Cell Metabolism, Volume *30*

Supplemental Information

Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of *Ad Libitum* Food Intake

Kevin D. Hall, Alexis Ayuketah, Robert Brychta, Hongyi Cai, Thomas Cassimatis, Kong Y. Chen, Stephanie T. Chung, Elise Costa, Amber Courville, Valerie Darcey, Laura A. Fletcher, Ciaran G. Forde, Ahmed M. Gharib, Juen Guo, Rebecca Howard, Paule V. Joseph, Suzanne McGehee, Ronald Ouwerkerk, Klaudia Raisinger, Irene Rozga, Michael Stagliano, Mary Walter, Peter J. Walter, Shanna Yang, and Megan Zhou

Supplemental Information

	All (N=20)	Female (N=10)	Male (N=10)
Age (years)	31.2±1.6	30.9±2.4	31.5±2.2
Height (m)	1.70±0.02	1.65±0.02	1.75±0.02
Body Weight (kg)	78.2±4.7	77.4±7.2	79.2±6.6
Fat Mass (kg)	24.6±3.0	29.3±4.5	19.8±3.7
Body Fat (%)	30.0±2	36.7±3	23.3±3
Resting Energy Expenditure (kcal/d)	1510±61	1438±86	1582±86

Table S1. Baseline anthropometrics of the study subjects. Mean ± SE.

The daily menus described below include photographs depicting meals representing the average amount presented to subjects corresponding to Table 1 of the main text.

Ultra-processed Menu

Day 1

Breakfast

Honey Nut Cheerios (General Mills)

Whole milk (Cloverland) with NutriSource fiber

Blueberry muffin (Otis Spunkmeyer) Margarine (Glenview Farms)

Ultra-processed Menu

Day 1

Lunch

Beef ravioli (Chef Boyardee)

Parmesan cheese (Roseli)

White bread (Ottenberg)

Margarine (Glenview Farms)

Diet lemonade (Crystal Light) with NutriSource fiber

Oatmeal raisin cookies (Otis Spunkmeyer)

Ultra-processed Menu

Day 1

Dinner

Steak (Tyson)

Gravy (McCormick)

Mashed potatoes (Basic American Foods)

Margarine (Glenview Farms)

Corn (canned, Giant)

Diet lemonade (Crystal Light) with NutriSource fiber

Low fat chocolate milk (Nesquik) with NutriSource fiber

Ultra-processed Menu

Day 2

Breakfast

Croissant (Chef Pierre)

Margarine (Glenview Farms)

Turkey sausage (Ember Farms)

Blueberry yogurt (Yoplait) with NutriSource fiber

Ultra-processed Menu

Day 2

Lunch

Deli turkey (Jenni-O) and cheddar and Monterey Jack cheese (Glenview Farms) quesadilla (Pasado tortilla)

Refried beans (Old El Paso)

Sour cream (Glenview Farms)

Salsa (del Pasado)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

<u>Day 2</u>

<u>Dinner</u>

Chicken salad (Giant canned chicken, Heinz pickle relish, Hellmann's mayonnaise) sandwich on white bread (Ottenberg)

Peaches canned in heavy syrup (Giant)

Shortbread cookies (Keebler)

Fig Newtons (Nabisco)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

<u>Day 3</u>

<u>Breakfast</u>

Egg (Papetti's), turkey bacon (Jenni-O) and American cheese (Glenview Farms) on an English muffin (Sara Lee)

Tater tots (Monarch) with ketchup (Heinz)

Orange juice (Sun Cup) with NutriSource Fiber

Ultra-processed Menu

Day 3

Lunch

Tempura fried chicken nuggets (Pierce) with ketchup (Heinz)

Baked potato chips (Lay's)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

Day 3

Dinner

Turkey meatballs (Devault Foods) with marinara sauce (Angelina Mia) on a hoagie roll (Ottenberg) with provolone cheese (Roseli)

Diet lemonade (Crystal Light) with NutriSource fiber

Cheese and Peanut Butter Sandwich Crackers (Keebler)

Ultra-processed Menu

Day 4

Breakfast

Scrambled egg, prepared from liquid (Fresh Start)

Pork sausage (Hormel)

Honey bun (Little Debbie)

Orange juice (Sun Cup) with NutriSource fiber

Ultra-processed Menu

Day 4

Lunch

Hot dog (Patunxent Farms) on bun (Hilltop Hearth) with ketchup (Heinz) and yellow mustard (Monarch)

Baked potato chips (Lay's)

Cranberry juice (Sun Cup) with NutriSource fiber

Blueberry yogurt (Yoplait) with NutriSource fiber

Ultra-processed Menu

Day 4

Dinner

Steak (Tyson) and Cheddar and Monterey Jack Cheese (Glenview Farms) burrito (Pasado Tortilla) with canned black beans (Pasado)

