a change of **9%** to your starting activity level

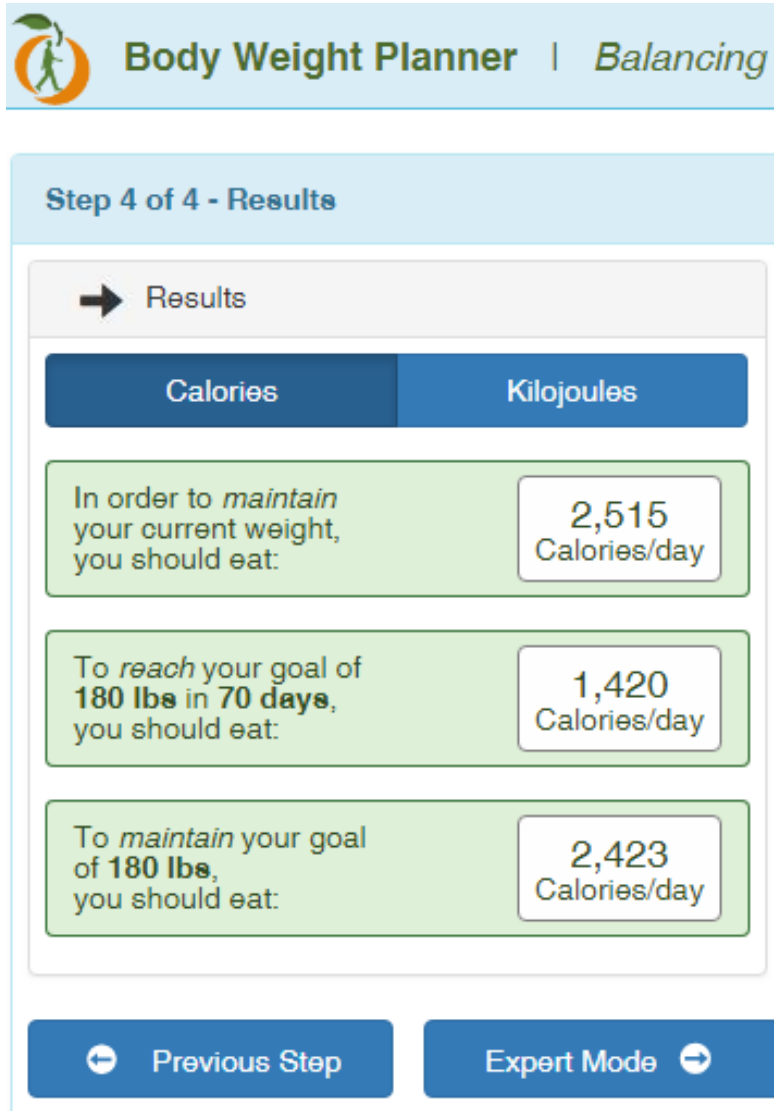
Specify Another Change

Cancel | Save

Recommendations for
1 lb of fat loss per week



Recommendations for
2 lbs of fat loss per week



Body Weight Planner | *Balancing Your Food and Activity*

Starting Information — Advanced Controls: OFF

Weight	200	lbs
Sex	Female	
Age	45	yrs
Height	5 ft. 6 in.	feet
Physical Activity Level	1.6	Estimate Your Level

Goal Weight | Lifestyle Change

Weight Goal

Goal Weight	180	lbs
I want to reach my goal in	45	days

OR select a date

I want to reach my goal by	6/21/2018	

Physical Activity Change (Optional)

