Obesity: Surgical and Pharmaceutical options & Navigating diet trends
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What is Obesity?
The Obesity Medicine Association
Definition of Obesity

• “Obesity is defined as a chronic, relapsing, multi-factorial, neurobehavioral disease, wherein an increase in body fat promotes adipose tissue dysfunction and abnormal fat mass physical forces, resulting in adverse metabolic, biomechanical, and psychosocial health consequences.”

Obesity is common, serious, and costly

• The prevalence of obesity was 39.8% and affected about 93.3 million of US adults in 2015-2016.

• Obesity-related conditions include heart disease, stroke, type 2 diabetes and certain types of cancer that are some of the leading causes of preventable, premature death.

• The estimated annual medical cost of obesity in the United States was $147 billion in 2008 US dollars; the medical cost for people who have obesity was $1,429 higher than those of normal weight.

https://www.cdc.gov/obesity/data/adult.html
Obesity Kills

• *Leading* cause of preventable death

• Recently surpassed smoking as leading cause

• Lifespan shortened 9 - 12 years

• Over 400,000 deaths per year

• 46 deaths each hour
Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2017

Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Obesity Prevalence

- In 2015 – 2016, the prevalence of obesity is estimated to be ~ 40% in US adults, and 18.5% of youths.
- The prevalence of obesity is higher among non-Hispanic black and Hispanic adults than among non-Hispanic white and non-Hispanic Asian adults and youth.
- At least since 1999, the trend towards an increase in prevalence in obesity continues to increase among adults and youths.
Prevalence of Obesity Among U.S. Adults Aged 20-74

Obesity Trends in % those with BMI>30 age 20-74 (Our Future???)

Derived from NHANES data (http://www.cdc.gov/nchs/data/hestat/obesity_adult_09_10/obesity_adult_09_10.html#table1)
Obesity as a Multifactorial Disease

Genetics/Epigenetics
Neurobehavioral
Medical
Endocrine
Environment (Social/Culture)
Immune

Obesity: Epigenetic Etiology/Causes

Epigenetics: Alterations in gene expression without alteration in the genetic code

Pre-pregnancy
• Pre-conception paternal or maternal overweight/obesity may influence epigenetic signaling during subsequent pregnancy:
  – Increased risk of overweight/obesity in offspring
  – Increased risk of other diseases (e.g., cardiovascular disease, cancer, diabetes mellitus, etc.) in offspring

Pregnancy
• Especially in the presence of gestational diabetes mellitus, unhealthy maternal nutrition in women who are pregnant and overweight or with obesity may increase placental nutrient transfer to fetal circulation:
  – Glucose
  – Lipids and fatty acids
  – Amino acids
• Increased maternal nutrient transport may alter fetal gene expression:
  – Covalent modifications of deoxynucleic acid and chromatin
  – May impact stem cell fate
  – May alter postnatal biologic processes involved in substrate metabolism
  – May increase offspring predisposition to overweight/obesity and other diseases

Post-pregnancy
• Adverse effects of epigenetic pathologies may help account for generational obesity
• Improvement in generational obesity in offspring will likely require generational change in nutrition and physical activity in prior generations of parents

Obesity: Extragenetic Etiology/Causes

Extragenetic

- Environment (family, home, geographic location)
- Culture
- Lack of optimal nutrition and physical activity
- Disrupted sleep (e.g., poor quality, too little, or too much)
- Adverse consequences of medications
- Mental stress
- Neurologic dysfunction (central nervous system trauma, hypothalamic inflammation, leptin resistance)
- Viral infections
- Gut microbiota neurologic signaling and transmission of pro-inflammatory state
Obesity is common, serious, and costly:

• The prevalence of obesity was 39.8% and affected about 93.3 million of US adults in 2015-2016.
• Obesity-related conditions include heart disease, stroke, type 2 diabetes and certain types of cancer that are some of the leading causes of preventable, premature death.
• The estimated annual medical cost of obesity in the United States was $147 billion in 2008 US dollars; the medical cost for people who have obesity was $1,429 higher than those of normal weight.

[Image: A balance scale diagram showing the relationship between calories ingested through diet and calories burned through activity.]
Obesity is a Metabolic Disease
Obesity Algorithm

Obesity as a Disease

Data Collection

Evaluation and Assessment

Management Decisions

Motivational Interviewing

Nutritional Intervention

Physical Activity

Behavior Therapy

Pharmacotherapy

Bariatric Procedures

Reference/s: [1]
Which Is the “Best” Measure of Obesity?