Sour cream (Glenview Farms)

Salsa (del Pasado)

Tortilla chips (Tostitos)

Diet Lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

Day 5 (Respiratory Chamber)

Breakfast

Plain bagel (Lender's) and cream cheese (Philadelphia) with NutriSource fiber

Turkey bacon (Jenni-O)

Ultra-processed Menu

<u>Day 5 (Respiratory Chamber)</u>

<u>Lunch</u>

Spam sandwich with American cheese (Glenview Farms) on white bread (Ottenberg)

Potato chips (Lay's)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

<u>Day 5 (Respiratory Chamber)</u>

<u>Dinner</u>

Beef and bean chili (Hormel)

Shredded cheddar and Monterey Jack cheese (Glenview Farms)

Sour cream (Glenview Farms)

Tortilla chips (Tostitos)

Salsa (del Posado)

Diet Ginger Ale (Shasta)

Peaches, canned in heavy syrup (Giant)

Ultra-processed Menu

Day 6

Breakfast

Pancakes (Eggo)

Margarine (Glenview Farms)

Syrup (Smucker's)

Turkey sausage (Ember Farms)

Tater tots (Monarch)

Apple juice (Sun Cup) with NutriSource Fiber

Ultra-processed Menu

Day 6

Lunch

Cheeseburger with American cheese (Glenview Farms) on a Kaiser roll (Anzio & Sons)

French fries (Monarch)

Ketchup (Heinz)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

Day 6

Dinner

Deli turkey (Jenni-O) with American cheese (Glenview Farms) and mayonnaise (Hellmann's) on white bread (Ottenberg)

Baked potato chips (Lay's)

Peaches canned in heavy syrup (Giant)

Vanilla nonfat greek yogurt (Dannon) with NutriSource fiber

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

Day 7

Breakfast

Cinnamon french toast sticks (Eggo)

Butter (Giant)

Pancake syrup (Smucker's)

Turkey sausage (Ember Farms)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

Day 7

Lunch

Macaroni and cheese (Stouffer's)

Chicken tenders (Perdue)

Canned green beans (Giant)

Diet lemonade (Crystal Light) with NutriSource fiber

Ultra-processed Menu

Day 7

Dinner

Peanut butter (Monarch) and jelly (Monarch) sandwich on white bread (Ottenberg)

2% milk (Cloverland) with NutriSource fiber

Baked Cheetos (Frito-Lay)

Graham crackers (Nabisco)

Chocolate pudding (Snack Pack) with NutriSource fiber

Ultra-processed Menu

Daily Snacks

Baked Potato Chips (Lay's), Dry Roasted Peanuts (Planters), Cheese & Peanut Butter Sandwich Crackers (Keebler), Goldfish Crackers (Pepperidge Farm), Applesauce (Lucky Leaf).

Unprocessed Menu

Day 1

Breakfast

Greek yogurt (Fage) parfait with strawberries, bananas, with Walnuts (Diamond), Salt and Olive Oil