Weight Change Phase

To reach my goal, I will change my physical activity by 9 % Calculate

Goal Maintenance Phase

To maintain my goal, I will change my physical activity by 9 % Calculate

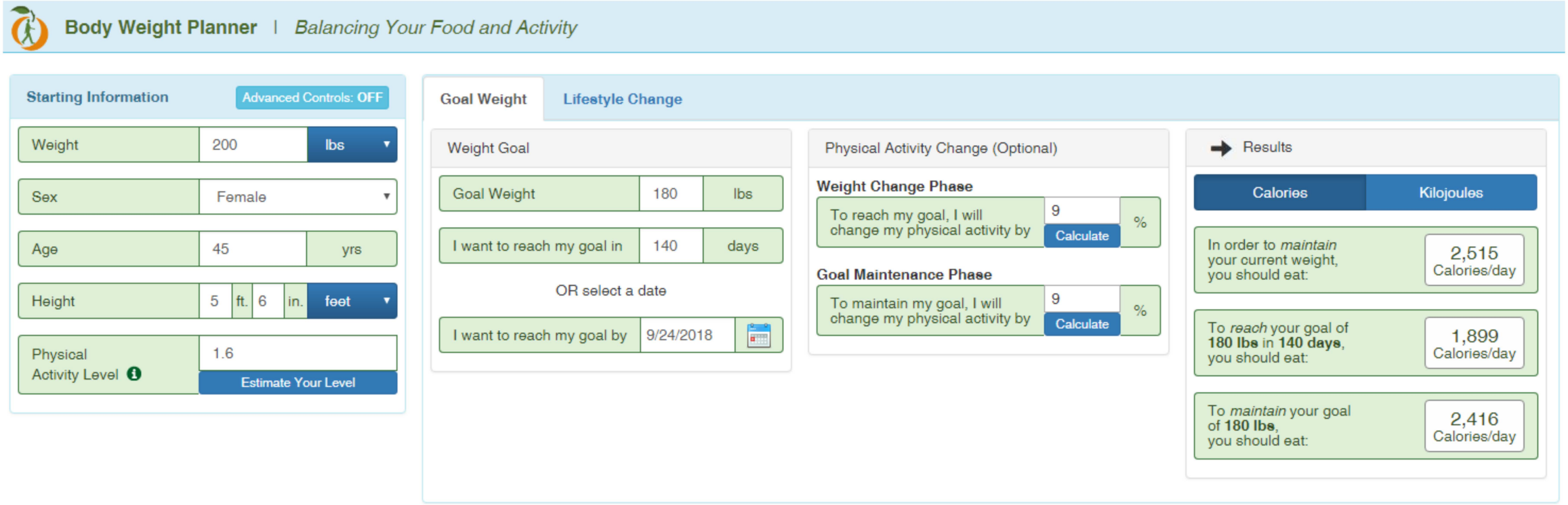
Results

Calories | Kilojoules

In order to *maintain* your current weight, you should eat:	2,515 Calories/day
To *reach* your goal of **180 lbs** in **45 days**, you should eat:	991 Calories/day
To *maintain* your goal of **180 lbs**, you should eat:	2,429 Calories/day

Simulation Displayed

The information you entered results in a calorie level that is too low.
Calorie goals must be at least 1000 calories/day. Food group targets and nutrient recommendations will not be met below 1000 calories/day.
The last change you made has been reset so that you can enter a different value. Try giving yourself more time to achieve your goal, changing your activity level, or setting a different goal.


Body Weight Planner | Balancing Your Food and Activity
Starting Information
Advanced Controls: OFF
Weight
200
lbs
Sex
Female
Age
45
yrs
Height
5
ft.
6
in.
feet
Physical Activity Level
1.6
Estimate Your Level
Goal Weight
Lifestyle Change
Weight Goal
Goal Weight
180
lbs
I want to reach my goal in
140
days
OR select a date
I want to reach my goal by
9/24/2018
Physical Activity Change (Optional)
Weight Change Phase
To reach my goal, I will change my physical activity by
9
Calculate
%
Goal Maintenance Phase
To maintain my goal, I will change my physical activity by
9
Calculate
%
Results
Calories
Kilojoules
In order to maintain your current weight, you should eat:
2,515
Calories/day
To reach your goal of 180 lbs in 140 days, you should eat:
1,899
Calories/day
To maintain your goal of 180 lbs, you should eat:
2,416
Calories/day

Application:

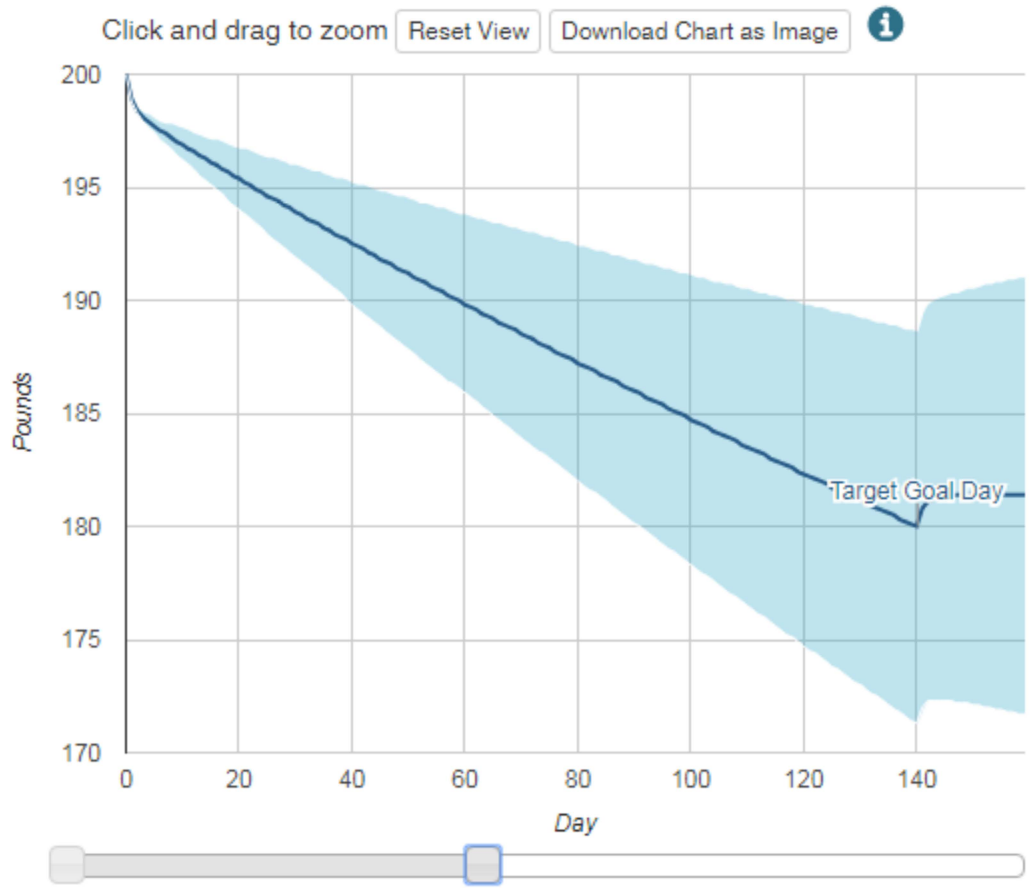
1. Patients can track food & calorie intake with an app on their phone, like My Fitness Pal, with goals and calorie recommendations that are:

- Evidence Based
- Realistic

Length of Simulation	365	days