Population Assessment

- Body mass index (BMI), waist circumference (WC), and percent body fat (%BF) similarly correlate with prevalence of metabolic syndrome

Individual Assessment

- BMI is a reasonable initial screening measurement for most patients

- WC provides additional information regarding adipose tissue function/dysfunction and predisposition to metabolic disease among individuals with BMI<35 kg/m²

- %BF may be more useful in patients with extremes in muscle mass (i.e., individuals with sarcopenia or substantial increases in muscle mass), and thus may be a more accurate measure of body composition when assessing the efficacy of interventions directed towards change in muscle mass

Reference/s: [1]
BMI = weight (kg)/height (m²)

= \left[ \frac{\text{weight (lbs)}}{\text{height (in}^2\text{)}} \right] \times 703

Acceptable Weight 18 – 25
Overweight 25 – 30
Obese 30 – 35
Severe Obesity 35 – 40
Morbid Obesity 40 – 50
Super Morbid Obesity above 50
Waist Circumference: Increased Body Fat (Adiposity)

Obesity classification:
Waist circumference (WC)*

Abdominal Obesity - Men
> 40 inches
> 102 centimeters

Abdominal Obesity - Women
> 35 inches
> 88 centimeters

*Different WC abdominal obesity cut-off points are appropriate for different races (i.e., > 90 centimeters for Asian men and > 80 centimeters for Asian women)
Waist Circumference

Advantages

• Well-correlated to metabolic disease
• Direct anatomical measure of adipose tissue deposition, with an increase in waist circumference reflective of adipose tissue dysfunction
• Low cost

Disadvantages

• Measurement not always reproducible
• Waist circumference is not superior to BMI in correlating to metabolic disease in patients with BMI $\geq 35$ kg/m$^2$
• Racial/ethnic differences
Body Fat Type and Distribution

“Apple”
“Android”
Visceral Fat
↑Waist Circumference
Metabolic Syndrome
Insulin Resistance

“Apple” vs. “Pear”

“Pear”
“Gynoid”
Subcutaneous Fat
↔ Waist Circumference
Non-Metabolic Syndrome
Normal Insulin Sensitivity

High Metabolic Risk

Normal Metabolic Risk

Carondelet Health Network
Overall Management Goals

- Adult patient with overweight or obesity
  - Improve patient health
  - Improve quality of life
  - Improve body weight and composition

### Motivational Interviewing Techniques: 5A’s of Obesity Management

| Ask | • Ask for permission to discuss body weight.  
• Explore readiness for change. |
|---|---|
| Assess | • Assess BMI, waist circumference, and obesity stage.  
• Explore drivers and complications of excess weight. |
| Advise | • Advise the patient about the health risks of obesity, the benefits of modest weight loss (i.e., 5-10 percent), the need for long-term strategy, and treatment options. |
| Agree | • Agree on realistic weight-loss expectations, targets, behavioral changes, and specific details of the treatment plan. |
| Arrange/Assist | • Assist in identifying and addressing barriers; provide resources; assist in finding and consulting with appropriate providers; arrange regular follow up. |


Reference/s: [226] [227]
Motivational Interviewing: Stages of Change

Pre-contemplation
Unawareness of the problem

Contemplation
Thinking of change in the next 6 months

Preparation
Making plans to change now

Action
Implementation of change

Relapse
Restart of unfavorable behavior

Progress

Reference/s: [204] [205]
Treatment of Adult Patients with Overweight or Obesity

Medical Management and Coordination

Nutrition  Physical Activity  Behavior Therapy  Pharmacotherapy  Bariatric Surgery
Nutritional Therapy for Obesity
Nutrition History

Meals and Snacks
- Timing
- Frequency (via questionnaire)
- Nutritional content
- Preparer of food
- Access to foods
- Location of home food consumption (i.e., eating area, television, computer, etc.)
- Location of away food consumption (i.e., workplace restaurants, fast food, etc.)

Behavior
- Previous nutritional attempts to lose weight and/or change body composition
  - If unsuccessful or unsustained, what were short- and long-term barriers to achieving or maintaining fat weight loss
- Triggers (hunger, cravings, anxiety, boredom, reward, etc.)
- Nighttime eating
- Binge eating
- Emotional eating
- Family/cultural influences
- Community influences
- Readiness for change

Records
- Food and beverage diary, including type of food or beverage consumed and amount consumed
  - 72-hour recall
  - Keep food and beverage record for a week and return for evaluation
- Electronic application tools

Reference/s: [78] [79] [80]
Carbohydrates

- Carbohydrates contain 4 kcal/gram
- Carbohydrates can serve as a source of energy and as well cellular structural elements such as hyaluronic acid and proteoglycans
- Carbohydrates may contain sugars, starch and/or fiber
- The digestion and absorption of carbohydrates results in monosaccharide (glucose, fructose, galactose) molecules
- Carbohydrates are not an essential macronutrient, as the liver and kidney can synthesize glucose
- Calorie deficiency can lead to marasmus (insufficient calories), but there is no known carbohydrate deficiency
- USDA DRI for carbohydrate is 130 grams/day
Fat