Apple Slices with Fresh Squeezed Lemon

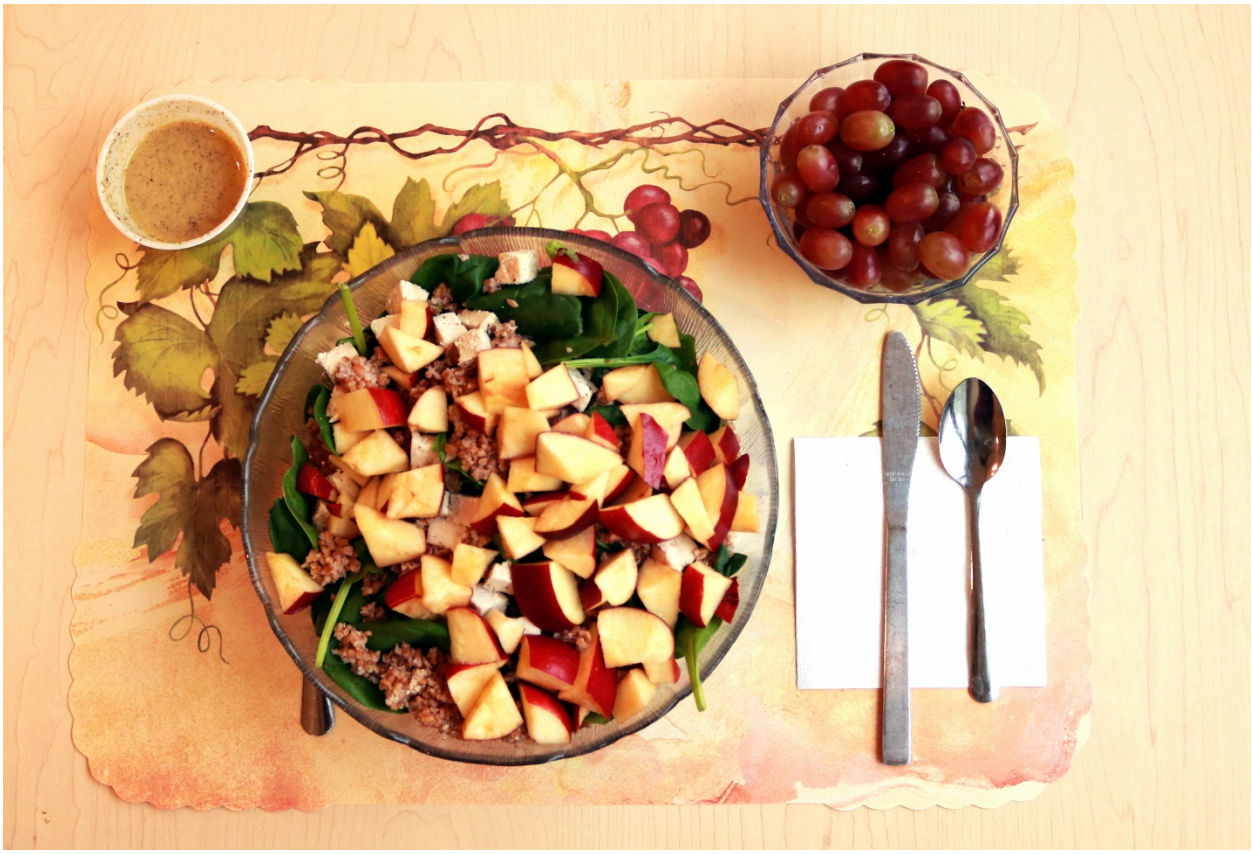
Unprocessed Menu

Day 1

Lunch

Spinach salad with chicken breast, apple slices, bulgur (Bob's Red Mill), sunflower seeds (Nature's Promise) and grapes

Vinaigrette made with olive oil, fresh squeezed lemon juice, apple cider vinegar (Giant), ground mustard seed (McCormick), black pepper (Monarch) and salt (Monarch)



Unprocessed Menu

<u>Day 1</u>

<u>Dinner</u>

Beef tender roast (Tyson)

Rice pilaf (basmati rice (Roland) with garlic, onions, sweet peppers and olive oil)

Steamed broccoli

Side salad (Green leaf lettuce, tomatoes, cucumbers) with balsamic vinaigrette (balsamic vinegar (Nature's Promise)

Orange slices

Pecans (Monarch)

Salt and Pepper (Monarch)

Unprocessed Menu

Day 2

Breakfast

Scrambled egg (made from fresh eggs)

Hash brown potatoes (potato, garlic, paprika (Simply Organic), ground turmeric (McCormick), cream (Stoneyfield) and onions)

Salt and Pepper (Monarch)

Unprocessed Menu

<u>Day 2</u>

<u>Lunch</u>

Entrée salad with grilled chicken breast, baked sweet potato, corn (Monarch, from frozen), avocado, onions, tomatoes, carrots on green leaf lettuce

Vinaigrette (red wine vinegar (Giant) and olive oil)

Skim milk (Cloverland)

Apple slices with fresh squeezed lemon juice

Unprocessed Menu

Day 2

Dinner

Stir fried beef tender roast (Tyson) with broccoli, onions, sweet peppers, ginger, garlic and olive oil

Basmati rice (Roland)

Orange slices

Pecan halves (Monarch)

Salt and Pepper (Monarch)

Unprocessed Menu

Day 3

Breakfast

Oatmeal (Quaker) with blueberries and raw almonds

Salt (Monarch)

2% milk (Cloverfield)

Unprocessed Menu

Day 3

Lunch

Entrée salad with grilled chicken breast, farro (Bob's Red Mill), apples, grapes

Vinaigrette (fresh squeezed lemon juice, apple cider vinegar (Giant), olive oil)

Salt and Pepper (Monarch)

Unprocessed Menu

Day 3

Dinner

Beef tender roast (Tyson)

Couscous (Near East) with fresh squeezed lemon juice, garlic and olive oil

Green beans, from frozen (Monarch)

Side salad with green leaf lettuce, cucumber and tomatoes

Vinaigrette (red wine vinegar, honey (Monarch), olive oil

Salt and Pepper (Monarch)

Black bean hummus (black beans cooked from dried, garlic, sweet pepper, olive oil, fresh squeezed lemon juice, ground cumin (Monarch), chili powder (Giant)) and baby carrots