Initial Weight (lbs):	200	Initial % Fat:	43.1	Initial BMI:	32.3
Final Weight (lbs):	181.2	Final % Fat:	39.7	Final BMI:	29.2

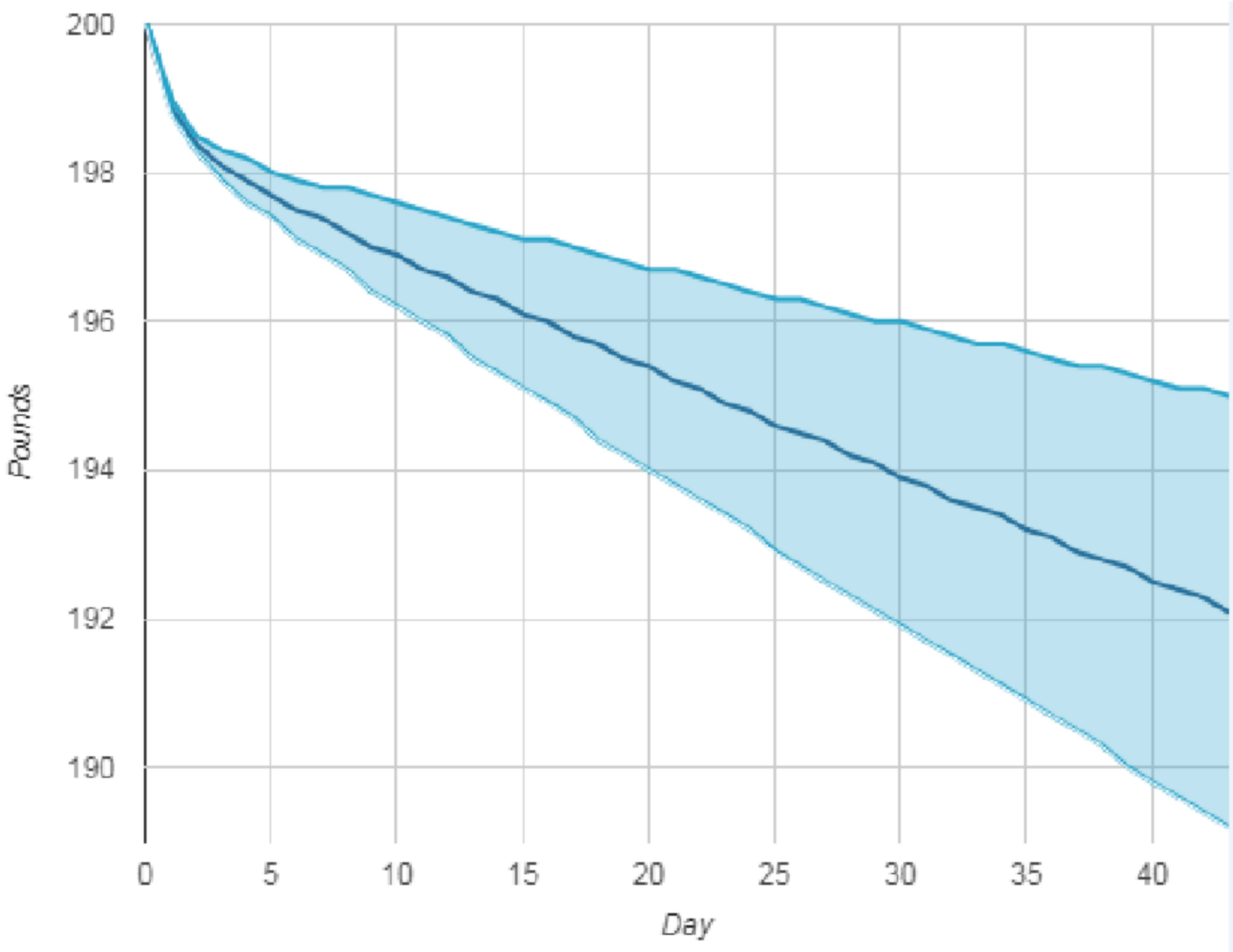
Weight | Body Fat % | Intake & Expenditure | Tabular