- Fat contains 9 kcal/gram
- Fats or lipids are a diverse group of compounds used as an energy source and for many metabolic processes:
  - Immune response (omega-3 fatty acids)
  - Cell membrane structure (phospholipids)
  - Brain tissue (cerebrosides)
  - Synthesis of bile acid, cholesterol, vitamin D, steroid hormones
  - Insulation
- Several fatty acids cannot be made by the body and these “essential” fatty acids must be consumed in the diet
- Fatty acid deficiency can lead to a disease state
- USDA DRI for fat is at least 30 grams/day
- Replacing saturated fats with polyunsaturated or monounsaturated fats may reduce cardiovascular disease risk
- Replacing saturated fats with refined carbohydrates and sugar is not associated with reduced cardiovascular disease risk

Reference/s: [146] [147]
Why Do We Need Protein?

• Growth & maintenance of tissues
• Biochemical reactions depend on enzymatic function
  • Digestion, energy production, blood clotting, muscle contraction
• Endocrine functions
  • Protein & polypeptides make up most of body’s hormones
• Provides structure
  • Fibrous protein makes up keratin, collagen, and elastin
• Maintains proper pH & fluid balance
• Immune health
• Transport & store nutrients
• Energy source in fasting states
Protein

- Protein contains 4 kcal/gram
- Protein contains amino acids and serves as the major structural building blocks of the human body: bone, muscle, skin, brain, nucleic acids
- Essential amino acids are those which cannot be made by the human body and must be consumed in the diet
- Some amino acids can be used as an energy source (converted to glucose or ketones when needed)
- Protein deficiency can lead to a disease state (Kwashiorkor is sufficient calories but insufficient protein)
- USDA DRI (Dietary Reference Intake) for protein is 0.8 to 2.0 grams/kg/day depending upon age, gender, physical activity
Principles of Healthy Nutrition

Limit:
- Highly processed foods of minimum nutritional value: sweets, “junk foods,” cakes, cookies, candy, pies, chips
- Energy-dense beverages: sugar-sweetened beverages, juice, cream

Encourage:
- Consumption of healthy proteins and fats, vegetables, leafy greens, fruits, berries, nuts, legumes, whole grains
- Complex carbohydrates over simple sugars: Low glycemic index over high glycemic index foods
- High-fiber foods over low-fiber foods
- Reading labels rather than marketing claims

Managing the quality of calories is important when reducing the quantity of calories, such as during weight loss.
Nutritional Therapy for Obesity

Factors related to improved outcomes:

- Evidence-based
- Quantitative
- Patient adherence
- Patient preference
- Qualitative
Choosing Nutritional Therapy for Obesity

The most appropriate nutritional therapy for weight loss should be safe, effective, and one to which the patient can adhere.

• Encourage foods that result in a negative caloric balance to achieve and maintain a healthy weight
• Consider the following:
  • Individual food preferences, eating behaviors, and meal patterns
  • Cultural background, traditions, and food availability
  • Time constraints and financial issues
  • Nutritional knowledge and cooking skills

Choosing Nutritional Therapy for Obesity

• Nutritional approaches for weight loss typically focus on the caloric manipulation of the three macronutrients: carbohydrate, fat, or protein

• Very low-calorie diets contain less than 800 kcal/day and require close medical supervision for safety reasons

• Low calorie diets range from 1200-1800 kcal/day (1200-1500 for women, 1500-1800 for men)

• Restricting dietary fat leads to a greater reduction in total and LDL cholesterol, whereas restricting dietary carbohydrate leads to a greater reduction in serum triglycerides and an increase in HDL-cholesterol

• Reduction of carbohydrates can lead to a greater reduction in serum glucose and hemoglobin A1C
Nutritional Therapy for Obesity

Energy consumption intended to cause negative calorie balance and loss of fat mass

- Low-calorie diets: 1,200-1,800 kcal/day
  - Restricted fat diet
    - Low-fat diet: <30% fat calories
    - Very low-fat diet: <10% fat calories
  - Restricted carbohydrate diet
    - Low-glycemic diet:
    - Low-carbohydrate diet 50-150 grams/day
    - Very low carbohydrate diet <50 grams/day (with or without nutritional ketosis)

- Very low-calorie diets: Less than 800 kcal/day
  - Physician supervision recommended
  - Recommended for shorter durations
  - Commercial shakes, bars, and soups which replace meals.
I don’t always go on diets
But when I do my mom orders pizza
Low-calorie Diets: Restricted-carbohydrate Diet

Low-carbohydrate diet defined as 50-150 grams of carbohydrates per day. Very low-carbohydrate diet defined as <50 grams of carbohydrates per day.