Unprocessed Menu

Day 4

Breakfast

Spinach, onion and tomato omelet (fresh eggs) cooked in olive oil

Sweet potato hash (sweet potato, olive oil and cinnamon)

Salt and Pepper (Monarch)

Skim milk (Cloverland)

Unprocessed Menu

Day 4

Lunch

Baked cod filet (Harbor Banks) with fresh squeezed lemon juice

Baked russet potato with olive oil

Steamed broccoli with olive oil and garlic

Side salad (green leaf lettuce, tomatoes, cucumber and carrots)

Vinaigrette (balsamic vinegar (Nature's Promise) and olive oil)

Salt and Pepper (Monarch)

Unprocessed Menu

Day 4

Dinner

Southwest entrée salad with green leaf lettuce, tomatoes, cucumbers, carrots, black beans (cooked from dried), corn (cooked from frozen), and avocado

Vinaigrette (red wine vinegar, fresh squeezed lemon juice and flaxseed oil (International Collection))

Salt and Pepper (Monarch)

Raw almonds (Giant)

Grapes

Unprocessed Menu

<u>Day 5 (Respiratory Chamber)</u>

<u>Breakfast</u>

Oatmeal (Quaker) with skim milk (Cloverland), cinnamon (Monarch), salt (Monarch), walnuts (Diamond), bananas, coconut (Nature's Promise) and fresh squeezed lemon juice

Unprocessed Menu

<u>Day 5 (Respiratory Chamber)</u>

<u>Lunch</u>

Grilled beef tender roast (Tyson)

Barley (Bob's Red Mill) with olive oil and garlic

Steamed broccoli

Side salad (green leaf lettuce, tomatoes, cucumber and baby carrots)

Vinaigrette (apple cider vinegar (Giant) and olive oil)

Salt and Pepper (Monarch)

Apple slices with fresh squeezed lemon juice

Unprocessed Menu

<u>Day 5 (Respiratory Chamber)</u>

<u>Dinner</u>

Shrimp (Xcellent) scampi with spaghetti (Barilla), olive oil, garlic, cream (Stoneyfield), tomatoes, parsley, basil and fresh squeezed lemon juice

Side salad (green leaf lettuce, tomatoes, cucumber)

Vinaigrette (balsamic vinegar (Nature's Promise) and olive oil)

Salt and Pepper (Monarch)

Plain Greek yogurt (FAGE) with blueberries (from frozen, no sugar added (Giant)

Unprocessed Menu

Day 6

Breakfast

Berry and walnut Quinoa breakfast cereal (quinoa (Nature's Earthly Choice), skim milk (Cloverland), ground cinnamon (Monarch), salt (Monarch), frozen strawberries and blueberries (no sugar added, Giant) and chopped walnuts (Diamond)

Unprocessed Menu

Day 6

Lunch

Salmon (Harbor Banks) with garlic and fresh squeezed lemon juice

Baked sweet potato with olive oil, ground cumin (Monarch) and chili powder (Giant)

Green beans (from frozen, Monarch) with olive oil and garlic

Plain Greek yogurt (Fage) with strawberries (from frozen, no sugar added (Giant)

Salt and Pepper (Monarch)

Unprocessed Menu

Day 6

Dinner

Entrée salad with beef tender roast (Tyson), barley (Bob's Red Mill), spinach, cucumber and tomatoes

Vinaigrette (balsamic vinegar (Nature's Promise), garlic, olive oil, basil, parsley, rosemary)

Salt and Pepper (Monarch)

Orange slices

Unprocessed Menu

Day 7

Breakfast

Spinach, onion and tomato omelet (fresh eggs) cooked with olive oil and salt (Monarch)

Hash browned potatoes (russet potatoes with garlic, olive oil, rosemary (Nature's Promise) and salt (Monarch))

Skim milk (Cloverfield)

Unprocessed Menu

Day 7

Lunch

Grilled chicken breast

Quinoa (Nature's Earthly Choice) salad with raisins (Monarch), onions, chopped walnuts (Diamond), parsley, fresh squeezed lemon juice and olive oil

Side salad (spinach, tomato and cucumber) with vinaigrette (balsamic vinegar (Nature's Promise) and olive oil)

Salt and Pepper (Monarch)

Unprocessed Menu

Day 7

Dinner

Penne pasta (Barilla) primavera (olive oil, garlic, pinto beans (cooked from dried), spinach, basil, tomatoes)

Side salad (green leaf lettuce, baby carrots, broccoli)

Vinaigrette (red wine vinegar (Giant) and olive oil)

Salt and Pepper (Monarch)

Grapes

Unprocessed Menu

Daily Snacks

Fresh oranges and apples, raisins (Monarch), raw almonds (Giant), chopped walnuts (Diamond)