Application:

2. Accurately measuring weight at home:

- Use the same digital scale each time
- Ensure scale is on firm flooring
- If possible use the bathroom before weighing
- Weigh nude or in underwear
- Check & record body weight in the morning before eating


200
198
196
194
192
190
Pounds
0
5
10
15
20
25
30
35
40
Day

Application:

3. Tracking body weight over time provides insight into calorie intake & expenditure

Calorie Deficit = Decreasing Weight

Calorie Balance = Weight Maintenance

Calorie Surplus = Increasing Weight

How else is this information useful?

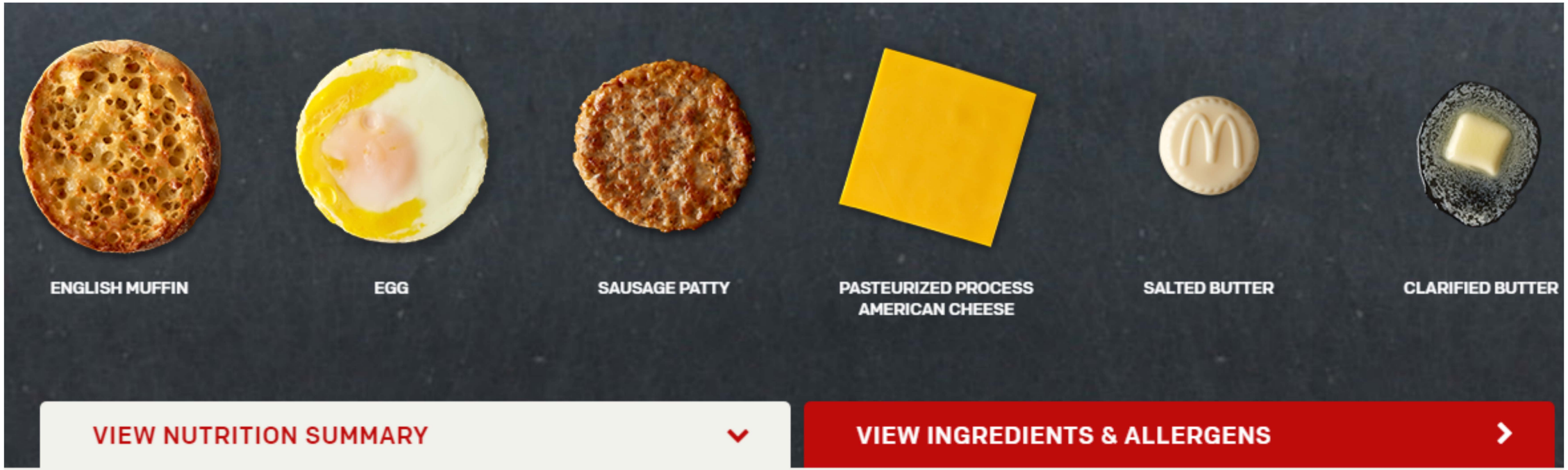

new
dollar menu & more
$1.00
new
Buffalo Ranch McChicken*
350 Cal.
new
BBQ Ranch Burger
350 Cal.
Grilled Onion Cheddar* Burger
310 Cal.
McChicken*
360 Cal.
1.29
Side Salad
20 Cal.
Sweet Tea lg.
220 Cal.
Fruit 'N Yogurt Parfait
150 Cal.
Cookies
150-160 Cal. ea.
Cone
170 Cal.
$1.49
Double Cheeseburger
440 Cal.
$1.19
McDouble*
390 Cal.
*Pasteurized process.
$2.00
& more
new
Bacon Cheddar* McChicken*
480 Cal.
new
Bacon Buffalo Ranch McChicken*
420 Cal.
new
Bacon McDouble*
460 Cal.
$5.00
20 pc. Chicken McNuggets*
Serves 2
470 Cal. ea.

Application:

4. Provide calorie guidelines for meals & snacks that patients can use when eating out:

Daily goal: 1,900 calories/day

If a patient ate 3 meals and 2 snacks per day, they could aim for 500 calorie for meals and 200 calories for snacks



VIEW NUTRITION SUMMARY

VIEW INGREDIENTS & ALLERGENS

470 Calories	30g Total Fat (46% DV)	30g Total Carbs (10% DV)	21g Protein
Calories From Fat: 270 Saturated Fat: 12g (60% DV) Trans Fat: 0g Cholesterol: 275mg (91% DV)	Sodium: 810mg (34% DV) Dietary Fiber: 2g (7% DV) Sugars: 3g	Vitamin A: 770IU (15% DV) Vitamin C: 2mg (4% DV) Calcium: 170mg (15% DV) Iron: 3.5mg (20% DV)	

*Percent Daily Values (DV) are based on a 2,000 calorie diet

Nutrition Facts

Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving

Calories 230	Calories from Fat 72
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Nutrition Facts

8 servings per container
Serving size **2/3 cup (55g)**

Amount per serving
Calories **230**

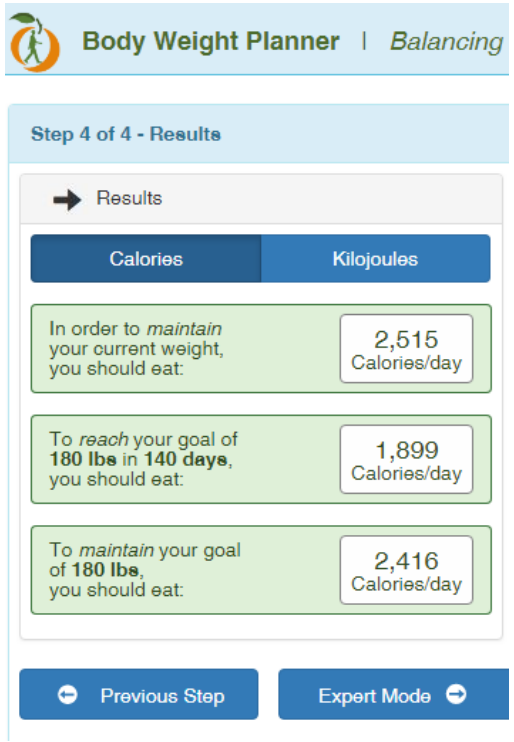
	% Daily Value*
Total Fat 8g	**10%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**13%**
Dietary Fiber 4g	**14%**
Total Sugars 12g	
Includes 10g Added Sugars	**20%**
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Application:

5. Understanding the daily calorie deficit necessary to reduce body fat allows a provider to predict the impact of individual dietary change

2,515 - 1,899 = **616 calorie deficit**



24 ounces of Pepsi (300 calories)

Conclusion:

1. The NIH Body Weight Planner is a free, easy and evidence based tool to estimate the calorie requirements needed to change body composition over a specific period of time

2. RDs & PCPs can use this information to educate patients in visits and make practical recommendations that don’t require counting calories

Thank you! Any Questions?

Gavin Moloney, MS, RD