Weight Loss
- May produce modestly greater weight loss compared to fat-restricted dietary intake for the first 6 months, wherein afterwards, the net weight loss may be similar to other calorie restricted nutritional interventions
- May assist with reducing food cravings

Metabolic Effects
- Reduces fasting glucose, insulin and triglycerides
- Modestly increases high-density lipoprotein cholesterol levels
- May increase low-density lipoprotein cholesterol levels
- May modestly reduce blood pressure
- The metabolic effects noted above may occur with or without weight loss
- In patients with epilepsy, a very low carbohydrate ketogenic diet (VLCKD) may reduce seizures
- LCKD may possibly improve diabetes mellitus complications (i.e., nephropathy)

Risks
- May produce carbohydrate cravings within the first few days of implementation, which may be mitigated by adding low-glycemic-index carbohydrate foods
- May induce gout flare if history of gout
- May present challenges in patients undergoing dietary protein restriction (severe kidney disease)
Low-calorie Diets: Restricted-fat Diet

Defined as 10-30% of total calories from fat.

Weight Loss
• After six months, fat-restrictive, low-calorie nutritional intervention generally produces the same amount of weight loss compared to the “low-carb diet”

Metabolic Effects
• May reduce fasting glucose and insulin levels
• Modestly decreases low-density and high-density lipoprotein cholesterol levels
• May modestly reduce blood pressure

Risks
• Hunger control may present challenges, which may be mitigated with weight-management pharmacotherapy
• If fat restriction results in a substantial increase in carbohydrate consumption, and if weight loss is not achieved, an increase in carbohydrate dietary intake may potentially contribute to hyperglycemia, hyperinsulinemia, hypertriglyceridemia, and reduced levels of high-density lipoprotein cholesterol

Reference/s: [159] [160]
Very Low-calorie Diets

Defined as less than 800 kcal/day, typically implemented utilizing specifically formulated meal-replacement products supervised by a trained clinician.

Weight Loss
• Produces more rapid weight loss than low calorie (low-fat or carbohydrate restricted) diets due to the lower energy intake

Metabolic Effects
• Reduces fasting glucose, insulin and triglycerides
• May modestly increase high-density lipoprotein cholesterol levels
• May modestly decrease low-density lipoprotein cholesterol
• Reduces blood pressure

Risks
• Fatigue, nausea, constipation, diarrhea, hair loss, and brittle nails
• Cold intolerance, dysmenorrhea
• Small increase in gallstones, kidney stones, gout flare
• If insufficient mineral intake, then may predispose to palpitations and cardiac dysrhythmias, muscle cramps
• Weight regain will occur if patients are not taught how to maintain healthy eating when transitioning to non-meal replacement
Dietary Patterns

Includes many dietary patterns but must be calorically restricted to effectively treat obesity. Weight loss and metabolic effects vary.

- Mediterranean diet
- Therapeutic lifestyle diet
- DASH (Dietary Approaches to Stop Hypertension)
- Atkins diet
- Ornish diet
- Paleo diet
- Vegetarian diet
- Commercial diet programs
Trans Fats

Trans fats are created through a process of artificially hydrogenating polyunsaturated fats (vegetable oils) into more saturated fats, allowing for higher melting temperatures more desirable for processed foods, cooking and frying.

- **Partially hydrogenated vegetable oils** were developed because they favorably affected taste in applicable foods and were less expensive than saturated fats from animals (lard)
  - Some early shortenings (fats) were made from partially hydrogenated vegetable oil (cottonseed and soybean oil), originally contained 50% trans fats, and were marketed as being a healthier alternative to animal fat, because they were derived from “vegetables”
  - Although it contains partially hydrogenated palm and soybean oils, common shortenings now contain minimal trans fats, soybean oil, fully hydrogenated palm oil (i.e., 3 grams saturated fats, 6 grams polyunsaturated fats, 2.5 monounsaturated fats)
- Trans fats may increase low-density lipoprotein cholesterol, reduce high-density lipoprotein cholesterol, and increase the risk of cardiovascular disease (myocardial infarction and stroke), type 2 diabetes mellitus, and certain cancers
- While the FDA has banned partially hydrogenated oil by 2018, trans fats can still be found in **some** cakes, pies, cookies (especially with frosting), biscuits, microwavable breakfasts, stick margarine, crackers, microwave popcorn, cream-filled candies, doughnuts, fried fast foods, and frozen pizza
- Conjugated linoleic acid (CLA) is a naturally occurring trans fat derived from ruminants (fermentation of plant-based foods via microbes in the stomach prior to digestion) which is not proven to be detrimental to health; conjugated trans linkages are not included as trans fats for nutritional regulations and food labeling
The Mediterranean Diet is not a defined “diet,” but rather a generalized term to described several meal pattern variants often found in Greece, Italy, and Spain. The Mediterranean Diet has the most consistent and robust scientific support in reducing atherosclerotic cardiovascular disease risk.

**Encouraged**
- Olive oil as main source of fat
- Vegetables, fruit, legumes, whole grains, nuts, and seeds
- Moderate intake of red wine
- Moderate consumption of seafood, fermented dairy products (cheese and yogurt), poultry, and eggs

**Discouraged**
- Limit consumption of high amounts of red meat, meat products, and sweets*

*Olive oil is a staple of most definitions of the Mediterranean diet; however, some Mediterranean cuisine includes lard and butter for cooking, and olive oil for dressing salads and vegetables

Reference/s: [166] [167] [168] [169]
The TLC Diet is a low-fat meal-plan variant that was recommended by the National Cholesterol Education Program, Adult Treatment Panel. It is the “diet” most often utilized in the conduct of lipid clinical trials.

**Encouraged**

- Total fat: 25–35% of daily calories
  - Polyunsaturated fat: Up to 10% of total daily calories
  - Monounsaturated fat: Up to 20% of total daily calories
- Carbohydrate: 50% to 60% of total calories
- Soluble fiber: At least 5-10 grams a day, preferably 10-25 grams a day
- 2 grams per day of plant stanols or sterols through foods or dietary supplements

**Discouraged**

- Limit saturated fat: < 7% of total calories
- Limit cholesterol: < 200 mg a day
- Avoid foods with *trans* fatty acids.

Reference/s: [170] [171]
The Atkins Diet is illustrative of a carbohydrate-restricted nutritional intervention which promotes utilization of fat for energy and generates ketosis, which may reduce appetite.

**Encouraged**

- **The induction phase** allows no more than 20 grams of carbohydrate per day from non-starchy vegetables and leafy greens; encourages adequate proteins from foods such as beef, pork, bacon, fish, chicken, eggs, and cheese, to reduce insulin levels and generate ketosis.
- **The ongoing weight loss phase** allows a wider variety of vegetables, seeds and nuts, and low-glycemic fruits (i.e., strawberries and blueberries).
- **The pre-maintenance phase**, after the goal weight is achieved, allows carbohydrate intake to be slowly increased as long as weight gain does not occur.
- **In the maintenance phase**, 60 to 90 grams of carbohydrates per day is allowed, which may allow legumes, whole grains, and fruits.

**Discouraged**

- Avoid:
  - Processed and refined foods
  - Foods with a high glycemic index
  - Foods rich in *trans* fatty acids

  In all but the maintenance phase, limit:
  - Cereals, breads, and grains
  - Dairy products, except cheese
  - Starchy vegetables
  - Most fruits
The Ornish Diet is illustrative of a fat-restricted nutritional intervention.

**Encouraged**
- Foods are best eaten in their natural form
- Vegetables, fruits, whole grains, and legumes
- One serving of a soy product each day
- Limited amounts of green tea
- Fish oil 3-4 grams each day
- Small meals eaten frequently throughout the day

**Discouraged**
- Limit dietary fat: < 10% of total daily calories
- Limit dietary cholesterol: < 10 mg per day
- Limit sugar, sodium, and alcohol
- Avoid animal products (red meat, poultry, and fish) and caffeine (except green tea)
- Avoid foods with *trans* fatty acids, including vegetable shortening, stick margarines, and commercially prepared foods, such as frostings; cake, cookie, and biscuit mixes; crackers and microwave popcorn; and deep-fried foods
- Avoid refined carbohydrates and oils

Reference/s: [176] [177] [178]
The “Dietary Approaches to Stop Hypertension” (DASH) is a diet pattern promoted by the U.S. National Heart Lung and Blood Institute, primarily to treat high blood pressure.

**Encouraged**
- Vegetables, fruits, and whole grains
- Fat-free or low-fat dairy products
- Fish, poultry, and lean meats
- Nuts, seeds, and legumes
- Fiber and the minerals calcium, potassium, and magnesium

**Discouraged**
- Limit sodium: 1,500-2,300 mg per day
- Limit total fat: ~27% of total daily calories
- Limit saturated fat: <6% of total daily calories
- Limit cholesterol: ≤150 mg per day for a 2,100-calorie eating plan
- Avoid red and processed meats
- Avoid sugar-sweetened beverages
- Avoid foods with added sugars
Paleolithic nutritional intervention is based upon a diet pattern presumed to exist during the Paleolithic period (lasting 3.4 million years, and ending 6000-2000 BC). It differs from some other diets in that it excludes grains, dairy, and processed foods.

**Encouraged**
- Fresh vegetables, fruits, and root vegetables
- Grass-fed lean red meats
- Fish/seafood
- Eggs
- Nuts and seeds
- Healthful oils (olive, walnut, flaxseed, macadamia, avocado, and coconut)

**Discouraged**
Avoid:
- Cereal grains
- Legumes, including peanuts
- Dairy products
- Potatoes
- Processed foods
- Refined sugar, refined vegetable oils, and salt

Reference/s: [181] [182] [183]
Vegetarian Diet

A vegetarian nutritional intervention includes a meal plan consisting of foods that come mostly from plants.

**Encouraged**
- Vegetables
- Fruits
- Whole grains
- Legumes
- Seeds
- Nuts
- May include eggs and milk

**Discouraged**
- Fowl
- Fish
- Beef
- Pork
- Lamb

Reference/s: [184] [185]
Vegetarian Diet Variants

**Vegan (“Total Vegetarian”):** Only plant-based foods (e.g., fruits, vegetables, legumes, grains, seeds, and nuts) with no animal proteins or animal by-products, such as eggs, milk, or honey

**Lacto-vegetarian:** Plant foods plus some or all dairy products (e.g., cheese)

**Lacto-ovo Vegetarian (or Ovo-lactovegetarian):** Plant foods, dairy products, and eggs

**Semi or Partial Vegetarian:** Plant foods and may include chicken or fish, dairy products, and eggs, but not red meat

**Pescatarian:** Plant foods and seafood

Reference/s: [184] [185]
It’s the latest thing.
It’s called the veterinarian diet.
The DIETFITS Randomized Clinical Trial

• Published in JAMA, February 2018

• Background
  • To determine the effect of a healthy low-fat (HLF) diet vs a healthy low-carbohydrate (HLC) diet on weight change and if genotype pattern or insulin secretion are related to the dietary effects on weight loss.

• Methods
  • 609 adults (ages: 18-50) without DM and with a BMI between 28-40
  • Participants were randomized to 12 month HLF (n = 305) or HLC (n = 304) diet

• Intervention
  • 22 diet-specific small group classes were conducted over 12 months
  • Both groups emphasized
    • Eating as many vegetables as possible
    • Choosing nutrient-dense whole foods & limiting processed foods
    • Preparing foods at home
    • Avoiding trans fats, added sugars, and refined carbohydrates
The DIETFITS Randomized Clinical Trial

• Intervention
  • Participants were instructed to reduce intake of total fat or digestible carbohydrates to 20 g/d during the first 8 weeks
  • Then slowly added fats or carbohydrates back to their diets in increments of 5 to 15 g/d per week until they reached the lowest level of intake they believed could be maintained indefinitely.
  • No explicit instructions for energy (kilocalories) restriction were given.
  • Encouraged to participate in 150 minutes per week of moderate aerobic physical activity

• Results
  • Mean macronutrient compositions
    • HLF: 48% carbs, 29% fat, 21% protein
    • HLC: 30% carbs, 45% fat, 23% protein
  • Weight change at 12 months
    • HLF: - 5.3kg
    • HLC: - 6.0kg

• Conclusion
  • No significant difference in weight change between HLF vs HLC diet.
The DIETFITS Randomized Clinical Trial

**Intervention**
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**Conclusion**
- No significant difference in weight change between HLF vs HLC diet.
Physical Activity

- At least 150 minutes (2.5 hours) per week of moderate physical activity or at least 75 minutes (1.25 hours) per week of vigorous intensity aerobic exercise = most health benefits, promote modest weight loss, and prevent weight gain
Physical Activity

Assess Mobility

Unable to Walk
- Seated exercise program
- Arm exercises (i.e., arm cycling)
- Swimming/aquatic exercises (e.g., shallow or deep water exercises)
- Gravity-mediated physical activity
- Consider physical therapy evaluation
  - Recommend rehabilitation & physical therapy guided activity program
  - Set physical activity goals
  - Assess special equipment needs

Limited Mobility, Able to Walk
- Walking
- Swimming/aquatic exercises (e.g., shallow or deep water exercises)
- Gravity-mediated physical activity
- Assess for special equipment needs

No Substantial Limitations to Mobility
- Exercise/physical activity prescription plan driven by patient and guided by clinician
- Assess for special equipment needs
Pathophysiology of Eating and Weight Regulation
Pathophysiology of Eating and Weight Regulation

Weight is controlled via a multi-level complex system involving:
1) Gut hormones
2) Adipose tissue hormones

These hormones input into the brain to affect hunger, sensory perception, cognition, emotion and behavior.
Pathophysiology of Eating and Weight Regulation

↑ Appetite ↓

↑ Energy Expenditure ↓

Peripheral Signals
Indications for Surgery

- BMI 40 or greater
- BMI 35 -40 with co-morbidities
- Patient must be an acceptable operative risk
- Patient must be motivated and demonstrates the ability to understand and participate in the program
- Patient must be dedicated to a major lifestyle change and long-term follow-up
- Consensus after bariatric team evaluation (Surgeon, Psychologist, Dietitian, etc.)
Normal GI Anatomy

Roux-en-Y Gastric Bypass (RYGB) Anatomy

Sleeve Gastrectomy (SG) Anatomy

A

Esophagus
Stomach
Duodenum
Jejunum

Colon
Ileum

B

Gastric pouch
Alimentary limb
Biliopancreatic limb
Common channel

Stomach remnant

C

Gastric sleeve
Pancreas

Colon
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Pros</th>
<th>Cons</th>
<th>Expected loss in percent excess body weight* at two years</th>
<th>Optimally suited for patients with:</th>
<th>Other comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roux-en-Y Gastric Bypass</td>
<td>Greater improvement in metabolic disease</td>
<td>Increased risk of malabsorptive complications over sleeve</td>
<td>60-75%</td>
<td>Higher BMI, GERD, Type 2 DM</td>
<td>Largest data set, more technically challenging than LAGB, VSG</td>
</tr>
<tr>
<td>Vertical Sleeve Gastrectomy</td>
<td>Improves metabolic disease; maintains small intestinal anatomy; micronutrient deficiencies infrequent</td>
<td>No long term data</td>
<td>50-70% (*3-year data)</td>
<td>Metabolic disease</td>
<td>Can be used as the first step of staged approach; most common based on 2014 data</td>
</tr>
<tr>
<td>Laparoscopic Adjustable Gastric Banding</td>
<td>Least invasive; removable</td>
<td>25-40% 5 year removal rate internationally</td>
<td>30-50%</td>
<td>Lower BMI; no metabolic disease</td>
<td>Any metabolic benefits achieved are dependent on weight loss</td>
</tr>
<tr>
<td>Biliopancreatic Diversion with Duodenal Switch</td>
<td>Greatest amount of weight loss and resolution of metabolic disease</td>
<td>Increased risk macro- and micronutrient deficiencies over bypass</td>
<td>70-80%</td>
<td>Higher BMI, Type 2 DM</td>
<td>Most technically challenging</td>
</tr>
</tbody>
</table>

*Excess body weight (EBW) = (total body weight) - (lean body weight)
Macro- and Micro-nutrient Digestion and Absorption

- Macronutrient digestion begins in mouth and stomach and continues in duodenum
  - Absorption of macronutrients occurs largely in duodenum and jejunum but continues throughout small intestine
- B12 absorption requires intrinsic factor (found in gastric acid)
- Ferric iron is converted to absorbable ferrous iron in gastric acid
- Vitamin D & folate absorbed in jejunum
- Calcium absorption is dependent on pH and vitamin D status

Reference: Kursheed N. Jeejeebhoy, Short bowel syndrome: a nutritional and medical approach., KhuCMAJ May 2002, 166 (10) 1297-1302;
**Nutrient Absorption**

- **Stomach**
  - Water
  - Alcohol

- **Duodenum**
  - Fatty acids
  - Amino acids
  - Minerals (e.g., calcium during calcium deficiency, iron)
  - Some vitamins

- **Jejunum**
  - Due to length and location, the jejunum absorbs the greatest amount of:
    - Simple sugars
    - Fatty acids
    - Proteins
    - Minerals
    - Vitamins

- **Ileum**
  - Bile salts
  - Bile acids
  - Vitamin B12
  - Some vitamins
  - Some minerals

- **Large Intestine**
  - Water
  - Sodium chloride
  - Potassium
  - Intestinally derived vitamin K

Reference/s: [37] [320]
Adjustable Gastric Band

• Restriction
Sleeve Gastrectomy

- Restrictive procedure – limits the amount of food patient is able to eat
  - 80% of stomach is removed
- Pyloric sphincter and intestines remain intact so food pathway is not altered
- Effect on gut hormones
  - GLP-1 increased (satiety)
  - PYY increased (satiety & GI mobility)
  - Ghrelin decreased (hunger)
- 2 years post-surgery – 25% weight loss of initial weight

Roux-en-Y Gastric Bypass

- Restrictive & malabsorptive procedure
  - Small gastric pouch (30 mL) is attached to jejunum
  - Stomach remnant & duodenum are reattached to create common channel

- Effect on gut hormones
  - GLP-1 increased (satiety)
  - PYY increased (satiety & GI mobility)
  - Ghrelin inconclusive (hunger)

- 2 years post-surgery – 35% initial weight loss
- 10 years post-surgery – 25% initial weight loss

Duodenal Switch

- Minimal weight regain
- High resolution of diabetes
### Bariatric Surgery: Common Micronutrient Deficiencies

<table>
<thead>
<tr>
<th></th>
<th>Vitamins</th>
<th>Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B1</td>
</tr>
<tr>
<td>RNY</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sleeve</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>LAGB</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>BPD</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Vitamin D deficiency is seen in a significant number of patients with obesity at baseline. However, due to malabsorption, the risk is further increased post-op.


Reference/s: [320] [366]
### ASMBS 2016 Nutrient Screening Recommendations

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Pre-WLS Screening Recommendation</th>
<th>Deficiency Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiamin</td>
<td>Recommended</td>
<td>Patients with obesity - &lt;29%</td>
</tr>
<tr>
<td>B-12</td>
<td>Recommended</td>
<td>Patients with obesity – 2-18% PPIs – 6-30%</td>
</tr>
<tr>
<td>Folate</td>
<td>Recommended</td>
<td>Patients with obesity – 54%</td>
</tr>
<tr>
<td>Iron</td>
<td>Recommended</td>
<td>Patients with obesity – 45%</td>
</tr>
<tr>
<td>Calcium</td>
<td>Recommended</td>
<td>Elevated values of CTX reported in 66.7% of patients &lt; 50 yo</td>
</tr>
<tr>
<td>Vitamin D3</td>
<td>Recommended</td>
<td>Patients with obesity – 90%</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Recommended</td>
<td>Patients with obesity – 14%</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Recommended</td>
<td>Patients with obesity – 2.2%</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Recommended</td>
<td>No data on pre-WLS patients</td>
</tr>
<tr>
<td>Zinc</td>
<td>Recommended</td>
<td>Pre-WLS – 24-28%</td>
</tr>
<tr>
<td>Copper</td>
<td>Recommended</td>
<td>Pre-WLS - &lt;70%</td>
</tr>
</tbody>
</table>
## ASMBS 2016 Supplement Guidelines for WLS

<table>
<thead>
<tr>
<th>Micronutrients</th>
<th>Sleeve Gastrectomy</th>
<th>Roux-en-Y Gastric Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVI</td>
<td>100% RDA (1-3 months)</td>
<td>200% RDA</td>
</tr>
<tr>
<td>B-1 (thiamin)</td>
<td>50 mg/day <em>(from B-complex or MVI)</em></td>
<td></td>
</tr>
<tr>
<td>B-12</td>
<td>350-500 ug/d <em>(oral/sublingual/nasal)</em> or 1,000 ug/month intramuscularly</td>
<td></td>
</tr>
</tbody>
</table>
| Folate         | 400-800 ug *(from MVI)*  
800-1000 ug for pre-menopausal women | |
| Iron           | 45-60 mg elemental iron | |
| Calcium        | 1,200 mg for men & pre-menopausal women  
1,500 mg for post-menopausal women | |
| Vitamin D3     | 3000 IU/d | |
| Vitamin A      | 5000-10,000 IU/d | |
| Vitamin E      | 15 mg/d | |
| Vitamin K      | 90-120 ug/d | |
| Zinc           | 100% RDA (8-11 mg/d) | 200% RDA (16-22 mg/d) |
| Copper         | 100% RDA (1 mg/d) | 200% RDA (2 mg/d) |
Results of Bariatric Surgery*

- Improvement or resolution of obesity-related medical problems
- Increased longevity
- Improved quality of life
  - psychological
  - health
  - social
  - personal
  - work
- Weight loss

*Results achieved in most, but not all cases. Degree of improvements vary by individual
Resolution of Obesity-related Conditions

- Type 2 Diabetes: 95%
- Hypercholesterolemia: 97%
- GERD: 98%
- Hypertension: 92%
- Cardiac Function Improvement: 95%
- Stress Incontinence: 87%
- Osteoarthritis: 82%
- Sleep Apnea: 75%

Conclusion

• Best diet is one that can be maintained for life

• Diet should be composed of high-quality, nutritious whole foods
  • Mostly fruits and vegetables
  • Avoid flours, sugars, trans fats, and processed foods

• Strive to be physically active
  • 2.5 hours of moderate aerobic activity per week

• Stress management

• Adequate sleep (7-9 hrs/night)
Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time.
Thank you!